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# **Educational Technology in German Primary Schools**

**Essential Factors to Influence the Attitude towards and Adoption and Adaption of EdTech**

Master thesis 15 HEC, course INFM10 in Information Systems

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ABSTRACT (MAX. 200 WORDS):

The increasing importance of technology in everyday life demands to look at this matter in the context of education as well. Whereas Educational Technology (EdTech) has been researched mainly in higher education, there is only little research focusing on primary schools.

The education of students should not suffer from an inadequate engagement with EdTech.

Nevertheless, there are countries like Germany, where it seems that the already done investments into EdTech have been too little and in an unsatisfactory way, respectively.

Hence, the way EdTech is invested in and engaged with in primary schools must be adjusted.

This research aims to identify essential factors that need to be addressed so that EdTech can transform into a state where it is engaged with as a regular means of tuition. We argue that this state must be reached because then, EdTech is not inferior to any traditional means of education.

Based on the theories of the UTAUT, the Sunk Cost Fallacy and the HCT we develop a model that argues about how this transformation can take place by going through the phases of attitude, adoption and adaption. Conducting an online survey in German primary schools leads to the identification of the essential factors.

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# 1 Introduction

*This chapter addresses the background this thesis is rooted in, making sure to give a common understanding of the topic, present the problem area and put on a research question based on the previous given information. Further, this chapter narrows its scope down by stating the exact purpose of this thesis as well as is making aware of any delimitations.*

## 1.1 Background

Since the beginning of the 20<sup>th</sup> century, theorists and practitioners have engaged with the topic of technology for operation and improving the quality of education (Cuban, 1986; Earle, 2002; Reiser, 2001; Rodríguez, Nussbaum & Dombrowskaia, 2012). Particularly in the last 25 years, the potential of computers to improve education has been explored (van Braak, Tondeur & Valcke, 2004). Researching the relation between technology and education has grown exponentially in importance during the last year, as the Covid-19 pandemic has forced a rapid change in the education sector (Bozkurt & Sharma, 2020; Trust & Whalen, 2020). Whereas the usage of technology was optional before, the pandemic has made it mandatory, as more than 90% of schools worldwide were shut down (Bozkurt & Sharma, 2020; UNESCO, 2020), leading to most of them transferring to online schooling.

Technology for education includes all kinds of Information and Communication Technology (ICT) that is used within the context of education and tuition. From now on, we will call this concept - based on literature from this field - *Educational Technology (EdTech)* (Culp, Honey & Mandinach, 2005; Keegan, 1995; Nieswand, Geschwill & Zimmermann, 2019; Richey, 2008; Schacter, 1999). Referencing Richey (2008), EdTech can be defined as “the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources” (Richey, 2008, page 24). Therefore, EdTech summons video conferencing tools, such as Zoom, more holistic applications, such as Microsoft Teams or Learning Management Systems (LMS) but also websites and applications providing virtually accessible learning material or ICT devices used for schooling.

The last year has shown that the aim of improving education through EdTech has moved into the background, whereas EdTech as a crucial means for proceeding tuition online has grown in importance, as – without this technology – schooling could not take place in an adequate manner. Therefore, it is increasingly important to use EdTech in an appropriate and customized way (Jennings, Hooker & Nichols, 2009; Nistor, Lerche, Weinberger, Ceobanu & Heymann, 2014), otherwise negative consequences may occur (Christakis, Zimmerman, Giuseppe & Mccarty, 2004; Wartella, Huston, Rideout & Robb, 2009).

A core area of interest within the field of Information Systems (IS) is the study of how technology and its designated users interact (Bannon, 2011; Tognazzini, 2005). Thus, this thesis’ topic is particularly relevant to the field of IS because all issues related to EdTech are not

exclusively technical in nature, but rather about how the technology is adopted by its users (Rodríguez, Nussbaum & Dombrowskaia, 2012).

While research on EdTech has been going on since technology became ubiquitous (Friedewald & Raabe, 2011; Margulis, Boeck & Laroche, 2020; Weiser, 1993), the rapid evolution of technology forces education to adapt quickly to EdTech development (Teräs, Suoranta, Teräs & Curcher, 2020). Van Braak, Tondeur and Valcke (2004) therefore call for a closer look on the factors that lead to technology being used differently in the classroom, Blackwell, Lauricella, Wartella, Robb and Schomburg (2013) demand more research that concentrates on the relationship between EdTech and young children in particular. However, these calls are not the only reason for why more research should be carried out; the current situation with forced online schooling is demanding research to focus more on the topic of EdTech as well.

## 1.2 Problem area

Despite the knowledge of the importance of an adequate and customized implementation of EdTech in schools (Jennings, Hooker & Nichols, 2009; Nistor, Gogus & Lerche, 2013), it seems to be the case that some countries, although they have the financial means and resources to develop EdTech in primary schools, still lack the potential in realizing that (Salavati, 2016). Research shows that the investments into EdTech are rather focused on schools of higher education (Blackwell et al. 2013; Wartella, Schomburg, Lauricella, Robb & Flynn, 2010) and as a result, the primary education is left behind. This situation is particularly visible in German primary schools as there is evidence that there is a lack of effective investments into digital education (European Commission, 2020). The study by Salavati (2016) shows that integrating EdTech in primary education is not an easy task. It is rather a complex task that involves the worldviews of teachers, students and how the environment operates to make it work.

From a practical point of view, one reason for lagging behind in integrating EdTech in countries such as Germany is the struggle with the basic requirements needed for modern EdTech, as well as the complexity involved in making it work, as Salavati (2016) points out. Another interesting practical perspective shows that 96% of households have an internet connection in Germany (Tenzer, 2021), but only 36% of schools are connected to fast internet (Rudnicka, 2019). In 2020, in the light of the Covid-19 pandemic, the statistics portal Statista published a data analysis on various issues related to the quality of digital schooling in Germany (Bocksch, 2020). Among other things, they reported that parents of primary school children are often unsatisfied with how their children interact with technology while at school. Another important reason for why EdTech is particularly relevant to get more attention from a primary school perspective is, that the share of female teachers is highly unbalanced, with research showing that in average, female teachers tend to encounter the acceptance and usage of technology rather negatively (Jenson & Rose, 2003; Mathews & Guarino, 2000; Rasinen, Virtanen, Endepohls-Ulpe, Ikonen, Ebach & Stahl-Von Zabern, 2009).

Due to all of the mentioned facts, it is clear that EdTech in German primary schools cannot fulfil its purpose in a holistic way, particularly when countries like Germany have the finance and resources but cannot easily address the complexity (Salavati, 2016). Thus, we presume a negative impact in primary school education, as also mentioned by much literature (Christakis

et al. 2004; Wartella et al. 2009). The problem we face is that it is not yet known how the investment behaviour needs to be adjusted so that the input into the EdTech environment in schools leads to a balanced output. Rodríguez, Nussbaum and Dombrovskaja (2012) have studied that most problems are in fact not technical but involve human problems that concern implementation and use, a fact that was also claimed by Salavati's (2016) research across Swedish primary schools. Therefore, it is necessary to investigate where exactly these human problems lie so that the investment strategy can be adjusted on the long-term.

### 1.3 Research Question

Since we identified a gap between the as-is and should-be state of EdTech in German primary schools due to various reasons, we aim to investigate this gap. Specifically, this work focuses to derive an answer on the following research question:

*What factors are essential so that the transformation towards EdTech as a regular means of tuition is widely accepted and used in German primary schools?*

To understand how this question is related to the previously mentioned problem, it can be said that the investment problem is partly because there are human factors involved (e.g., complexity of teacher's worldviews in using technology (Salavati, 2016)) that are currently not addressed in German primary schools. Because EdTech has different characteristics than traditional education methods, the investments into it need to be adjusted. To have a better imagination of the problem, think about investing into a new board or into a new whiteboard, respectively. Whereas tuition would not be affected by the first, meaning that a "regular" output can be achieved, the introduction of a whiteboard needs to come with additional resources, otherwise, tuition will most likely stumble across challenges. Therefore, if EdTech is perceived just as a traditional education method, so no interruption is to be expected, the investments would reach the meant-to-be outcome. Investigating on the research question is one step to come closer to this conversion.

### 1.4 Purpose

The purpose of this study is to identify factors that influence the transformation towards EdTech being accepted and used as a regular means of tuition. We identify these by questioning a selection of users of EdTech in German primary schools, the teachers, of their personal attitude towards EdTech and their thoughts about adopting and adapting EdTech. Gaining an insight about the perception and motivation of use of EdTech, this thesis intends to create the foundation for improving the situation that we problematize upon earlier, leading to more adequate and customized EdTech usage in the classroom (Nistor, Gogus & Lerche, 2013; Teräs et al. 2020) and therefore, leading to the designated actors being more content with the technology and in the end, leading to an improved transformation of the EdTech investments.

## 1.5 Delimitation

This thesis is, just like any other scientific work, subject to some delimitations. First of all, the most obvious constraint is the geographical scope of this work: the thesis is only concerned with the situation of EdTech in the country Germany, more specific, the region of Bavaria. This is due to comparison reasons, as the exact curriculum and education for teachers varies per region. A second limitation is that this thesis will not comment about the topic from a political point of view. This is simply because we, the authors of this thesis, are missing the expertise in these matters and also, it is not the purpose of this thesis to make any directed claims. Disclaiming about this in another way, it has to be stated that this thesis is also not about how good or efficient EdTech is used, about how much better or worse it compares to traditional, non-virtual tuition or even suggests replacing these methods by EdTech. It is solely about the current state of EdTech and what is needed to create an ideal but basic integration of EdTech into everyday tuition.

## 2 Theoretical Background

*Being aware of the context of this thesis, this chapter matches some core theoretical concepts onto it. Not only is this for leading the thesis into the direction of addressing the problems mentioned before, but also for giving a scientific basis for the upcoming chapter.*

### 2.1 Educational Technology

Before it is possible to elaborate how technology can be used in the classroom, the term EdTech needs to be elaborated. EdTech is often used as an umbrella term for all kinds of technology that is used to support and even improve learning in schools as well as in higher education or private companies (Mascarenhas, 2020; Nieswand, Geschwill & Zimmermann, 2019). The term describes any technological device or software, starting with a simple calculator to advanced technology for distance learning, such as LMS, and even Virtual or Augmented Reality simulations that are used to transfer knowledge (Lathan, 2021). To put it in one sentence: EdTech describes any technology used in connection with education.

The current Covid-19 pandemic pushed the need for technology that supports distance learning massively, which makes EdTech extremely popular (Teräs et al. 2020). Since there is no common definition for EdTech, a literature research was conducted that summon definitions and the way how EdTech was described so far (see Table 1).

<b>SOURCE</b>	<b>DEFINITION</b>	<b>USAGE OF ABBREVIATION</b>	<b>TYPE OF SOURCE</b>	<b>EDUCATIONAL AREA OF INTEREST</b>
<b>RICHEY (2008, P.24)</b>	“Educational Technology is the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources”	-	Journal Article	All
<b>CULP, HONEY &amp; MANDINACH (2005)</b>	-	-	Journal Article	Primary and Secondary education

<b>SCHACTER (1999, P.10)</b>	“[...] access to (a) computer assisted instruction, or (b) integrated learning systems technology, or (c) simulations and software that teaches higher order thinking, or (d) collaborative networked technologies, or (e) design and programming technologies”	-	Journal Article	Primary and Secondary education
<b>KEEGAN (1995)</b>	<i>Any kind of technology that supports distance learning</i>		Journal Article	All
<b>WELLER (2018)</b>	-	EdTech	Journal Article	All
<b>NIESWAND, GESCHWILL &amp; ZIMMERMANN (2019)</b>	-	EdTech	Book	Private Sector
<b>MASCARENHAS (2020)</b>	-	-	Web Page	All
<b>LATHAN (2021)</b>	“The technological tools and media that assist in the communication of knowledge, and its development and exchange.”	-	Web Page	University
<b>NISTOR, GOGUS &amp; LERCHE (2013)</b>	-	-	Journal Article	All

<b>TERÄS ET AL. (2020)</b>	-	ed-tech	Journal Article	All
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Table 1: Literature overview on EdTech definitions

Whereas EdTech has been out there for some time already, it can still be considered an alternative approach to tuition in contrast to traditional teaching methods (Tondeur, Forkosh-Baruch, Prestridge, Albion & Edirisinghe, 2016). However, because EdTech, just like other technology, must be viewed specifically, we believe that it is not straightforward to integrate EdTech into the classroom, which has also been observed by Salavati (2016). The process of fully integrating EdTech into the classroom, just as any other teaching method, is what we call “tension” from now on.

### 2.1.1 A Selection of Characteristics impacting a Teacher’s Perception of EdTech

Knowing about what EdTech is, there comes the need to theorize which characteristics and skills, respectively, have to be met by teachers so that the tension between traditional and modern tuition gets reduced. We are talking about these characteristics to be acknowledged by teachers in specific, as their personal perception of EdTech does have an impact on its acceptance and usage in the classroom of primary schools (Rohaam, Taconis & Jochems, 2012). Spiteri and Chang Rundgren (2020) have done a broad literature review on which characteristics might influence a primary school teacher on whether he accepts and uses technology during lessons. These elements are summarized under the factors *teacher knowledge*, *teacher attitudes*, *teacher skills* and also *school culture* (Spiteri & Chang Rundgren, 2020). Whereas we agree that school culture is of course playing a role regarding the acceptance and usage of technology in primary schools, it is not specifically of relevance for this subchapter. Therefore, selecting some elements that we opinionize are the core essential ones, the following is about the believe system of primary school teachers and its effect on the acceptance and usage of EdTech, about a teacher’s confidence toward EdTech and specifically required knowledge.

Hermans, Tondeur, van Braak and Valcke (2008) mention that *teacher believes* can be analysed to understand why they adopt technology during class or not. The authors found out that having constructivist believes is nourishing the adoption of technology in the classroom, whereas having a traditional believe system is rather limiting (Hermans et al. 2008). The aspect of a specific worldview of teachers and its connection to technology usage in the classroom has also been studied by (Salavati, 2016).

Further, the *confidence* toward EdTech can be named as a characteristic that is crucial for primary school teachers to convey (Rohaam, Taconis & Jochems, 2012; Spiteri & Chang Rundgren, 2020). Rohaam, Taconis and Jochems (2012) have researched about the influence of teacher knowledge on the way technical topics, which therefore includes EdTech as well, are taught in primary schools. They came up with the logical conclusion that the more technology confidence exists, the better the attitude towards technology gets, which then leads to a higher frequency of usage and thus, a better teaching experience (Rohaam, Taconis & Jochems, 2012). Also, Spiteri and Chang Rundgren (2020) found out through their literature research that confidence can be listed under the factor of teacher attitude.

Having a constructivist mindset and confidence toward EdTech are ideal to possess, yet the even more fundamental aspects for primary school teachers are to have the *subject matter and pedagogical knowledge* as well as the *technical know-how* (Rohaam, Taconis & Jochems,

2012; Spiteri & Chang Rundgren, 2020). The former two are necessary to give the credibility and make tuition possible in the first place. The latter is mostly to support the teacher in building more confidence towards EdTech.

The just mentioned characteristics might seem logical, yet it cannot be assumed that every teacher takes them in stride. Spiteri and Chang Rundgren (2020) deduced from various literature that teachers are in need for *training and guidelines* to make sure that EdTech is thoroughly understood. This means, that there is a process that primary school teachers have to go through on a personal and professional level, which very much resembles the way Kugel (1993) has described a similar evolution for how professors become teachers. The author argues that there are several stages a teaching person walks through, until the focus is less on teaching but more on learning (Kugel, 1993). This idea can be very well translated to the topic of this thesis, as the ideal situation of EdTech in German primary schools would be achieved when it is just an as equal teaching method as traditional ones and is fully accepted and used.

## 2.2 Unified Theory of Acceptance and Use of Technology

Research about technology acceptance has been a hot topic in IS research for many years now (Fathema, Shannon & Ross, 2015; Lee, Kozar & Larsen, 2003; Venkatesh et al. 2003; Venkatesh & Davis, 1996). Whereas much research focused strictly on the acceptance of technology by its designated users, the *Unified theory of acceptance and use of technology (UTAUT)* expands previous research with explanations about the intention of use (Venkatesh, Morris, Davis & Davis, 2003; Venkatesh & Davis, 1996). Therefore, it just makes sense to use this theory because it aligns exactly with the intentions of this work. The complex challenge of integrating EdTech completely into German primary schools is well suited to be mapped onto the UTAUT, because the theory displays the impact of different key moderators and determinants on the acceptance and usage of technology, respectively. Therefore, the research behind the UTAUT can be used to deduce specifically fitting questions for the upcoming study.

In the following section, the key moderators and determinants given by the UTAUT are described. Whereas the key moderators display user characteristics that are fixed at a certain time of consideration and are “brought” by the user (*Gender, Age, Experience, Voluntariness of Use*), the determinants are directly impacting on the user’s intention and use of a certain technology (*Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions*). Also, the key moderators affect the strength of the determinants themselves. The following information is based on the work of Venkatesh et al. (2003), which is also presented in Figure 1.

The authors mention that gender affects how much a user expects from a technological system, moreover, how much time to expect in learning the technology as well as how strong the expectation of others is perceived. The same goes for the age of a user, yet it additionally influences on how the facilitating conditions are viewed. Next, the experience influences how strongly the required effort to learn about the technology is rated. Furthermore, the experience plays a role in relation to the expectations of others as well as to the enabling circumstances. The last key moderator, voluntariness of use, is described by the authors solely impacting on the social expectancy determinant, as it can be assumed that a low voluntariness, for example, implies high social pressure.

Performance expectancy is the degree of the expected performance boost by the user, if a system is successfully adopted. Effort expectancy is the expected effort that needs to be invested to understand a system to an extent that usage is possible in an efficient way. Social influence can be described as the expectance of other people about that the user actually uses the system. For example, a higher social pressure may lead to actual system usage. These determinants influence the behavioural intention, which describes the attitude and acceptance of a user towards a technology. This element then impacts on the use behaviour, which represents the adoption and adaption of a technology by a user. The facilitating conditions, meaning the infrastructure around the system that makes usage possible in the first place, have a direct influence on the use behaviour only, since it will be massively harder for a user to adopt and adapt a system, if the infrastructure would need to be created by the user itself.

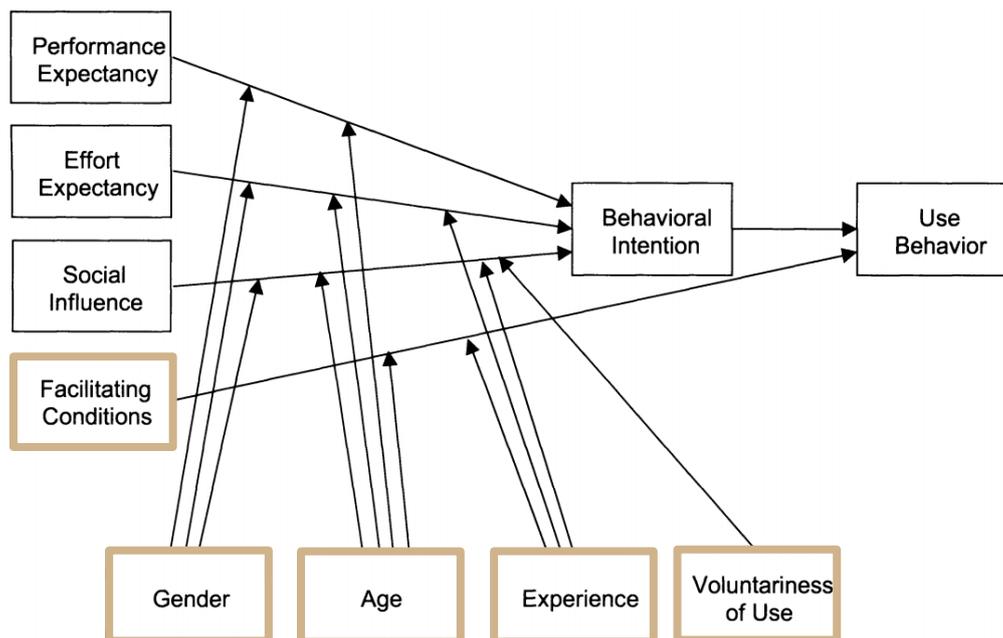


Figure 1: UTAUT research model (Venkatesh et al. 2003)

Our research will focus on the elements of gender, age, experience, voluntariness of use and the facilitating conditions and on how these factors work together to influence the adoption and usage behaviour of EdTech by German primary school teachers. Previous research already widely describes the key moderators gender (Hermans et al. 2008; Jenson & Rose, 2003; Mathews & Guarino, 2000; Rasinen et al. 2009), age (Hermans et al. 2008) and experience (Blackwell et al. 2013; Rohaan, Taconis & Jochems, 2012; Wartella et al. 2009) in connection with EdTech. Less research was conducted about the voluntariness of use and the facilitating conditions in Germany specifically, although there are strong hints that there are structural problems (Rudnicka, 2019; Tenzer, 2021).

### 2.2.1 UTAUT in the Context of EdTech in German Primary Schools

Bringing UTAUT into the context of education has been done before (Radovan & Kristl, 2017). Nevertheless, applying the theory to EdTech in German primary schools in this section, we want to outline a deeper understanding of the single moderators and determinants that influence acceptance and usage behaviour.

Jenson and Rose (2003), Mathews and Guarino (2000), Rasinen et al. (2009) and Hermans et al. (2008) agree that gender does play a huge role in EdTech acceptance, as females tend to have more uncertainty regarding technology in general. This is especially relevant in this context, as mentioned in Chapter 1.2, nearly 90% of German primary school teachers are female (Rasinen et al. 2009; Statista Research Department, 2020a). The next key moderator having an impact on the determinants of acceptance and usage behaviour of EdTech is the age of the users. With more than a third of over 50-year-old teachers in German primary schools (Rudnicka, 2020a), it is very likely that these groups face a challenge of fully accepting and using EdTech. This is due to the fact that these teachers have been introduced to modern technology in general quite late in their lives, making it hard to engage with it, in comparison with, e.g., digital natives (Clark, 2009). Related to this, prior experience with EdTech might play an issue, because the support of developing individual technology experience has been put into the background in primary schools so far (Blackwell et al. 2013; Wartella et al. 2009). This should cause attention, as there is research that argues that prior experience has a positive impact on the acceptance and usage of EdTech (Williams, Coles, Wilson, Richardson & Tuson, 2002). Furthermore, the decreasing voluntariness of use of EdTech in German primary schools due to external and internal changes should be noted, as according to Liu (2012) this can lead to, among other things, a loss of trust in technology.

Not only the key moderators of the UTAUT are relevant for the specific topic of this thesis, but also the determinants can be mapped to EdTech in German primary schools. Spiteri and Chang Rundgren (2020) mention that it is as fundamental to have the knowledge on how to apply technology skills as it is to have them. This performance expectancy seems to not be fulfilled enough in German primary schools, considering the fact that it has been researched that teachers do not engage with EdTech in a satisfactory way for all actors (Bocksch, 2020). The social influence on the acceptance and usage behaviour of EdTech has been emphasised by Spiteri and Chang Rundgren (2020) and Nistor, Gogus and Lerche (2013). The authors have specifically focused on the significance of school culture for engaging with EdTech (Nistor, Gogus & Lerche, 2013; Spiteri & Chang Rundgren, 2020). Thinking about this determinant and the fact that most of German primary school teachers are female, who – in average – are less likely to have a positive attitude towards technology (Jenson & Rose, 2003; Mathews & Guarino, 2000; Rasinen et al. 2009; Statista Research Department, 2020a) – the chances of developing a rather “EdTech-negative” environment in schools cannot be neglected. The facilitating conditions that allow the usage of EdTech in the first place are also rather negatively rated in German primary schools, as, what has been showcased in more detail in Chapter 1.2, the first problems start, e.g., with the basic internet infrastructure (Rudnicka, 2019; Tenzer, 2021).

Whereas the above-mentioned section presented the overall quite negative starting point of the determinants and key moderators influencing the acceptance and usage behaviour of EdTech in German primary schools, this section will focus on further aspects studied by literature that needs to be paid attention to. Nistor, Gogus and Lerche (2013) mention, that both computer anxiety and computer literacy should be taken into account as additional predictors when it comes to the UTAUT. Liu (2012) found out, that anxiety towards technology as well as a decrease in trust and satisfaction get stronger when the usage of technology gets forced. This is alarming as the current pandemic, to name just one factor, pushes schools to mandatorily use EdTech. Reaching a state of voluntarily adopting EdTech in German primary schools could lead to a decrease of anxiety towards and an increase in trust and satisfaction of EdTech. Confirming the necessity of research such as this thesis does, Nistor, Gogus and

Lerche (2013) call for the need to make heard of the specific user need regarding support and expectation of EdTech.

## 2.3 Human Capital Theory

Coming to the next theoretical foundation of this thesis, *Human Capital Theory (HCT)* is discussed in this section. Briefly, the theory's main statement is that the more a human being invests in themself, the higher the economic outcome will be (Becker, 1962; Welch, 1975). This investment into human capital can be done by providing education and training to humans, or more general, as Becker (1962) describes, it summons all activities that impact the future of a person and thus, its economic value. The reason for why investments into human capital should be made is because in average, the higher the investment into human capital has been, the higher the income of a specific person seems to be (Welch, 1975). This means that not only the person affected benefits from living a life with higher prosperity but is also an advantage for the whole affected economy.

Bringing this social-economic theory into context with the topic on hand, let's look at the importance of education for the HCT. Because education is the main aspect to impact the human capital (Becker, 1962) and thereby, in the end, the whole economic growth of a country as well, it should be considered priority. According to the HCT, the higher the quality of the investment, the higher the quality of the outcome (Becker, 1962), therefore, education should be carried out as efficient as possible in order to avoid low quality. Having modern EdTech tools and methodologies on hand has the potential to influence tuition in both a positive but also negative way (Nistor et al. 2014; Christakis et al. 2004; Wartella et al. 2009). As it is - without doubt - of interest for all actors concerned that tuition is offered in the most appropriate way, there needs to be an emphasis on using EdTech in an adequate, education-nurturing manner; it should not be a burden or disadvantage during lessons due to not wanting to use it, not understanding how to use it or not understanding on how to use it in an adequate way.

### 2.3.1 HCT in the Digital Age

Focusing on HCT specifically in connection to ICT and the current digital age, there are some lines that can be drawn between the work of Murphy and Siedschlag (2013) and the topic of this thesis. The authors studied on the relationship between human capital and its impact on ICT companies, more specifically on the relevance of ex-ante human capital. Their research resulted into finding a positive relation between the two, meaning that the higher the quality of the exiting human capital of a person was, the higher the benefit for the ICT company employing this person (Murphy & Siedschlag, 2013).

It has been mentioned by Becker (1962) and Welch (1975) that we can, on the one side, foster human capital through providing education, Murphy and Siedschlag (2013), on the other side, have even found out that the higher the amount and quality of the human capital is, the higher the potential benefits. Therefore, we can deduce in regard to the topic of this thesis, that the higher the quality of education of primary school students is, the more likely they will graduate with a high-quality degree. The need for EdTech being used in a positive light therefore gets even more important as it both carries the opportunity to support or even improve tuition

but also to weaken the quality (Christakis et al. 2004; Wartella et al. 2010). Davies (2000) and Spiteri and Chang Rundgren (2020) mention in regard to this point, that the teacher's attitude toward EdTech can directly influence on how it is perceived by its students. Thus, the more adequate and customized EdTech is used within the classroom in order to increase human capital, the better the mutual experience of EdTech. This positive affirmation then leads to a higher potential outcome regarding either the subject matter knowledge itself or also the technical understanding as such. This addresses exactly the market need for more high-skilled and technology-affine workers, claimed by much literature over the last years (Biggemann, Williams & Kro, 2014; Leu, Kinzer, Coiro & Cammack, 2004; Rohaan, Taconis & Jochems, 2010; Spiteri & Chang Rundgren, 2020; UNESCO, 2011)

HCT is highly relevant in the digital age and therefore, research addressing the theory needs to be conducted. This is necessary, so that knowledge on how to improve the current state of EdTech and the dissatisfaction with it (see Chapter 1.2) can be created. By impacting the human capital through using EdTech in an adequate and customized way, it is possible to reach an optimized state that nurtures positive experiences for its users.

HCT is relevant to this thesis as it captures the transformation of investments into the education system. This thesis claims that integrating EdTech as a regular means of tuition will benefit the outcome of primary school education.

## 2.4 Sunk Cost Fallacy

Adding a further theoretical component to this thesis, this section is about the theory of *Sunk Cost Fallacy*. Any investment that cannot be recovered is called sunk (Friedman, Pommerenke, Lukose, Milam & Huberman, 2007). The theory describes the widely spread psychological error to give irrational attention to sunk cost from the past, while making current decisions (Soman, 2001). A good way to explain this cognitive error is the following example: "A man joins a tennis club and pays a \$300 yearly membership fee. After two weeks of playing he develops a tennis elbow. He continues to play (in pain) saying 'I don't want to waste the \$300!'" (Thaler, 1980, p. 47)

While this example makes the effect obvious, it is much more hidden in real world problems, often ignored and can lead to massive follow-up costs. This issue is especially relevant in IT-projects, because the complexity in technology projects is especially high and errors often are overlooked. Therefore, the Sunk Cost Fallacy is in general a greater issue in IT-projects than in non-IT-projects (Wang & Keil, 2007).

The supply of primary schools with EdTech is generally seen as an IT-project. It is likely that the Sunk Cost Fallacy is very present in this kind of project because skilled planners and IT-professionals are generally paid less by the government compared to private companies and therefore, less skilled people are concerned with these projects (Afonso, Schuknecht & Tanzi, 2005). Moreover, EdTech is most likely paid for with taxpayers' money, like in the case of Germany, Sweden or Finland, which can lead to the planners' lack of commitment to money and the sunk cost effect being overlooked even more. In fact, the complexity involved in integrating EdTech in primary schools goes beyond the investment, targeting the human nature with spent resources in terms of efforts and worldviews (Salavati, 2016), for example.

The right way would be to not take past decisions into consideration and evaluate the current situation, then decide from this point if a project shall be continued (Soman, 2001). According to Soman (2001), people do not value invested time and efforts the same, as they value invested money: The Sunk Cost Fallacy is less intense when people invested time, than when they invested money. Nevertheless, this effect exists with experience too, and it therefore is very likely that teachers will not be willing to change their style of teaching, especially if they have much experience with traditional methods. More so, if teachers are involved in spending time and efforts to bring in their worldviews in how teaching is conducted using EdTech, and such technology fails before it is adopted and adapted, then, according to the Sunk Cost Fallacy (Wang & Keil, 2007), it is very hard to reverse the situation.

The Sunk Cost Fallacy is relevant to this thesis as it is a good representation of the current situation, in which investments have already been made in education system and therefore work continues on this basis, regardless of whether it is beneficial or disadvantageous. This thesis claims that integrating EdTech as a regular means of tuition will be achieved more easily when adjusting the investment strategy and thus lead to a better outcome of primary school education.

## 2.5 EdTech Tension Model

Giving another foundation to this subchapter, next to the already given information about related theories and further literature before, a literature overview on some key concepts in relation to EdTech is given in this section (see Table 2). The concepts are defined by literature that investigated on the *attitude* (Blackwell et al. 2013; Ifenthaler & Schweinbenz, 2013; Jenson & Rose, 2003; Mathews & Guarino, 2000; Nistor, Gogus & Lerche, 2013; Rohaan, Taconis & Jochems, 2008, 2012; Salavati, 2016; Spiteri & Chang Rundgren, 2020) towards and the *adoption* (Blackwell et al. 2013; Hermans et al. 2008; Ifenthaler & Schweinbenz, 2013; Jenson & Rose, 2003; Mathews & Guarino, 2000; Rodríguez, Nussbaum & Dombrovskaja, 2012; Salavati, 2016; Spiteri & Chang Rundgren, 2020; Teräs et al. 2020; Van Braak, Tondeur & Valcke, 2004) of EdTech. There is no specific research about the concept of *adaption* of EdTech yet, but the importance for including this concept into our study as well will be clarified in the following paragraphs.

TITLE	AUTHOR(S)	SUMMARY	CONCEPT
<b>GENDER DIFFERENCES IN COMPUTER ATTITUDES AND USE AMONG COLLEGE STUDENTS</b>	Shashaani (1997)	The study investigated on the attitude towards technology from a student's perspective. It revealed that in average, female students tend to feel less confident about technology, yet in general the confidence towards technology can be improved by offering computer training.	Attitude
<b>PREDICTING TEACHER COMPUTER USE: A PATH ANALYSIS</b>	Mathews & Guarino (2000)	The authors studied on how the different variables gender, academic degree, experience, school level, computer literacy and computer ability affect the computer usage of teachers. It is important to note that EdTech users have	Attitude, Adoption

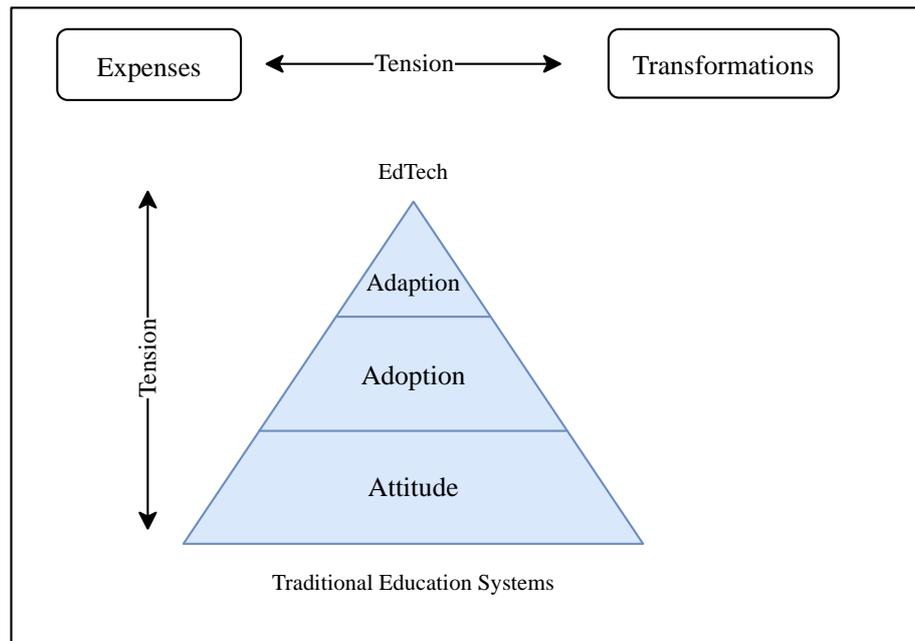
		different levels of competencies so that this fact can be addressed when introducing it.	
<b>WOMEN@WORK: LISTENING TO GENDERED RELATIONS OF POWER IN TEACHERS' TALK ABOUT NEW TECHNOLOGIES</b>	Jenson & Rose (2003)	The authors studied on the fact that the introduction of technology in the classroom comes with changes for the working conditions and professional experiences of teachers. This situation is oftentimes left behind, when implementing EdTech rather focuses on preserving a functioning education environment. The study looked especially on the role of gender in the context of their competence with and use of computers and the social component that comes with it.	Attitude, Adoption
<b>EXPLAINING DIFFERENT TYPES OF COMPUTER USE AMONG PRIMARY SCHOOL TEACHERS</b>	Van Braak, Tondeur & Valcke (2004)	The authors studied upon the topic of two types of computer usage in primary schools, namely supportive or actual classroom usage. Amongst other things they concluded their work with the following result: supportive computer use is affected by general computer attitudes, while classroom use is affected by attitudes towards computers in education.	Attitude, adoption
<b>REVIEWING THE RELATIONS BETWEEN TEACHERS' KNOWLEDGE AND PUPILS' ATTITUDE IN THE FIELD OF PRIMARY TECHNOLOGY EDUCATION</b>	Rohaan, Taconis & Jochems (2008)	The literature review revealed that due to the increasing importance of technology, education has to adapt accordingly. Because our society has the need for more engineers and technologists, it is important to nurture the attitude of students towards technology early in their life, e.g., through technology in the classroom. The authors investigated on which aspects of teacher knowledge is essential so that their teaching affects their students' attitude towards technology.	Attitude
<b>THE IMPACT OF PRIMARY SCHOOL TEACHERS' EDUCATIONAL BELIEFS ON THE CLASSROOM USE OF COMPUTERS</b>	Hermans et al. (2008)	The authors' study revealed that teacher's having a constructivist belief system can support the use of computers in the classroom, whereas a traditional mindset is rather limiting in this regard. Having a worldview that is open towards new things effects whether teacher's adopt technology in the classroom.	Adoption
<b>ANALYSING TEACHER KNOWLEDGE FOR</b>	Rohaan, Taconis & Jochems (2012)	The authors conducted a study across 354 primary school teachers about technology-specific teacher knowledge. Despite the fact that the work focused on technology education	Attitude

<b>TECHNOLOGY EDUCATION IN PRIMARY SCHOOLS</b>		as such, it showcased that the technical expertise of a teacher influences the tuition of technical topics. The more positive the attitude of a teacher towards technology is, the more likely the teaching experience of technical topics can develop.	
<b>ICT FOR EDUCATION: A CONCEPTUAL FRAMEWORK FOR THE SUSTAINABLE ADOPTION OF TECHNOLOGY-ENHANCED LEARNING ENVIRONMENTS IN SCHOOLS</b>	Rodríguez, Nussbaum & Dombrovskaja (2012)	The authors argue that technology in the classroom does not necessarily lead to a positive impact of tuition. Therefore, they developed a framework to measure whether a particular technology program in schools leads to an effective adoption of the technology.	Adoption
<b>ADOPTION AND USE OF TECHNOLOGY IN EARLY EDUCATION: THE INTERPLAY OF EXTRINSIC BARRIERS AND TEACHER ATTITUDES</b>	Blackwell et al. (2013)	The paper researched on the potential burdens that might arise for when integrating technology in the classroom. Main findings were that it is mostly personal characteristics that matter and also that there is the need to do more research about the quality of this integration. The authors further mentioned that there is still little research about technology use in the classroom of early childhood education.	Attitude, adoption
<b>EDUCATIONAL TECHNOLOGY ACCEPTANCE ACROSS NATIONAL AND PROFESSIONAL CULTURES: A EUROPEAN STUDY</b>	Nistor, Gogus & Lerche (2013)	The quantitative study across 4589 educational technology users concerned with the acceptance of EdTech revealed that A. The authors made use of the UTAUT, more specifically a version of it that models educational technology acceptance. The model includes the UTAUT's determinants as well as computer anxiety and literacy.	Attitude
<b>THE ACCEPTANCE OF TABLET-PCS IN CLASSROOM INSTRUCTION: THE TEACHERS' PERSPECTIVES</b>	Ifenthaler & Schweinbenz (2013)	The qualitative study revealed that the acceptance of tablet-PCs by teachers is highly influenced by their attitude towards it, as well as the determinants performance expectancy and the facilitating conditions, taken from the UTAUT. The authors further pointed out that there is still a lack in technology equipment in German schools, as	Attitude, adoption

		Germany has been the country where the study was conducted.	
<b>USE OF DIGITAL TECHNOLOGIES IN EDUCATION: THE COMPLEXITY OF TEACHERS' EVERYDAY PRACTICE</b>	Salavati (2016)	The extensive thesis focuses on the complexity of integrating EdTech into the classroom. To mention some relevant aspects in this regard, the author studied on how a teacher's profession, philosophy, willingness to change and technical skills, as well as the infrastructure influence on the attitude towards and adoption of EdTech.	Attitude, adoption
<b>LITERATURE REVIEW ON THE FACTORS AFFECTING PRIMARY TEACHERS' USE OF DIGITAL TECHNOLOGY</b>	Spiteri & Chang Rundgren (2020)	Literature review of 27 studies to identify the necessary elements for a digitally competent teacher. The authors found out that there are different factors that effect a teacher's use of digital technology, which all can be categorised into either school culture, teacher skills, teacher attitude or teacher knowledge.	Attitude, adoption
<b>POST-COVID-19 EDUCATION AND EDUCATION TECHNOLOGY 'SOLUTIONISM': A SELLER'S MARKET</b>	Teräs et al. (2020)	The authors discuss upon the rapid change towards EdTech usage in the classroom due to the pandemic. Next to putting an emphasis on the fact that schools need customised solutions, they came to the conclusion that it is especially relevant to assure an adequate quality of the students' education.	Adoption

Table 2: Literature overview on the concepts of attitude and adoption of EdTech

Our literature review in the context of EdTech across primary schools as well as possible theories that can explain the complexity of why EdTech is still lagging behind are important for two reasons. First, EdTech in primary education lacks a transformative process from the traditional education system, compared to higher education institutions. Second, we will reason that the concepts of attitude, adoption and adaption are key to identify what can influence this transformation towards EdTech being invested upon, accepted and used as a regular means of tuition. Moreover, the complexity of integrating EdTech in primary schools (Salavati, 2016) shows that there are tensions which prevent EdTech from being easily adopted and adapted, primarily by an attitude that has a negative tendency. Therefore, we develop the *EdTech Tension Model* (see Figure 2) as a visualization to reason about and display the different tensions within the environment of EdTech that happens in cases such as in German primary schools.



**Figure 2: EdTech Tension Model**

Making mainly use of the knowledge about the Sunk Cost Fallacy, the model showcases the tension between the input of and output through EdTech into the school system on the top level (horizontal tension). The expenses into the German primary school system, that have emerged over the last decades on the one side and the thereby resulting transformations on the other side should be reasonably balanced. As mentioned at multiple points before, this does not yet seem to be the case (Bocksch, 2020; European Commission, 2020; Rudnicka, 2019; Tenzer, 2021). Further, the vertical tension describes the friction between transforming from the current, still quite traditional education system into modern, EdTech supported tuition. The triad is built upon the HCT, by putting education into the focus, as well as by the UTAUT, in that the process of “reaching” EdTech goes through different stages of concepts. Whereas our research will not focus specifically on the tensions as such, it is necessary to state that they exist and imply mutual interplay between expenses and transformations on the one side and attitude, adoption and adaption on the other side. Accordingly, the intention of our research is to find out how these tensions can be minimized by adjusting the investment strategy. Both the expenses as well as the transformations are to be understood as mediators that can impact the stages beneath, as their theoretical foundation states so.

Going into detail, the attitude towards EdTech can be interrogated and influenced, as one has to ask how a teacher, for example, perceives EdTech, whether she or he perceives it in a positive or negative light, respectively. This assumption is rooted in the statements of Ifenthaler and Schweinbenz (2013) and Van Braak, Tondeur and Valcke (2004), who both mentioned the ability of attitude to affect the adoption of EdTech. It can be assumed that the more positive the attitude toward EdTech is the easier the next stage can be reached. In this stage, the acceptance of EdTech should be in focus: does a teacher adopt EdTech? Is she or he willing to use it as a tool for tuition? Again, the more likely a teacher adopts EdTech, the more likely the following stage is reached. Despite there being no justification found for the adoption influencing on the adaption of EdTech yet, we argue that this stage of adaption of EdTech has to be reached in order to state that EdTech is not only understood but willingly used. Aligning

with Liu (2012), the compulsion of using technology can only lead to negative outcomes – therefore, the adaption of it is necessary so that the outcome is more likely to be a positive one. The process of going through these stages in order ideally reach EdTech as a normalized means of tuition can very well be aligned with the stages that Kugel (1993) described earlier. The explanation of these concepts might have sound relatively abstract so far, therefore, describing it additionally in a more compact way: the attitude towards and the adoption and adaption of EdTech can be influenced. The more down in the triad the concept is, the easier it can be influenced by different actors, amongst others, the government, the schools themselves, the social environment around EdTech users. Also, it can be assumed that the more solid a concept farther down is, the more stable the concept(s) on top can develop.

## 2.6 Hypothesis Development

Now that we have laid the theoretical foundation, this chapter names and explains the hypotheses that can be derived from the theories and the model and that will be tested through the subsequent research work. Stating these hypotheses aligns with the research question of this thesis, as they investigate on the importance of the factors that have an influence on the transformation towards fully integrating EdTech as a regular means of tuition.

Whereas the literature overview done in 2.5 has revealed a direct influence of the concept of attitude toward EdTech on the adoption of EdTech (Ifenthaler & Schweinbenz, 2013; Van Braak, Tondeur & Valcke, 2004), it could not identify any particular research about the adaption of EdTech or even the effects of adoption on adaption. The only paper that slightly gives an indication that this mediation is the case is the research work of Liu (2012). As the author states that the forced use of EdTech negatively influences the adoption of it, it can be deduced that the convinced use of EdTech positively affects the adoption, thus making it more likely that users adapt EdTech. When this stage is reached, one can say that EdTech is a regular means of tuition. Therefore, we hypothesize that the stage of adoption of EdTech directly influences the subsequent stage of adaption of EdTech:

*H1: A strong adoption of EdTech positively affects the adaption of EdTech.*

The hypothesis can also be stated in a logical form, which will later on, in Chapter 4.2.3.1, be also expressed in terms of explicit variables, after having introduced the survey questionnaire:

H1: Strong adoption → Strong adaption

Further, we want to hypothesize based on the statements of the Sunk Cost Fallacy in the context of EdTech in German primary schools. One could claim that the role of the expenses mediates why attitude towards EdTech is negatively affecting the adoption of EdTech. This is the case as the teachers have “invested” a huge extend of their personal education on learning about traditional education systems and might not be willing to move away from it. The more years away the education of a teacher is, the stronger it can be assumed that she or he learned about relatively traditional education systems, as EdTech was less important some years and decades ago. As literature has already been investigating about the mediating abilities of the user’s age (Blackwell et al. 2013; Venkatesh & Davis, 1996), we want to take it a step further and research on the relation between the age of EdTech users and the likelihood of adapting EdTech. Thus, the following hypothesis can be derived:

*H2: The higher in age a user of EdTech is the less likely the adaption of EdTech becomes.*

Showcasing H2 in logical form, we derive the following:

H2: High age → Low adaption

Lastly, mainly deducing from the problems mentioned in Chapter 1.2, we want to investigate which reasons lead to dissatisfaction in dealing with EdTech in German primary schools and thus to non-adaption. We can envision that the lack of a guideline for what tool to use leads to confusion and overextension. As Bocksch (2020) mentions, teachers tend to use multiple EdTech tools as a means of communication, which might lead to dissatisfaction for the recipients. This number of tools could be perceived as negative because it makes tuition less effective; arguing based on the HCT this would negatively impact the transformation of the investments into the school system and should therefore be avoided. Hence, the following hypothesis has to be validated:

*H3: A high number of EdTech tools negatively influences the attitude towards EdTech.*

Presenting this hypothesis in a logical form to be later checked in terms of actual variables, the following has to be tested:

High number of EdTech tools → Low attitude

## 3 Methodology

*This chapter reasons about the way this thesis is conducted, including an understandable explanation of the approach we use to solve the research question. As this thesis' content is built upon a survey, the way the survey questions are constructed but also the survey conduction and results analysis are given in detail. All of this can only be done by following an adequately ethical and scientific approach on hand.*

### 3.1 Research Strategy

Referencing Johannesson and Perjons (2014), a research strategy is necessary for any kind of scientific work, as it complements the research with a guideline on how to plan, execute and monitor the work. Depending on the goal of the research, different research strategies might apply (Johannesson & Perjons, 2014). Because the goal of this thesis is to validate factors on their importance, a quantitative approach is an adequate research strategy; in particular, using a quantitative research method such as a survey is appropriate, because it supports the purpose of this thesis (Johannesson & Perjons, 2014). This is the case, as Johannesson and Perjons (2014) state that surveys are adequate to investigate on, for example, the attitude of people. Also, Bhattacharjee (2012) and Recker (2012) state that quantitative data such as the one collected by surveys is well suited to test theories. Although our research strategy focuses on quantitative data collection, the work also has a slightly qualitative character as we will include room for open feedback. As Johannesson and Perjons (2014) say, a quantitative strategy is good to measure phenomena, whereas a qualitative strategy helps to describe them. As we concentrate on the first but also aim to derive the maximum value out of our data collection – especially in regard to the implications for the stakeholders – a qualitative approach can very well be integrated into this work.

The research process of this thesis is aligning with the following structure: the theoretical basis is given in Chapter 2, so that a sound understanding for the subsequent content is available. Also, in Chapter 2, hypotheses are stated to broaden the theoretical foundation. Further, the current situation is captured by conducting an empirical study. This is necessary to later on combine the theoretical knowledge with the empirical knowledge to investigate on whether the hypotheses can be approved, meaning how the body of knowledge can be extended.

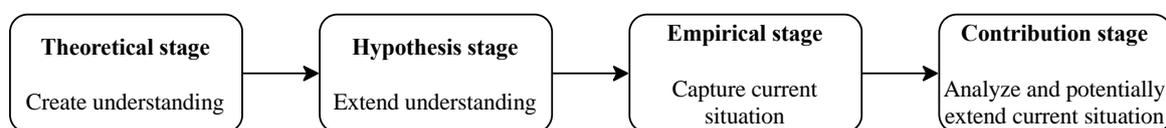


Figure 3: Research process

### 3.2 Conducting the Literature Review

Giving an insight into how we selected the literature for this thesis, we used Google Scholar as the source for references. We conducted queries using a variety of keywords, including but not limited to technology primary schools, technology primary schools education, Germany

primary schools technology, attitude primary schools technology, adoption primary schools technology, adaption primary schools technology, acceptance usage education technology, education technology definition, EdTech, EduTech, educational technology. These keywords are just a fraction but give a good indication for the direction we took. Further, we partly conducted backwards searches for the literature mentioned in some of the papers we found before.

Clearly, quite a few results were returned overall; however, we selected literature largely limited to the context of primary schools. In some cases, however, there were no sources specifically focused on this topic, so we referenced literature that was related in a similar context (e.g., EdTech in universities, technology acceptance in general, technology education).

The hypotheses, which were stated in chapter 2.6, are based on literature as well as on our own conjectures, which we, as scholars of IS, formed with our expertise.

### 3.3 Online Survey

Addressing our research question, our data collection technique of preference is to conduct an online survey on a selection of German primary schools, specifically addressed to teachers, as they are one of the main users of EdTech. Choosing to conduct a survey, and not interviews, for example, has been done because they are well suited to test theories (Bhattacharjee, 2012; Newsted, Huff & Munro, 1998; Recker, 2012). Also, as the nature of this thesis is to measure certain aspects rather than understand why these aspects exist, surveys are an adequate data collection technique (Pinsonneault & Kraemer, 1993). As Pinsonneault and Kraemer (1993) and Recker (2012) further state, that survey research is typical to only investigate on a selection of the population, as it is sufficient to have a sample group whose results can be generalized on the broader population.

The structure of the online survey is as follows: in the beginning we give preliminary information about the topic, the purpose, aim and content of the survey. Also, we inform the participants about the ethics of the research as well as their individual rights regarding data protection (German: Appendix 1, English: Appendix 2). Subsequently, we ask thirteen questions, that are clustered into five overall categories: *demographic questions*, *general EdTech questions*, *questions concerning the attitude towards EdTech*, *questions concerning the adoption of EdTech* and *questions concerning the adaption of EdTech*. Following the recommendation of Patton (2014) for qualitative research, we have an additional text field in the end so that the survey participants have the option to comment on further related aspects. We decided to form the questions in these categories as we could identify the aforementioned themes for questions based on the selected literature. Also, we stated some questions in regard to getting an indication for our hypotheses. The detailed justification for each question can be found in Table 2.

CATEGORY	QUESTION THEME	QUESTION ENGLISH	QUESTION GERMAN	SOURCE	JUSTIFICATION FOR QUESTION
<b>DEMOGRAPHIC QUESTIONS</b>	Age [D1]	What's your age?	Wie alt sind Sie?	Blackwell et al. (2013); Venkatesh	The age might indicate about the believe system of a teacher as well as about their

				et al. (2003)	experience, which might influence the attitude
	Gender [D2]	<p>What's your gender?</p> <ul style="list-style-type: none"> <li>- Male</li> <li>- Female</li> <li>- I'd rather not say</li> </ul>	<p>Wie ist Ihr Geschlecht?</p> <ul style="list-style-type: none"> <li>- Weiblich</li> <li>- Männlich</li> <li>- Keine Angabe</li> </ul>	Hermans et al. (2008); Jenson & Rose, (2003); Mathews & Guarino, (2000); Rasinen et al. (2009)	Females showed a lower level of computer ability which could lead to negative experience and therefore, negative attitude towards technology
<b>GENERAL EDTECH QUESTIONS</b>	Number of Tools [I1]	<p>How many different EdTech Systems do you use on a regular basis?</p> <ul style="list-style-type: none"> <li>- Less than 4</li> <li>- Between 4 and 7</li> <li>- More than 7</li> </ul>	<p>Wie viele verschiedene EdTech Systeme nutzen Sie regelmäßig?</p> <ul style="list-style-type: none"> <li>- Weniger als 4</li> <li>- Zwischen 4 und 7</li> <li>- Mehr als 7</li> </ul>	Bocksch (2020)	Relevant for H3
	Kinds of EdTech [I2]	<p>Which kinds of EdTech Systems do you use?</p> <ul style="list-style-type: none"> <li>- E-Mail</li> <li>- Combinatory Products (e.g. Microsoft Teams)</li> <li>- Video conferencing tools (e.g., Zoom, Fair Teaching)</li> <li>- Learning Management Systems (e.g. Moodle)</li> <li>- Cloud Systems (e.g.</li> </ul>	<p>Welche EdTech Systeme nutzen Sie?</p> <ul style="list-style-type: none"> <li>- E-Mail</li> <li>- Kombinationsprodukte (Microsoft Teams etc.)</li> <li>- Videokonferenzsysteme (Zoom, Fair Teaching etc.)</li> <li>- Lernplattformen (Moodle, Mebis etc.)</li> <li>- Cloud Systeme</li> </ul>	Bocksch (2020)	Relevant for H3

		<ul style="list-style-type: none"> <li>OneDrive, Drop-box)</li> <li>- Messengers (e.g., WhatsApp, Facebook)</li> <li>- Video platforms (e.g., YouTube)</li> <li>- Physical EdTech products (e.g., Tablets, Whiteboards, Projectors)</li> <li>- Others</li> <li>- None</li> </ul>	<ul style="list-style-type: none"> <li>(OneDrive, Drop-box etc.)</li> <li>- Messenger Dienste (WhatsApp, Facebook etc.)</li> <li>- Videoplattformen (YouTube etc.)</li> <li>- Physische EdTech Produkte (Tablet, Whiteboard, Projektoren etc)</li> <li>- Sonstige</li> <li>- Keine</li> </ul>		
	Using private solutions [I3]	<p>Do you ever have to use private technical solutions instead of provided EdTechSystems?</p> <ul style="list-style-type: none"> <li>- Often</li> <li>- Sometimes</li> <li>- Never</li> </ul>	<p>Kommt es vor, dass Sie privat technische Lösungen an Stelle eigentlich vorgesehener EdTech Systeme anwenden müssen?</p> <ul style="list-style-type: none"> <li>- Häufig</li> <li>- Manchmal</li> <li>- Nie</li> </ul>	Bocksch (2020); Rudnicka (2019)	Could be an indication for an inappropriate infrastructure, as provided EdTech solutions might not work properly, take too long to receive etc.
<b>ATTITUDE</b>	Confidence (1 – 5 Likert scale) [I4]	<p>How confident do you feel about EdTech?</p> <ul style="list-style-type: none"> <li>- Very uncertain</li> <li>- Very confident</li> </ul>	<p>Wie sicher fühlen Sie sich im Umgang mit EdTech?</p> <ul style="list-style-type: none"> <li>- Sehr sicher</li> <li>- Sehr unsicher</li> </ul>	Davies (2000); Spiteri & Chang Rundgren (2020)	Teachers with low confidence towards EdTech feel frustrated and develop a negative attitude, which is necessary for encouraging pupils for it.
	Experience (Years) [I5]	<p>How many years of experience do you have with EdTech?</p> <ul style="list-style-type: none"> <li>- Less than 2 years</li> </ul>	<p>Wie viele Jahre Erfahrung im Umgang mit EdTech haben Sie?</p>	Blackwell et al. (2013); Van Braak, Tondeur	Research has shown that the more experience with EdTech the more positive the

		<ul style="list-style-type: none"> <li>- Between 2 and 4 years</li> <li>- Between 5 and 10 years</li> <li>- More than 10 years</li> </ul>	<ul style="list-style-type: none"> <li>- Weniger als 2 Jahre</li> <li>- Zwischen 2 und 4 Jahren</li> <li>- Zwischen 5 und 10 Jahren</li> <li>- Mehr als 10 Jahre</li> </ul>	& Valcke (2004)	attitude towards it.
	Computer training [D3]	<p>Have you already participated in EdTech trainings?</p> <ul style="list-style-type: none"> <li>- Yes</li> <li>- No</li> <li>- I am not sure</li> </ul>	<p>Haben Sie bereits an EdTech Schulungen teilgenommen?</p> <ul style="list-style-type: none"> <li>- Ja</li> <li>- Nein</li> <li>- Keine Angabe</li> </ul>	Shashaani (1997); Spiteri & Chang Rundgren (2020)	Research has shown that users that experienced computer training have a higher attitude towards technology
<b>ADOP-TION</b>	Frequency of use [I6]	<p>How frequently do you use EdTech in class?</p> <ul style="list-style-type: none"> <li>- Daily</li> <li>- Multiple times per week</li> <li>- Once or less per week</li> </ul>	<p>Wie häufig verwenden Sie EdTech im Unterricht?</p> <ul style="list-style-type: none"> <li>- Täglich</li> <li>- Mehrmals wöchentlich</li> <li>- Einmal oder weniger pro Woche</li> </ul>	Van Braak, Tondeur & Valcke (2004)	Research has proven that frequent computer use leads to a higher confidence which then influences on the attitude towards EdTech
	Perceived voluntariness of use [I7]	<p>Do you feel pressured by others to use EdTech?</p> <ul style="list-style-type: none"> <li>- Yes</li> <li>- No</li> <li>- I am not sure</li> </ul>	<p>Fühlen sie sich von anderen unter Druck gesetzt, EdTech zu verwenden?</p> <ul style="list-style-type: none"> <li>- Ja</li> <li>- Nein</li> <li>- Keine Angabe</li> </ul>	Liu (2012); Venkatesh et al. (2003)	Research has shown that the forced use of technology leads to a negative attitude towards it, which then influences whether to adopt the specific technology. Also, the UTAUT has identified the voluntariness of use

					as a key moderator on behaviour and thus, use.
	Technology policy, guideline, support [D4]	Is technical support for problems with EdTech (e.g., in form of a hotline) provided to you?  - Yes - No - I am not sure	Wird Ihnen für die Verwendung von EdTech technische Unterstützung (z.B. in Form einer Hotline) bereit gestellt?  - Ja - Nein - Weiß nicht	Blackwell et al. (2013)	Research has shown that a technology policy that functions as a guideline for primary school teachers helps to increase the effectiveness of EdTech usage.
<b>ADAP-TION</b>	Impact (1 – 10 Likert scale) [I8]	How would you rate the impact of EdTech on your classes?  - Strong burden - Strong support	Wie schätzen Sie die Wirkung von EdTech auf Ihren Unterricht ein?  - Starke Belastung - Große Hilfe		Relevant to H1 as it can be assumed that teachers that adopt EdTech because they feel it to have a positive effect on their classes are more likely to adapt EdTech as well.
	EdTech as a normal means of education [I9]	Assume Covid-19 would not exist any longer and schooling would be back to normal and classes would be held on site as usual from now on. Would you continue to use EdTech in your classes?  - Yes - No - I am not sure	Nehmen Sie an, Covid-19 würde nicht mehr existieren und der Unterricht würde ab nun wieder ganz normal vor Ort stattfinden. Würden Sie EdTech weiterhin in ihrem Unterricht verwenden?  - Ja - Nein - Weiß nicht		Important for H1 because it is very likely that the participants who answer with “yes” have adapted EdTech.

Table 3: Justification for survey questionnaire

To rephrase the structure of the survey questionnaire in Table 2, one can say that the categories can be declared partly as dependent variables and partly as independent variables. Whereas D1, D2, D3 and D4 are independent, the I1, I2, I3, I4, I5, I6, I7 and I8 can be enumerated as dependent variables.

The survey questionnaire was simultaneously created in both English and German, since the literature and thesis is in English, but the potential participants are German citizens. Because

we, as the authors of this thesis, are both German native speakers, the quality of the translation into German is assured. The original, German version including the results of the online survey can be found in the appendix (see Appendix 1), whereas the according translated English version is published in a later section.

In order to collect the data, the E-Mail addresses of German primary schools were collected via the online register of the Bayerisches Staatsministerium für Unterricht und Kultus (2021a). The distribution of the survey was supported by additional information, as the recipient of the survey is usually the head of school or his assistance, respectively. It was communicated that the survey link shall be forwarded to the teachers at a particular school. The survey duration was set to two weeks.

### 3.3.1 *Selecting Survey Participants*

When it comes to the selection of the participants for our online survey we have to explain how and why we narrowed a huge potential group down to our actual participants. As this thesis is targeting German primary schools, there was a potential number of about 15431 primary schools in the beginning, including public, private and specialized schools, to be contacted (Rudnicka, 2020b). Because we were of the opinion that the participants should be as comparable as possible, we only focused on public primary schools that are situated in the south-east of Germany, in the region of Bavaria. This is due to the fact that the curriculums differ from region to region and education is financed by local authorities, which leads to an imbalance of spent money per student (Rudnicka, 2021). After deciding that we only want to target public Bavarian primary schools, we conducted an internet query for a public register of the schools' contact information. On the website of the Bayerisches Staatsministerium für Unterricht und Kultus (2021a) we found a filterable overview of the primary schools we were looking for. Narrowing the results down according to our limitations, we resulted in 2257 potential schools (Bayerisches Staatsministerium für Unterricht und Kultus, 2021b). All of the conducted queries have been done on the 25<sup>th</sup> of April 2021 and therefore only capture the state as it has been at that specific time.

The results of the query could be downloaded as a csv-file. The file only included the name of the schools, their address, website and organizational data about each primary school. Because the only suitable way of contacting the primary schools is via their E-Mail address, and looking each of these up manually is inefficient, we created a python 3 script to automate this task.

The script was going through the csv-file and called every school website via a browser. Some websites could not be reached due to connection errors. Further, the script scraped through the accessible websites to search for the E-Mail address. Some schools did not provide an E-Mail address or did not want to be found due to replacing the “@” with an “(at)”, for example. Yet, with all the results the script could find, a new csv-file has been created that saved the schools' websites, E-Mail addresses and the organizational links. In the next step, the script went through all of these organizational links so that we could pull the number of teachers from the website we did the query on (e.g. see Bayerisches Staatsministerium für Unterricht und Kultus (2021b)). We wanted to have this information as it gave us an indication of the number of potential participants we could reach with our online survey.

After we ran our script, we had an overview of the E-Mail addresses of all the schools that we could actually contact (see column 2 in Table 4). After that, we emailed our online survey, including a cover letter, to the E-Mail address holders. From the potential 11321 participants, 217 submitted the online survey in the end.

# POTENTIAL PRIMARY SCHOOLS	# CONTACTED PRIMARY SCHOOLS	# POTENTIAL PARTICIPANTS	# ACTUAL PARTICIPANTS
2257	914	11321	217

Table 4: Overview of the potential and eventually contacted public schools and the potential and actual participants

For the aforementioned reasons, the sampling process of the survey participants can be described as purposeful sampling as the reasons for narrowing the participants down has been justified (Johannesson & Perjons, 2014).

### 3.3.1.1 Selecting Survey Participants – an Extension

Although we have stated our reasons for delimiting the scope of our online survey in the previous chapter, we include this extension after recognizing that we can generate additional value with just little effort: we conducted a second online survey that targeted specifically private Bavarian primary schools.

The reason for this addendum is, that we assume it is interesting to compare some of the survey questions between the public and private schools. It might be that there is a difference in the average answers, as private schools are self-regulated, meaning they have their own economic administration and therefore can invest into EdTech more easily, less bureaucratic and in their own pace.

Analogously to the previous chapter, Table 5 displays an overview of the potential and eventually contacted schools and participants, respectively.

# POTENTIAL PRIMARY SCHOOLS	# CONTACTED PRIMARY SCHOOLS	# POTENTIAL PARTICIPANTS	# ACTUAL PARTICIPANTS
151	64	994	20

Table 5: Overview of the potential and eventually contacted private schools and the potential and actual participants

## 3.4 Data Analysis Methods

As Johannesson and Perjons (2014) explain, collected data has to be “prepared, interpreted, analyzed, and presented before any conclusion can be drawn from them” (p.61). This is the case because raw data as such does not state anything (Johannesson & Perjons, 2014). Thus, this chapter showcases what we do with the collected data from the online survey in order to later on imply our findings.

Partly, a quantitative analysis method is used in order to measure the collected quantitative data. The quantitative data collected in the online survey is all the question answers excluding the text field input. Before doing any kind of interpretation of the data, it is necessary to understand with which kind of data we are handling with. The online survey had questions of three types of data: nominal data were all answers for the questions of the variables D2, I2, I3, D3, I6, I7, D4, I9, ordinal data was all rated answers (D1, I4, I8) and interval data was all data collected by the questions for the variables I1, I5 (Johannesson & Perjons, 2014). In order to do a quantitative analysis, we have to analyze the raw data returned by our survey tool, Google Forms. Therefore, we both look manually over the data to get an impression of the overall result as well as analyzed it using Excel, Python and Matplotlib. Depending on the result gained through Excel, Python and Matplotlib, we deduced findings, both general and hypotheses related, that can be found in the subsequent chapter.

To another extend, a qualitative analysis method is used so that the small amount of qualitative data can be interpreted. The qualitative data collected in the online survey is solely the text field input. To analyze the data, we conduct a content analysis. Aligning with the description of Johannesson and Perjons (2014), we start with breaking the text down into its smaller units, being the single answers from the survey participants. Next, we analyze overall themes in the units, so that we can categorize each unit accordingly. For some units we can identify multiple categories. The detailed categorization of the units can be found in the appendix (Categories: Appendix 3; Public schools: Appendix 4; Private schools: Appendix 5). Based on this content analysis, we could both gain a deeper understanding of the opinion of the participants but also extend the previous findings from the quantitative analysis by qualitative measures.

### 3.5 Scientific Quality and Ethics

To make research “research-worthy”, scientific work should be conducted according to the highest principles and standards. Measuring the quality of research is commonly carried out by investigating on the reliability and validity of the work Bhattacharjee (2012). The reliability of a scientific work is high if conducting it again would lead to a similar result (Bhattacharjee, 2012). Validity refers to the fact that the results of the research are correct and credible (Bhattacharjee, 2012). Therefore, in order to ensure that this research work aligns with common principles and standards for good quality and ethics, this section will present the ethical principles given by Diener and Crandall (1978). These principles are especially of interest as they align with the survey research this thesis is making use of. Also, we will make use of the *set of principles for the conduct and evaluation of interpretive field research in information systems* by Klein and Myers (1999), as it is especially useful for this work, covering the specific characteristics and needs that IS research comes with. Further, we, as the authors of this thesis, will give specific explanations on how we will follow these guidelines.

The most fundamental principle given by Diener and Crandall (1978) is about the idea that the *risk of harm* during research conduction should be minimized. This principle can be assured by following key practices such as the ones covered by the subsequent principles. None of the affected actors of the research shall be negatively affected by the conduction of it. Because the survey creation, through put, analysis and evaluation of this thesis will be rooted in these principles, it can be presumed that the principle of minimizing the risk of harm is followed.

Next, the emphasis is put on the principle of *informed consent* (Diener & Crandall, 1978). It is important that the participants of our survey are both knowingly informed about the fact that they are taking part in a research as well as what the research is about. Assuring these points is essential to get credible and morally acceptable answers from the research objects. We align our survey with this principle by giving explanations as well as the option to contact us for further support.

Further, Diener and Crandall (1978) include the importance of *anonymity and confidentiality* into their set of principles. Ensuring that the data collection is done in an anonymized way helps to give the survey participants more trust; it can be assumed that the answers are filled out in a more credible manner as the participants can rely on the security of anonymity. Handling the collected data in a secure and confidential frame gives the whole research more credibility. As our survey research will not collect any personal data that can be traced back to an individual. Also, in the aftermath, the results will be kept anonymized and only deduced and generalized statements will be made.

The principle of *avoiding deceptive practices* Diener and Crandall (1978) states that research should only be conducted in a truthful and justified manner. Carrying research out with false intentions or purposes is morally not acceptable and shall therefore be avoided. Because we, as the authors, are personally passionate about understanding the current situation and potential issues of EdTech in German primary schools, we guarantee to not engage into these kinds of practices. Nonetheless, we are aware that potential biases, following the principle of suspicion by Klein and Myers (1999), might shift some of the research results. Yet, we guarantee that we aim at minimizing these.

Lastly, Diener and Crandall (1978) point on the importance of the *right of the participant to withdraw* from a research project. The survey of this research work is sent out via E-Mail to a number of German primary schools, asking them for voluntary participation. Equally to the participants being free to choose to take part in the survey they are also free to leave it at any point and for any reason.

Shifting the focus on one other principle given by Klein and Myers (1999) that seems worthy to mention for our thesis is the principle of *dialogical reasoning*. We are aware and sensible to potential contradictions between the theory and the outcomes of our survey work. The reason for us mentioning specifically this principle is, that exactly this type of sensitivity is what we want to make aware of: we have claimed multiple times throughout this thesis that it might be the case that Germany has not given enough attention to the specific need of the users of EdTech. Taking this statement onto an abstract level and connecting it with the principle, it is like only “following” a theory or guideline is not enough – special attention has to be given the potential contradictions or shifts between the theory and actual happenings.

With this research being a qualitative study, referencing Stenbacka (2001) is adequate, as the author mentions that in general, qualitative research tends to be less valid in contrast to quantitative research. This is the case because the results in qualitative research are based on the correct analysis of the collected data, whereas quantitative research is based on “facts” (Bhattacharjee, 2012). By aligning this thesis with all of the above-mentioned principles, we aim to guarantee for a correct analysis.

## 4 Findings

*After having the online survey conducted, this chapter's purpose is to present the findings of our data analysis. Not only is there information about general deductions from the results but also more detailed interpretations regarding the hypotheses.*

### 4.1 General Impressions

This section gives a more general impression of the online survey results, focusing on the main survey targeted at public schools. Whereas Chapter 4.2.1 will have a closer look into each question result, this introduction is to state that overall, we can identify two main types of results: one is confirming results in the sense of results aligning with what has been stated in literature and what we have also been suspecting, e.g., our sample has an about 90% quota of female participants, which perfectly aligns with what has been mentioned by research before (Statista Research Department, 2020a). These results give the whole online survey credibility, as if this aligns with what has been investigated before, the remaining questions can be declared to be “valid” as well. To another extend, the survey results have been, more or less intense, alarming in the way that we can clearly see that there is the need for some action to take place from various stakeholders, so that the last stage of adapting EdTech can be reached.

To make use of the additionally collected data of the online survey targeting the private schools, there are also some findings that should not be neglected. It is interesting to mention these results, as there might be certain learnings from the private schools that can be transferred to the public ones. A detailed version of the results can be found in the appendix (see Appendix 7).

### 4.2 In Detail Impression

#### *4.2.1 Focusing on the Qualitative Results*

In the first question, which asked about the age of the participants, it can be seen that almost every age between 24 and 65 is present (see Figure 4). This means that the online survey covered participants who have recently entered the workforce, participants who are likely to retire shortly, and almost every age group in between. The average age of the participants is 43.6 years. It can be seen that there are two slight lows in the data, one at around the age of 35 to 44, another one at around the age of 60 to 65. We suspect the first low to be present, as this age range might be a typical age for people to be on parental leave, the second low can be justified by either a lower share of this age group in primary schools (Statista Research Department, 2020b) or with less people in this age group answering (online) surveys.

How old are you?

227 responses

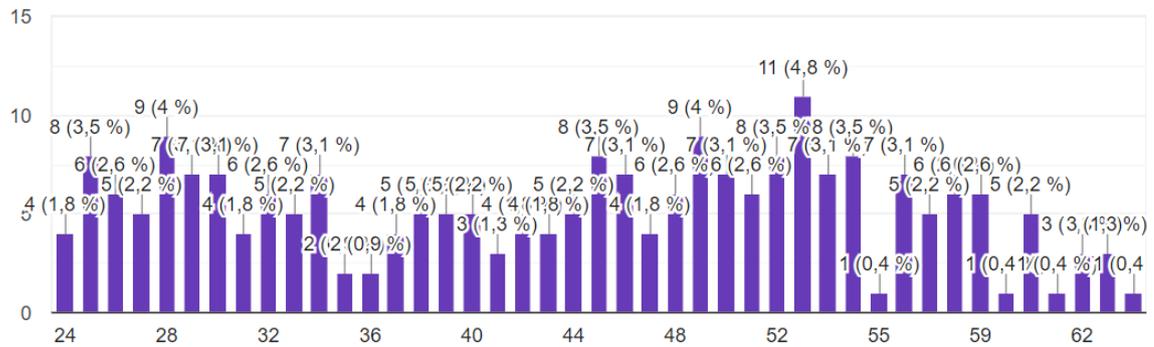


Figure 4: Survey question 1

Just as we suspected before, as it has been presented by research (Statista Research Department, 2020a), the share of female and male participants is highly unbalanced with 89.9% female teachers and only 8.8% male teachers (see Figure 5). This result made us believe that our overall survey can be taken as a source of valid information, because our sample seems to match the actual population of teachers in primary schools.

What's your gender?

227 responses

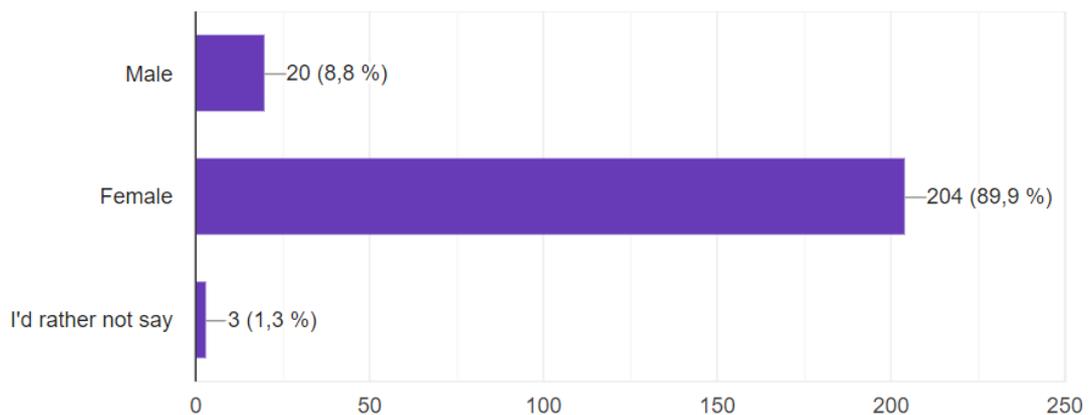


Figure 5: Survey question 2

Regarding the number of EdTech tools that are used by the participants on a regular basis, there was an obvious peak at four to seven tools (see Figure 6). Because (Bocksch, 2020) has identified that the number of tools can quickly lead to an uncoordinated way of communication, we felt that this range is a good indication for whether a relatively low (and therefore “coordinated”) or relatively high (and therefore “uncoordinated”) number of EdTech tools is used.

## How many different EdTech Systems do you use on a regular basis?

227 responses

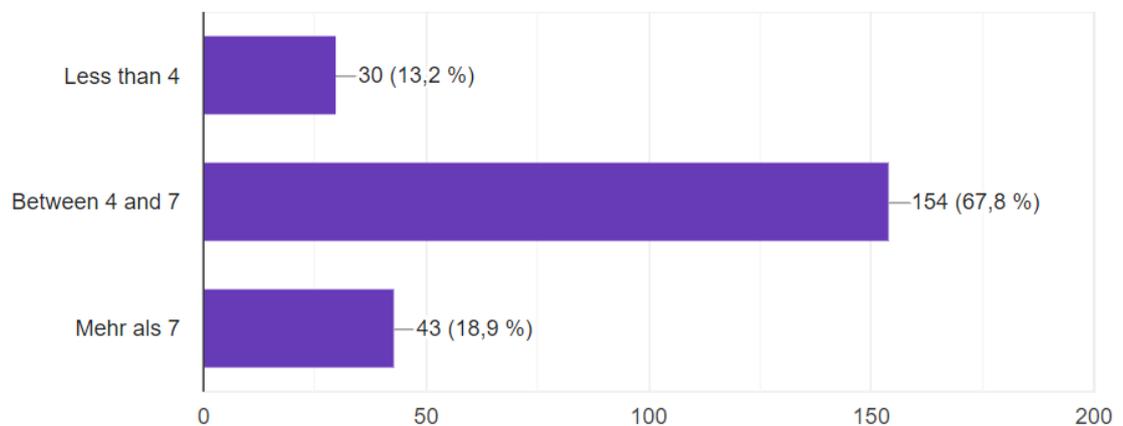


Figure 6: Survey question 3

The types of EdTech systems used by the participants has been relatively balanced, with the video conference technologies leading the statistic and the rather modern technologies, such as cloud systems, being at the end (see Figure 7). It can be assumed that the first is so popular, because at the time of the online survey, the participants have been conducting their lessons online for approximately one year, making this technology indispensable. Also, in this regard, the interest for using video platforms can be explained as it combines visual and auditory elements.

## Which kinds of EdTech Systems do you use?

227 responses

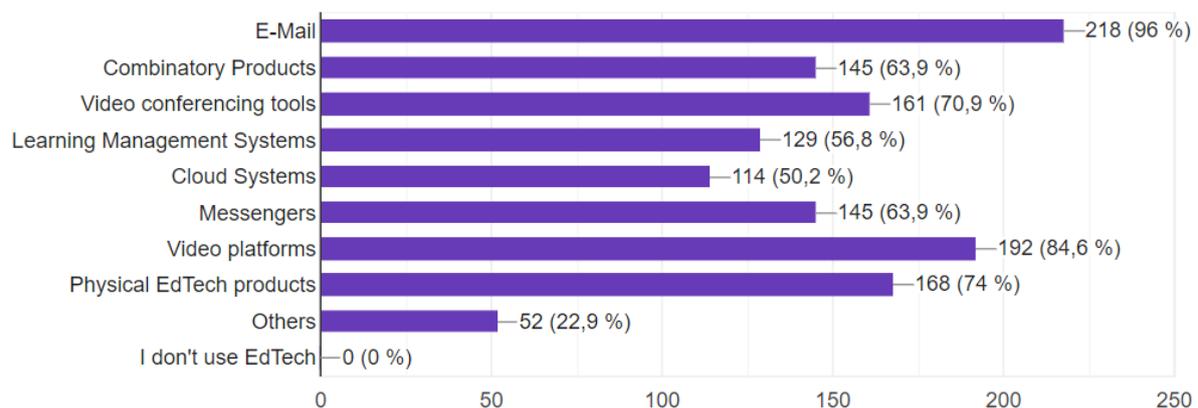


Figure 7: Survey question 4

What can be identified looking at the results from the question of how confident the participants are in regard to using EdTech, that the majority feels confident (49.8%), 4 on a scale from 1 to 5, or even very confident (12.8%), 5 on a scale from one to 5 (see Figure 8). Only 6.2% feel very uncertain or uncertain. In average, the participants are located at 3.68 on the scale. Despite this being an overall very positive result, it has to be mentioned that some of

the really low ratings could probably not be fetched with this online survey, as some of the teachers that do feel like they lack in confidence towards using EdTech might not feel comfortable enough to even answer an online survey.

How confident do you feel about EdTech?

227 responses

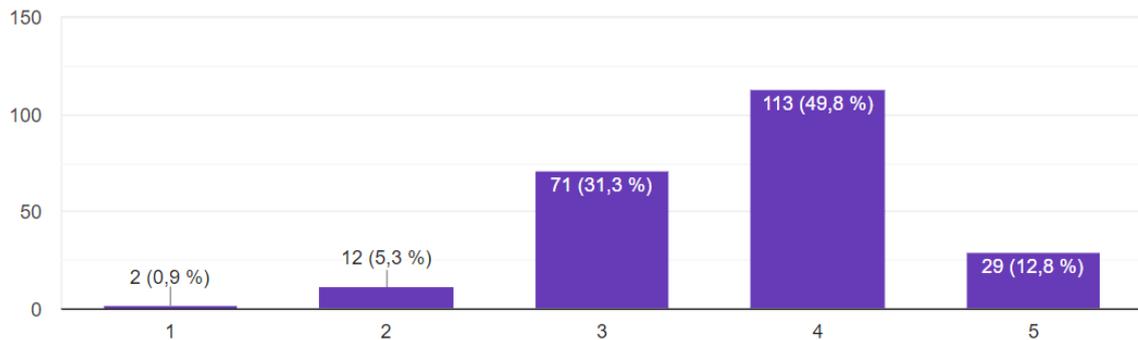


Figure 8: Survey question 5

Coming to the next question that focused on the years of experience with EdTech, most of the participants of the survey targeting the public schools have answered with two to four years (see Figure 9). Combining this with the fact of the average age of the participants being 43.6, it can be deduced that most of the teachers have spent their majority of work using traditional education methods.

How many years of experience with EdTech do you have?

227 responses

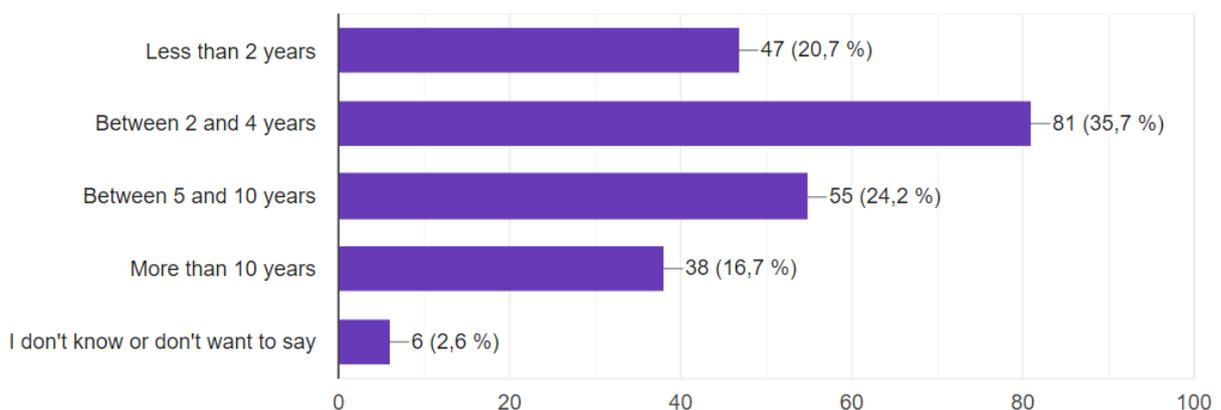


Figure 9: Survey question 6

Comparing this specific result with the one from the survey targeting the private schools, there is an alarming difference: in private schools, it is the case that there is a strong peak of teachers having more than 10 years of experience (see Figure 10). This could be evidence for the aforementioned assumption that private schools were able to supply their teachers with EdTech solutions earlier.

How many years of experience do you have with EdTech?

20 responses

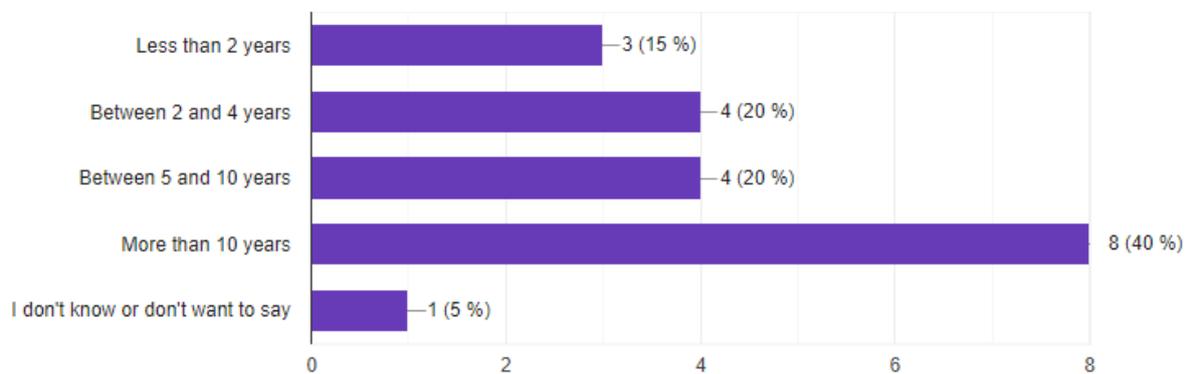


Figure 10: Survey question 6 (private schools)

As to be expected due to the current distance learning situation, most of the participants answered the frequency of EdTech usage with daily or at least multiple times per week (see Figure 11). The 7% answering this question with only using EdTech solutions once or less per week might be teachers in special circumstances (e.g., part-time working, parental leave, highly specified teachers).

How frequently do you use EdTech in class?

227 responses

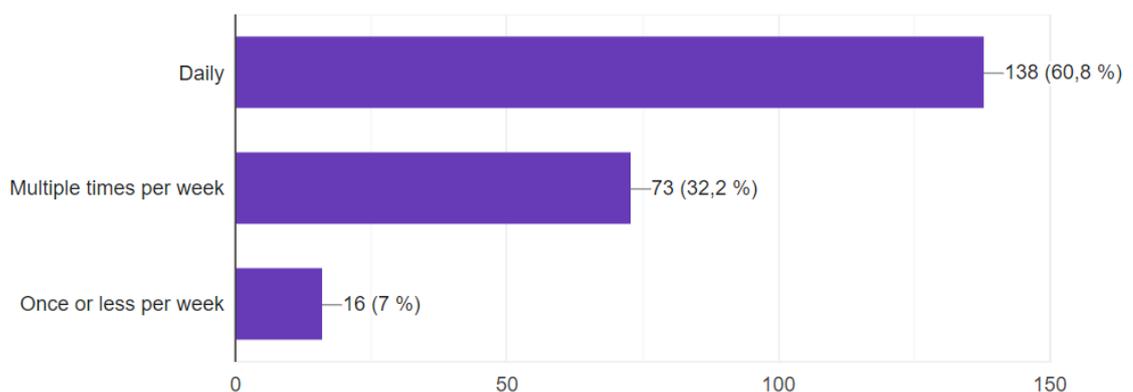


Figure 11: Survey question 7

Whereas the results regarding the quantity of EdTech trainings (see Figure 12) can be named high with 82.8%, we cannot make a statement about the quality of these. Nevertheless, it is a positive finding in general, since literature has mentioned the importance of trainings towards the confidence of EdTech usage before (Shashaani, 1997). Therefore, it is clearly important to provide them in the first place - the quality is another matter.

Have you already participated in EdTech trainings?

227 responses

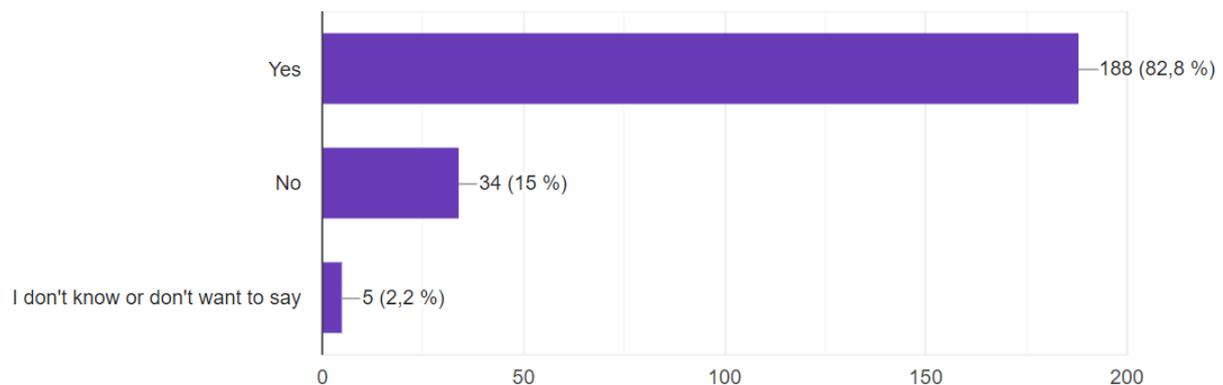


Figure 12: Survey question 8

About one third of the survey participants has answered that they feel pressured to use EdTech (see Figure 13). this is alarming thinking about that it means, that one in three teachers probably feels stressed about using EdTech; this might cause a negative attitude and perception of EdTech, leading to further challenges.

Do you feel pressured by others to use EdTech?

227 responses

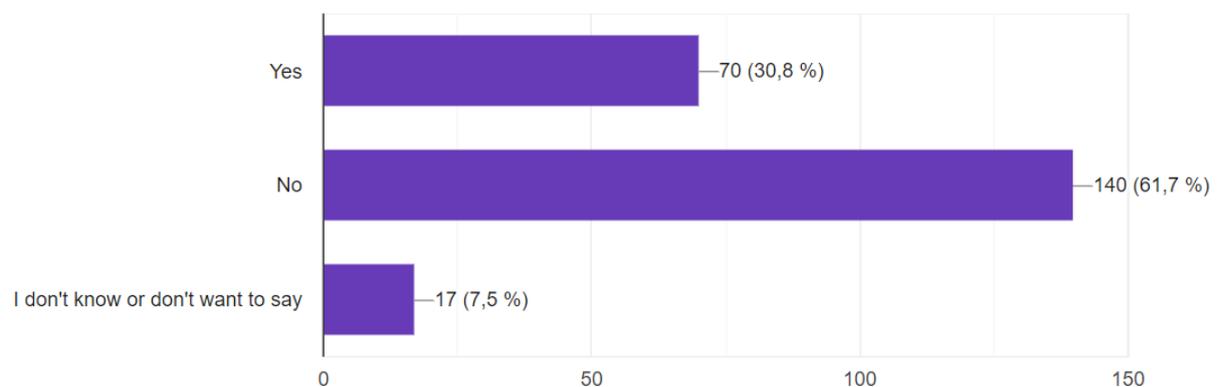


Figure 13: Survey question 9

When it comes to technical issues, 18.9% of the participants answered that they do not know if technical support is provided for them, 48% being sure of that, the other extend being uncertain about it (see Figure 14). This is alarming in that it means that most of the teachers have to handle technical questions or difficulties on their own, even though it is not expected to be part of their profession. This finding can be seen as a huge problem, as many teachers probably have to invest a lot of time and effort, maybe even private financial means, to solve technical challenges.

Is technical support for problems with EdTech (e.g. a hotline) provided to you?

227 responses

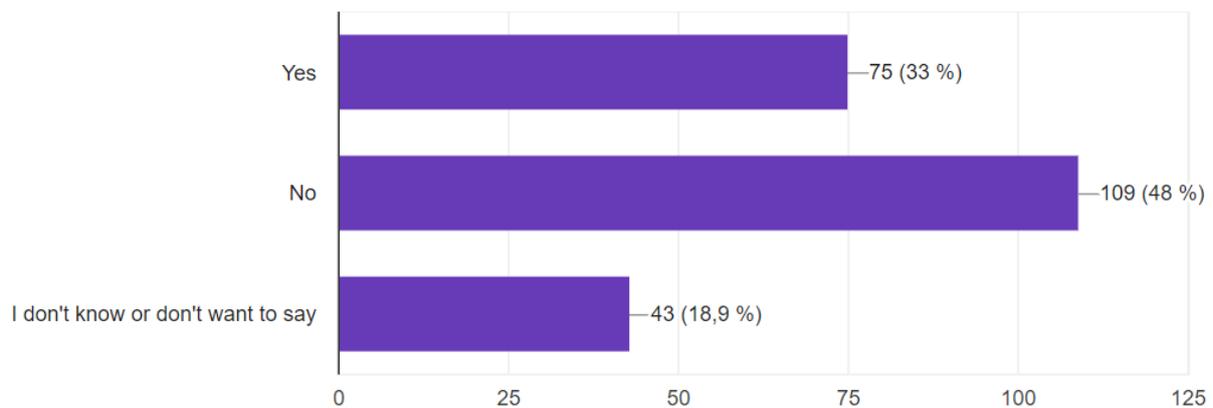


Figure 14: Survey question 10

Next, taking a look onto the question of how teachers estimate the effect of EdTech on their lessons, only 2.7% answered that they have a rather negative perception (see Figure 15). 10.1% of the participants view EdTech as a neutral influence on their lessons, while the rest opinions the effects as rather positive. The average result is 7.4 on a scale of 1 to 10. This result can be interpreted as positive in regard to the statements of the EdTech Tension Model, as teachers that perceive the effects of EdTech as beneficial are quite likely to adapt EdTech already in their lessons.

How would you rate the impact of EdTech on your classes?

227 responses

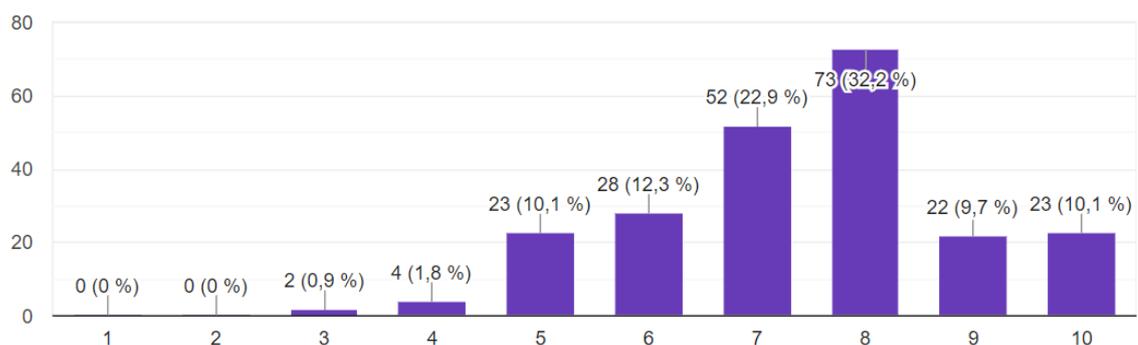


Figure 15: Survey question 11

Whereas it should be the case that the question on whether private EdTech solutions are used instead of provided ones is answered with “never”, the survey revealed that 95.2% of the participants have to do so sometimes or even frequently (see Figure 16). The exact reasons for this situation cannot be identified by solely this question, but in our opinion, it should not have to come to that in the first place.

Do you ever have to use private technical solutions instead of provided EdTech Systems?

227 responses

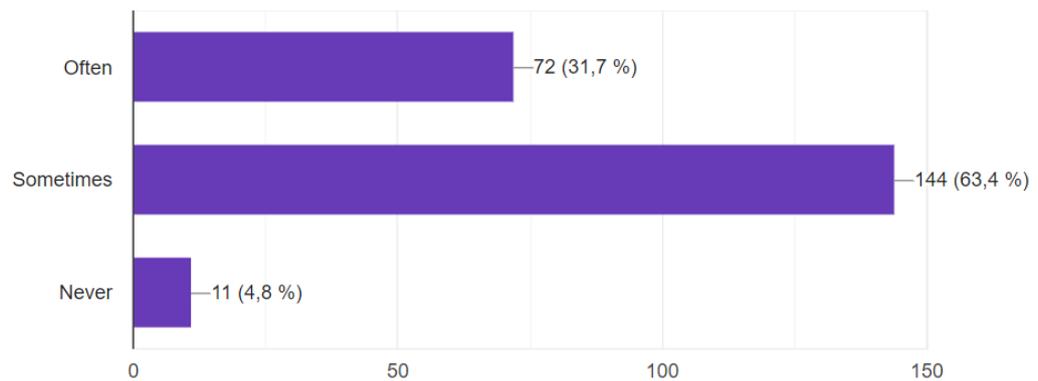


Figure 16: Survey question 12

As a positive ending of the quantitative data interpretation, most of the participants answered that they will continue using EdTech in their lessons, even after the current distance learning situation has ended (see Figure 17). This can be interpreted as EdTech being adapted and seen as a regular means of tuition by most of the teachers. Only very few participants stated they would not continue engaging with EdTech during their lessons.

Assume Covid-19 would not exist any longer and schooling would be back to normal and classes would be held on site as usual from now on. Would you continue to use EdTech in your classes?

227 responses

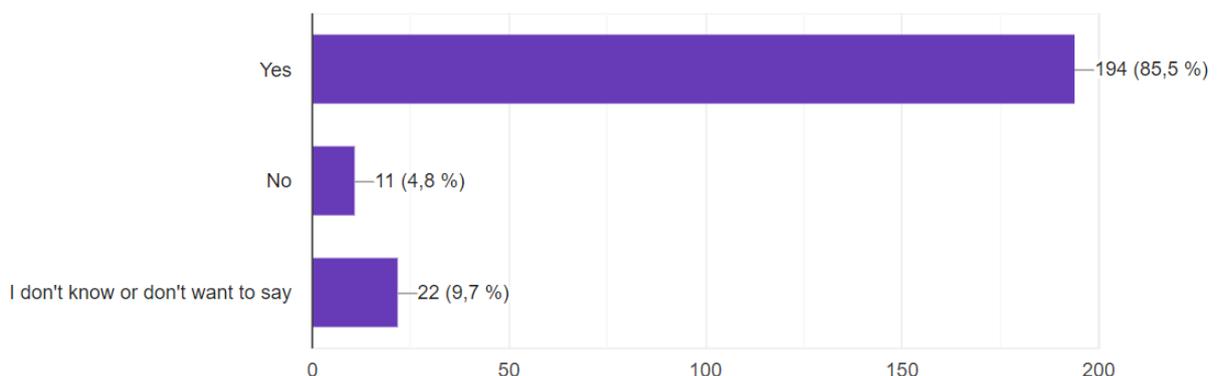


Figure 17: Survey question 13

#### 4.2.2 Focusing on the Qualitative Results

To improve the quality of our research, we added a text field in the end of the online survey to capture potential comments. This improves our research in such, that it summons more detailed and individual feedback, perhaps leading to revealing issues that have not been covered by previous literature. The original and translated content analysis can be found in Appendix 6. From the total 217 participants of the online survey, we received 83 utilizable comments.

After conducting the content analysis, as stated in Chapter 3.3, we identified the following categories on which we can build our findings on.

Four items of the feedback were non-utilizable answers due to giving answers of low relevance for our thesis. As it can be seen in Table 6, most of the feedback was concerning the lack of (high quality) equipment and a better infrastructure in general. This aligns with the survey question on whether private solutions have to be used, because the less appropriate the given equipment and infrastructure is, the more likely it is that teachers need to resort and rely on alternative and private solutions.

Further, this also matches what has been mentioned by literature before, claiming that the technical infrastructure in German primary schools leaves much to be desired (Bocksch, 2020; Rudnicka, 2019; UNESCO, 2020). Whereas most of the comments about equipment have been about the fact that there is not enough, others have brought up the increasing inequality of opportunity for some students (C10, C46); this can result in students from wealthier families or students in areas with stronger infrastructure having an educational advantage. Also, teachers have claimed multiple times that there is the need to provide service devices for the teaching staff themselves (C5, C37, 64). One example is the feedback from a teacher who complains that there are only 10 tablet devices available for the 200 students at her school (C4). Another teacher mentions that there are EdTech hardware solutions available, but not at every classroom – this means that she has to get a projector and set it up every time she wants to show a short video to her students (C16). Generally, the lack of equipment and infrastructure seems to be a hot topic for the teachers at German primary schools, since the use of the text field was not mandatory but still 32 of 217 participants used it to write a more or less detailed comment about this topic alone.

Strongly connected to the feedback about the insufficient equipment are comments that criticize the manner of how EdTech is handled and introduced within German primary schools, meaning criticism on the digitalization and EdTech strategy of Germany. Some teacher statements have claimed that Bavaria has been too slow with introducing such technologies, leading to the current situation in which the primary schools lag behind (C1, C15). Judging from the feedback, it seems as if the German ministry of education, that is responsible for introducing EdTech with an appropriate strategic approach, did not have such one on their agenda when it was necessary. This assumption can be seen by multiple teachers commenting on the fact that they partly have to invest private financial means for EdTech solutions if they want to keep up with the pace of EdTech development (C41, C44, C48, C60, C65, C67, 76, C80). This might be the case because the process of requesting EdTech or even a refund for private investments into these might take a lot of time and bureaucracy. Also, as other participants claimed, the data protection regulations slow this process and the use of EdTech in general down as well (C32, C35). Another finding regarding the negative perception of the strategy of introducing EdTech is the inefficient investments into the digitalization of German primary schools. One example for this malinvestment has been mentioned in the feedback: instead of every teacher having a personal work device, such as a smartphone or laptop, most investments have been put into technology that is fixed to a specific classroom, leading to physical dependance and inequality among the teachers without an own classroom or during distance teaching, respectively (C47). The comments about teachers often having to put in extra work time for understanding and learning about EdTech can be attributed to the lack of strategy as well. While the quantitative results presented that most teachers had the possibility to participate in EdTech trainings, the qualitative results showed that there is still the need to put more emphasis onto the quality of the trainings themselves: selected feedback mentioned that it is especially important to have pedagogically qualified staff to conduct the trainings (C42).

Of course, the pandemic has changed the way we teach. It's almost undisputed that this situation has inevitably driven the use of EdTech. This is also reflected in numerous comments, all of them positive. Many of the participants who commented feel that the pressure is absolutely necessary to catch up with the dragging digitalization process (C2, C6, C9, C14, C16, C17, C21, C26, C40, C43, C56, C72, C77). Many teachers are concerned that this development will not be maintained once normality sets in. For example, one participant says that EdTech can only be used in distance learning because her classroom lacks the necessary equipment (C17).

Overall, there was also a lot of positive answers regarding EdTech in general, some mentioned EdTech as the enabler for digitalization, others commented on the enabling abilities through EdTech. Also, there was feedback on the importance of EdTech for exposing children with technologies at an early age, as this might be necessary for their future career and life (C3, C62).

The next category we could identify in the qualitative data was about the wish for customized and target suitable EdTech solutions, which matches with what has been mentioned by literature before (Nistor, Gogus & Lerche, 2013; Teräs et al. 2020). Some participants stated that EdTech should be used in an especially appropriate way in primary schools, e.g., only as an additional means next to analog methods, so that the students are less likely to get overwhelmed (C3). But not only the students should be put into the focus when designing EdTech solutions, but also the teachers need to be targeted, as their understanding of the technologies is just as important.

Another aspect that occurred at multiple points in the feedback was the additional workload through EdTech usage on teachers. This is an especially important finding as it can be strongly connected to the mental health of the teachers, which of course should be prioritized. For example, one teacher gave the answer that at her school only one teacher is responsible for the complete EdTech administration at the school and is only meant to invest one hour per week for it (C15). Other teachers mentioned that they have to take care for the organization of EdTech more or less on their own, which leads to a huge number of additional hours that do not even get valued financially (C12, C15, C33). Overall, the constant availability and the fact of oftentimes having no other choice than investing free time into EdTech related matters have been mentioned repeatedly as a huge problem, leading to work overload and therefore, a mental burden.

In connection, the lack of an adequate technical support structure could be identified as a category. Multiple teachers ask for more professional aid that is also adequate to their needs, meaning the communication between teachers and the EdTech support has to be on one level and not overly complicated (C42). Also, the aforementioned overload of some colleagues responsible for EdTech at their schools currently could be reduced by having additional help. Whereas we captured multiple negative comments on the current strategy of introducing EdTech in German primary schools, there also has to be mentioned some exception: one teacher mentioned that at her school, the situation of EdTech has already been appropriate before, meaning that she was content with the digitalization (C31).

Lastly, there have also been some comments on the connection between EdTech, the teachers, the students and the parents, in specific. The teachers agree that it is especially important for the students at primary schools to have a strong support by their parents. Cultural background, disinterest or parenting specific aspects like screen time limitation can have a negative impact on this support (C71).

The following table summarizes the frequency of the categories found in the qualitative data:

<b>CATEGORY</b>	<b>NUMBER OF OCCURRENCES</b>
<b>equipment</b>	32
<b>positiveEdTech</b>	17
<b>covid-19</b>	13
<b>support</b>	11
<b>negativeStrategy</b>	11
<b>customizedEdTech</b>	8
<b>workload</b>	8
<b>training</b>	6
<b>parents</b>	5
<b>nonUtilizable</b>	4
<b>positiveStrategy</b>	2

Table 6: Frequency of qualitative data categories

### 4.2.3 Focusing on the hypotheses

#### 4.2.3.1 H1

To test H1, the data were analyzed in tabular form using Microsoft Excel. This procedure is necessary because we worked with nominal data instead of ordinal data, so a correlation analysis is not readily possible. Again, if the hypothesis is expressed in logical form, the following must be checked:

Strong adoption → Strong adaption

In other words, the following variables have to be tested:

I6 AND I7 AND D4 → I8 AND I9

However, the dependent variable D4 cannot be included into the implication, as the result of it cannot be influenced by the teachers themselves.

The following is therefore tested:

I6 AND I7 → I8 AND I9

First, we identified when the input, so the adoption, is strong. We came to the conclusion that only the two combinations in which the answers are either “Täglich” (engl. daily) for I6 and

“Nein” (engl. No) for I7 or the answers are “Mehrmals wöchentlich” (engl. multiple times per week) for I6 and “Nein” (engl. No) for I7 this can be the case. Accordingly, we defined when the output, so the adaption, is strong. This is the case if the first answer, so the answer for I8, is equal or higher than five and the second answer is “Ja” (engl. yes) for I9.

On this base, we built an analysis that consists of one column containing the results for whether a participant has a strong adoption and another one containing the results for whether a participant has a strong adaption. All values have been either TRUE or FALSE. Subsequently, we created a third column for result of the implication. The result equals TRUE only in the cases in which both the strong adoption and the strong adaption resulted in TRUE. To test hypothesis one, the numbers of TRUE and FALSE in the implication results column were counted:

TRUE: 75

FALSE: 152

Based on these results, we cannot confirm the statement in H1, since the FALSE results outweighs the TRUE results. Only if the number of TRUE results would be higher than the FALSE results, the hypothesis could have been accepted.

#### 4.2.3.2 H2

Coming to the testing of H2 we can make use of some quantitative data collected. Expressing the hypothesis in logical form, accordingly to the previous subchapter, it looks like the following:

High age → Low adaption

Thus, the subsequent variables are of interest for our analysis:

D2 → I8 AND I9

Because we only work with ordinal data in this case and want to find out whether the age of a participant is connected to her or him adapting EdTech, it makes sense to create a scatterplot to visualize the three data sets. Thereby, it is possible to recognize how the age of a user is connected to its adaption of EdTech.

The y axis of the scatterplot carries the age of the participants, whereas the x axis displays the rating of the perceived impact of using EdTech in class. Depending on the answer of whether a participant would continue using EdTech after the current distance learning situation has ended, the created data points have been colored accordingly. Because it might happen that participant have exactly the same combination of age and their perception of EdTech’s impact on their classes, we made the data points transparent with alpha = 0.4; overlapping points, representing multiple equal answers, get darker and colors mix accordingly. Figure 18 displays the scatterplot that has been generated using python 3 in connection with Matplotlib.

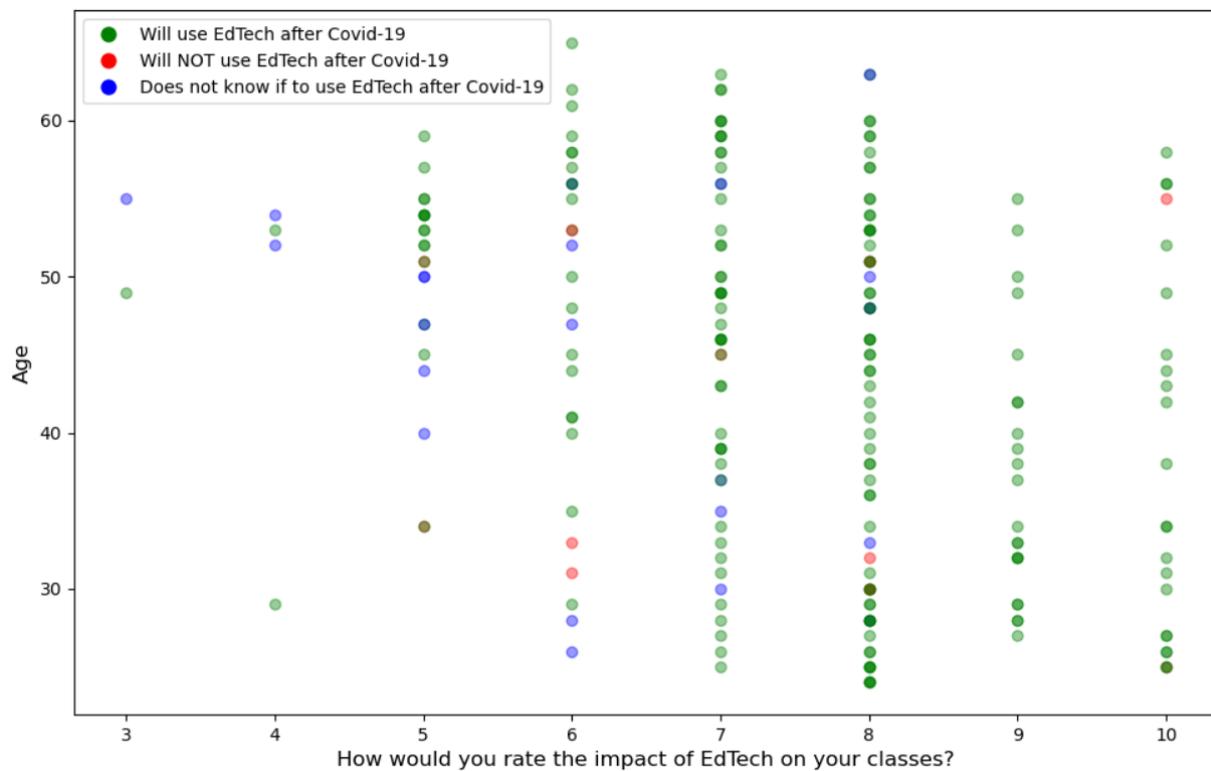


Figure 18: Scatterplot H2

What can be seen in the scatterplot is that when looking mostly at the data points of participants with a higher age, e.g., above the average of 43.6 years, the distribution of the impact estimation seems to be relatively broad. Participants with an age lower than the average tend to estimate the impact of EdTech on their classes slightly higher. Combining this information with the color coding for the potential future use of EdTech after the pandemic, it can be said that most of the uncertain answers have been given by participants that also rate the impact of EdTech on their classes as not so high. Overall, a weak tendency of the data points moving from the top left to the lower right side can be discovered, which means that there seems to be a slight correlation between the age of the participants and their adaption of EdTech in the classroom.

As we want to make sure of this assumption, the following matrix shows the actual correlation in percentage between the variables. For the creation of the correlation matrix, the dots being displayed in red and blue color in the scatterplot have been removed, as they imply that a teacher (perhaps) would not continue using EdTech and thus cannot even adapt it.

	AGE	IMPACT
AGE	1	-0,33483
IMPACT	-0,33483	1

Figure 19: Correlation matrix H2

As the matrix reveals, there is indeed a weak correlation of -0,33483 between the age of a user of EdTech and their adaption of EdTech.

Based on our findings, we can accept H2: although there seems to be just a relatively weak correlation between a high age and a low adoption of EdTech, it can be stated that it exists.

### 4.2.3.3 H3

In order to validate the last hypothesis stated by our research, the following has to be checked for approval or reject:

High number of EdTech tools → Low attitude

Formulating H3 in terms of the previously mentioned variables from the survey questionnaire, we have to test:

I1 → I4 AND I5 AND D3

Analogously to how we reasoned in the previous subchapter, we will not include the dependent variable that captures the computer training, as it is an aspect that cannot be influenced by the participants themselves. Thus, the implication to be tested looks actually like:

I1 → I4 AND I5

Because we are dealing with ordinal and interval data, the creation of diagrams capturing all the survey results on these variables is possible. To make the results more expelling and the content less complex to understand, we create two bubble graphs instead of one overall.

The first bubble graph (see Figure 20) showcases the number of tools used on the y axis and the confidence rating on the x axis. The larger in size a bubble is displayed, the more results have been given this specific combination of tools and confidence. The figure proves that the majority of teachers that stated that they feel averagely confident about using EdTech also use an average number of EdTech tools, as the bubbles in these specific combinations are the largest ones. What causes our attention is that despite our assumption of a large number of EdTech tools potentially negatively influencing on the confidence, as it increases the complexity, it does not seem to be the case: quite the contrary, the bubbles in the row “More than 7” could be interpreted as rather leaning to a high confidence. Therefore, the teachers that gave these results might not be the ones that are “overwhelmed” or “stressed” with the number of tools but maybe rather the “tech-savvy” teachers. In contrast to that, the teachers that crossed the “Less than 4” regarding the number of tools tend to have a rather positive to medium confidence. Nevertheless, this does not yet prove that H3 can be rejected as the bubble graph pictured in Figure 20 just captures two of the three variables.

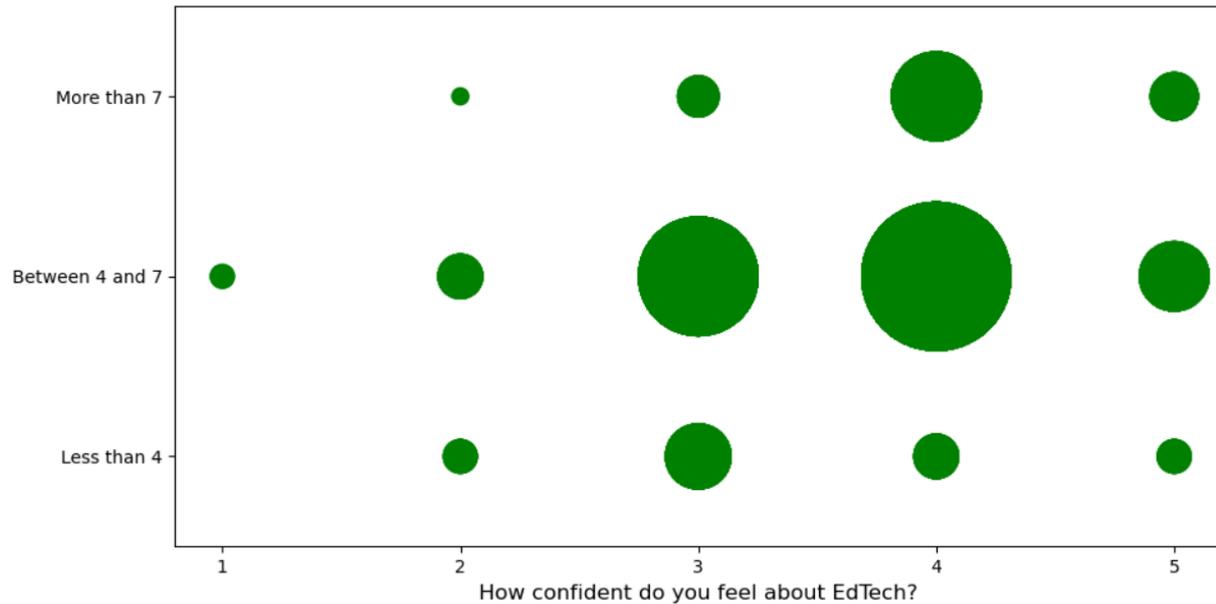


Figure 20: Bubble graph confidence / # of tools H3

The second bubble graph (see Figure 21) presents the experience in years on the y axis and the confidence rating on the x axis. The larger in size a bubble is displayed, the more results have been given this specific combination of experience and confidence. We excluded the data for “I don’t know or don’t want to say” from the experience data, as it does not contribute to our findings. What can be seen is that, in average, the more years of experience with EdTech a teacher has, the more confident she or he feels about using it. This tendency can be understood best by looking at the bubbles for each experience range. Whereas the teachers with “Less than 2 years” experience answered their confidence relatively broad, the teachers that have increasingly more years of experience stated their confidence rather concentrating to the right (equals a rather high confidence). Accordingly to before, we cannot reject or accept H3 solely with the graph displayed in Figure 21, as it only captures two of the three variables involved in its logical representation.

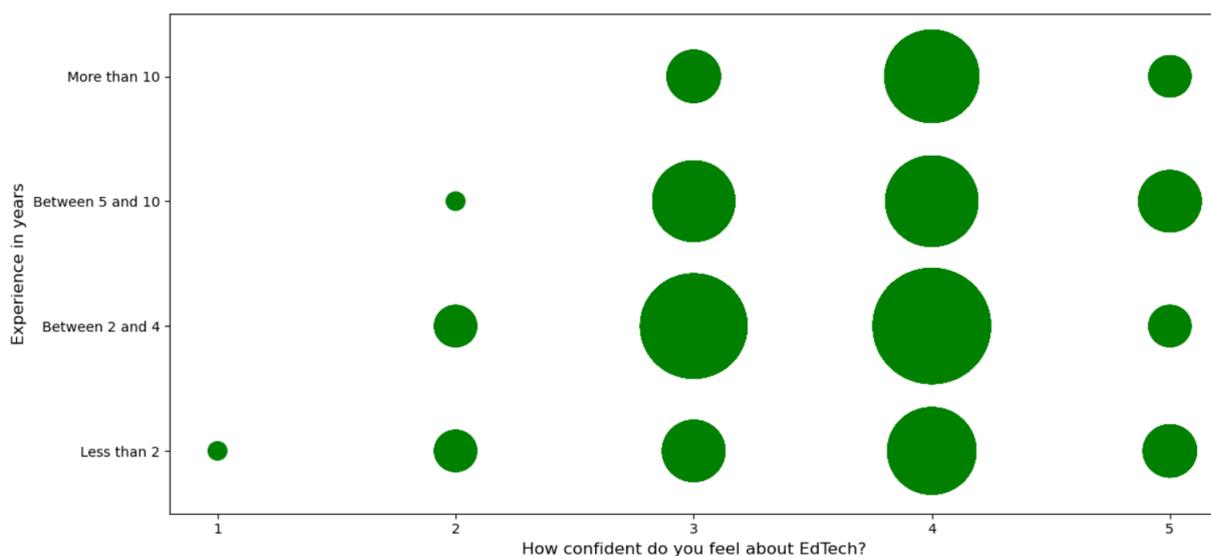


Figure 21: Bubble graph experience / confidence H3

To summarize the analysis and to make a clear statement about H3, the following has to be said: the hypothesis could only be accepted if both graphs visualized before would follow the expected tendencies. However, since this is not the case with Figure 20, since according to the hypothesis there should be a tendency from top left to bottom right, or such a tendency cannot be clearly read from our data, H3 cannot be accepted. Even if the graph in Figure 21 corresponds to the expected tendency, this is only a part of the previously stated hypothesis and not sufficient to clearly prove it.

## 5 Discussion

*This chapter's purpose is to discuss on the empirical findings from the previous chapter and also reflect on the findings together with what has been stated by literature before. Not only does this chapter make some remarks about how the current study could be improved but also, it presents some concrete implications for the various stakeholders of relevance for this thesis' topic.*

### 5.1 General Impressions

Overall, this thesis' results go not only hand in hand with the literature but revealed certain areas of special attention as well.

We do agree with the literature that the worldview and personal belief system of teachers impacts on the attitude towards technology (Hermans et al. 2008; Salavati, 2016). Also, this statement can be supported by the result of H2, where we found out that there is indeed a slight correlation between the age of a teacher using EdTech and the potential adaption of EdTech. As we have reasoned before, the adaption of EdTech is only possible if the teacher has gone through the stages of attitude and adoption before (see Chapter 2.5). We talk about the worldview and belief system of teachers in terms of their age, as it is the easiest way to grasp it, as these characteristics are something implicit that is hard to capture by asking for it; therefore, matching the worldview and belief system of teachers towards technology to their age makes sense in our opinion (Venkatesh et al. 2003). What we can draw from our study is, that despite having a relatively broad range of teachers in terms of their age, the majority of them had a strongly positive perception in general of EdTech and also, most of them were in the phase of adaption, according to the EdTech Tension Model. What has to be added here is also, that there was much critique about aspects like missing equipment, a lacking infrastructure, an inadequate strategy and more. Taking this into account, it is astonishing in a positive way that most of the teachers still approved EdTech as a regular means of tuition. Therefore, it could be interesting to discuss on that - despite the worldview and the belief system of teachers towards EdTech being important - the will and motivation to accept and use EdTech might be just as relevant.

Further, just as we had different statements from literature concerning the forced use of technology (Liu, 2012; Trust & Whalen, 2020; Venkatesh et al. 2003), our study has pointed out that in this very situation, external pressure was actually considered as necessary. Much feedback from the participants concerned the current pandemic and that its push to the digitalization in primary schools has been very much appreciated (Teräs et al. 2020). Nevertheless, we believe that pressure, especially social pressure as mentioned by literature (Venkatesh et al. 2003), can also have a negative effect on the acceptance and usage of EdTech. Therefore, it might be worthwhile to put research into the distinction between positive and negative pressure on the usage of technology in the classroom.

Another overall theme that we would like to discuss on after getting the results of the study of this thesis is the aspect of computer trainings. Again, both literature (Shashaani, 1997) and our survey results proved that training for EdTech is essential for primary school teachers. Yet, there have not been done studies that particularly focus on the quality of these trainings. From

the survey results it can be deduced that the responsible person or institution making sure to provide such trainings seem to not care enough about providing a pedagogically adequate quality assurance of them. Thus, looking closer into the concrete requirements for different target groups of such computer trainings would contribute to the practical outcomes of the problematized area.

Regarding H1, it has to be mentioned that its rejection could be argued with that our testing was not capturing the whole picture. It might be worth to recreate the hypothesis testing with additional variables for both the adoption and adaption of EdTech. Also, it might be that there are some difficult to measure qualitative aspects that play a role, that our survey could not grasp. Perhaps the hypothesis could be accepted if a more holistic testing were available.

## 5.2 Implications to Research

Reflecting on our study, some aspects must be mentioned that could improve the study if adjusted; we noted these aspects during our empirical process.

Literature has shown that integrating EdTech in primary schools is a complex undertaking (Salavati, 2016) and that the way of how it is presented is not shown from a drastic change perspective, but is rather a smooth process. Due to the recent changes in how technology became pervasive across schools worldwide (Trust & Whalen, 2020) due to forced changes such as Covid-19 (Teräs et al. 2020), it is imperative to realize that research should look at how an event enforces changes in using technology in an educational context, compared to when it is done on free will. Further, literature (Spiteri & Chang Rundgren, 2020; Van Braak, Tondeur & Valcke, 2004) as well as our research revealed that computer training is an integral part of improving the attitude of teachers towards EdTech. Nevertheless, whereas literature has not put an emphasis on the quality and adequacy of the training, our study pointed out that further research should focus on specifically this matter.

Regarding the EdTech Tension Model, we noted that a more concrete and interconnected structure would have helped the later on analysis of the collected data. We came to this conclusion as we built the online survey partly on the findings of the model. Having a model that showcases the connection from, for example, a mediator to a stage, and the strength of this connection would have made the evaluation of the analysis much easier, as this connection could have been tested. This would be helpful in such that the model and its validity could have been verified in a more expressive manner. Also, an extension of the model could be done by adding reasoned key moderators, especially impacting on the triad from the outside, in order to capture how the external environment effects on the concepts.

Having a look onto the survey, the empirical process revealed that a more holistic questionnaire could have been helpful as it might have given even more insight to our research area. With that we mean that the question categories (demographic questions, general EdTech questions, attitude, adoption, adaption) could have contained more sub questions in order to lead to more answers and thus a more detailed view into the problematized area. Nevertheless, having more questions might lead to a lower participation rate and therefore would have to be done carefully. Yet, some questions, like control questions, would have been worth to put into the questionnaire as they would help to improve the validity of answers. Forming questions of an ordinal character would certainly simplify the later data analysis and thus make the whole

research process more efficient. In addition, questioning the postal code in the survey questionnaire would provide information about the clustering of the survey answers, leading to the knowledge about which teachers have the same preconditions.

## 5.3 Implications to Practice

### 5.3.1 *Implications for the Digitalization Strategy*

Some implications of our research on EdTech in primary schools can directly be targeted to the government and institutions responsible for the digitalization strategy in the educational sector, respectively. As the survey results and therein mainly the qualitative data revealed, there are some areas that can be addressed by improving the strategy on how to integrate EdTech as a regular means of tuition into the classroom.

First of all, more financial investments should be made in the area, as this has been perceived negatively not only by teachers, who often have to apply their own solutions, but also because it has been pointed out by the European Commission (UNESCO, 2020). Moreover, thinking back to the HCT (Becker, 1962; Welch, 1975), an economy should be all about the education of its citizens, as it returns positive results. Bringing the investments into context with the Sunk Cost Fallacy (Friedman et al. 2007), it is important not to hold on to possible poor investments, but to reassess the situation day by day and therefore invest in high-quality technologies and structures in a future-oriented manner. Not only should these financial means be put into a more stable and reliable infrastructure, but also teacher and classroom devices and specialized professional support and training. Further on, information about which kind of EdTech, training and support are available for teachers should be communicated closely with the primary schools, so the investments can be used in an efficient way. Looking at EdTech from a more long-term perspective, those responsible for the digitization strategy should also ensure that the development of adequate and customized EdTech tools is pursued, working closely with users and EdTech vendors. Drawing a last interpretative implication from our study, it might also be worthwhile to get supported by specialized consultancies in matters of EdTech to reduce a potential gap of expertise.

### 5.3.2 *Implications for Primary School Teachers and Parents*

Deducing from our study, teachers in particular can participate in improving the current situation of EdTech, supporting to drive the technology forward to being used as a regular means of tuition. We could identify that most of the survey participants view EdTech as a positive development in primary schools and that most of them participated in given trainings. Yet, it can be stated that by actively participating in the offered trainings, including giving their feedback on the quality of these, teachers can contribute to further improvements. Especially by letting others know about their needs, experiences and also critique with the trainings, the responsible actors can improve in the future and adapt. Communication should also be strengthened with the parents of primary school students when engaging with EdTech, as the well-being and education of the students should be paramount; an important part of that is collaboration. Nevertheless, primary school teachers should also be conscious about balancing this collaboration to an adequate level in order to not have a work overload that, in the worst case,

might even cause health problems such as burnout syndrome. Just because the times have changed and EdTech makes communication between students, parents and teachers more accessible, it does not mean that one has to be available even outside of the working hours. Creating a relation to EdTech that is nurturing in the sense of tuition shall be put into the focus, while at the same time, a healthy and non-pressure creating perception of EdTech shall be created by, e.g., encouraging uncertain colleagues or parents. This not only aligns with what has been stated by Venkatesh et al. (2003), but also with what has been stressed by the qualitative data results. In general, it can also be said that a lively exchange with the school management can be particularly useful, as they can achieve the highest impact regarding EdTech investment decisions.

Looking at what the parents of primary school students can do in order to create a harmonized acceptance and use of EdTech, when there is the fact that technology of this kind is and will be used more regularly during class, it is mainly about working together and communicating. Working together with the teachers on the one side in order to improve the specific way in which EdTech is engaged with, by being understanding of exposing their children to new technologies and means of tuition. Communicating by listening to what their children's needs and concerns are and letting the teachers know about it. If there is a parenting limitation in place, e.g., limited screen time for their children, parents should strictly distinct between necessary distance learning and optional leisure time. As their children will grow into a future where technology is a lot more normalized, education has to adapt, and parents need to understand.

### *5.3.3 Implications for EdTech Vendors*

Further, our survey revealed that there are some aspects that EdTech vendors themselves can address to contribute to the transformation of EdTech as a regular means of tuition in primary schools. Not only has literature called for more customized solutions (Nistor, Gogus & Lerche, 2013; Teräs et al. 2020) but also the qualitative survey data presented that there is actually the wish for more adequate EdTech. EdTech vendors should therefore try to not just “copy” business soft- and hardware and offer it to primary schools but listen closely to what the target group needs (Teräs et al. 2020). Also, in this regard it is worthwhile working together with governments and institutions responsible for the digitalization strategy on the one side to capture requirements and promote their products, and with students, parents and teachers on the other side to get their feedback and improvement suggestions.

## 6 Conclusion

*This chapter concludes this thesis by putting an emphasis on the principal findings. Not only are there some general assertions, but also, a final statement on the research question and fulfillment of this thesis' purpose, that have been stated in Chapter 1, is given. Further, this last section will summon the key findings and subsequently conclude with stating some potential applications for future research.*

### 6.1 Research Question

The purpose of this thesis was to identify factors that influence the transformation towards EdTech being accepted and used as a regular means of tuition. Deducing from this aim, we stated the following research question as a guideline for our study:

*What factors are essential so that the transformation towards EdTech as a regular means of tuition is widely accepted and used in German primary schools?*

For our study, we developed a model that is grounded in literature and theories concerning the topic on hand. Based on this model, we narrowed down a survey questionnaire that addressed different concepts that are part of the model. Deriving a broad range of quantitative and qualitative data, we can identify the following results and thus, answer the research question accordingly:

Because these aspects have been mentioned most frequently in both literature and our survey results, we deduce *six final factors* as the most essential ones for the transformation towards EdTech as a regular means of tuition being widely accepted and used.

The first factor is the *existence of stable infrastructure and equipment*. Whereas both are indispensable to make the usage of EdTech possible, not providing them in an adequate manner might even cause unsatisfied users that are not content with the situation. A lack in this factor means that although some users might want to use EdTech as a regular means of tuition they could not, therefore, slowing the transformation down.

The second factor mentioned frequently in the context of the transformation towards EdTech being widely accepted and used as a regular means of tuition is the aspect of *confidence* towards using the technology. Deriving this factor mostly from literature (Jenson & Rose, 2003; Venkatesh et al. 2003), we also want to mention the social components of encouraging and strengthening colleagues in this regard. Our survey results showed that a majority of the participants had a relatively high confidence using EdTech and also, most of them were aware of the benefits of using EdTech in the classroom and thus, would continue using it.

Further, factor three is about the *experience* of EdTech users. Not only has it been proven by literature (Blackwell et al. 2013; van Braak, Tondeur & Valcke, 2004) that experience positively influences the confidence towards using EdTech, but also, we can deduct a similar correlation from testing H3 in Chapter 4.2.3.3. Thus, it should be a priority to increase the experience of EdTech users so that they can benefit from increasing their expertise.

Factor four is connected to the previous one, as *computer training* directly affects the experience. Again, computer training has been mentioned by both literature (Shashaani, 1997; Spiteri & Chang Rundgren, 2020) and our survey participants, yet what could be deduced mainly from the qualitative data results is the importance of an adequate quality for such

training.

The penultimate factor, factor five, is the *pressure* towards using EdTech. Not only has literature (Liu, 2012; Venkatesh et al. 2003) mentioned the ability of pressure affecting the acceptance and use of technology, but also our study results revealed the same. What has to be said in this regard is, that the pressure to engage with EdTech can both have a positive and negative flavour in the context of the transformation towards EdTech being widely accepted and used as a regular means of tuition in primary schools. Thus, knowing which type of pressure is favourable is a beneficial finding.

*Professional support* can be mentioned as factor six for answering our research question. Having the opportunity to contact, e.g., a specialized and knowledgeable person was mentioned by the primary school teachers in our survey frequently and also as urgently necessary in order to boost the transformation towards EdTech being widely accepted and used as a regular means of tuition.

## 6.2 Key Findings

The problematized area and aim of this thesis, titled “Educational Technology in German primary schools: Essential factors to influence the attitude towards and adoption and adaption of EdTech”, can be addressed as follows:

We identified that technology in the educational context is an important topic to all levels of education. Nevertheless, research so far has mostly addressed EdTech in higher education, leaving primary education aside. As EdTech has been proven to bring a broad range of benefits into the classroom, we identified six factors, rooted in literature and a study across a selection of German primary schools, that are key to support the transformation towards EdTech being widely accepted and used as a regular means of tuition in primary schools. The malinvestments we have mentioned in Chapter 1 can be addressed focusing on the factors, so that the process of going through the triad presented in the EdTech Tension Model runs smooth and the problematized area can ideally be harmonized.

It is clear to say that because of the primary school environment having changed (due to, e.g., more accessible and ubiquitous technology (Friedewald & Raabe, 2011; Margulis, Boeck & Laroche, 2020; Weiser, 1993) schools have to adapt quickly in order to provide the best possible education to their students (Teräs et al. 2020). Yet, this task is not only up to the teachers using EdTech during their classes, but there are various stakeholders that can support.

Concluding all the previous information and results in a short statement, it seems like currently, the main problem with transforming EdTech to a state of it being widely accepted and used as a regular means of tuition is not that there is a lack of positive attitude, willingness to adopt and adapt EdTech, but rather, there are some basic requirements that are not yet met. Whereas this could be seen as something negative, it is a good thing: basic requirements, such as the ones mentioned in the factors of infrastructure and equipment, computer training and professional support are relatively easy to address. Now it is just a matter of actually doing so as the government, the institutions responsible for the digitalization strategy, the teachers, parents and EdTech vendors.

### 6.3 Future Research

Whereas the topic of our thesis is specifically fitted to the context of German primary schools, the basic idea behind the thesis, including the theories, the EdTech Tension model and the derived factors, can be transferred to similar research in the future. Doing so will help to broaden the body of knowledge about technology in the context of education and therefore, has the potential of improving the situation further.

Not only could there be research about the attitude, adoption and adaption of EdTech in other parts of Germany, but also other countries in general. It could be interesting to even compare different countries according to the factors, for example. Also, conducting similar research on other school levels and in higher education, respectively, could be interesting; even though EdTech on these levels has been studied before, there is still a lack of literature about the adaption of EdTech in particular. Abstracting this thesis' context even further, research could even look into how EdTech is being perceived, adopted and adapted in companies and across different industries, as even they use technology for educating their employees.

As we want to state again that no research is free from limitations, the extension of the EdTech Tension model would be another topic for future research, potentially even making the hypotheses part of it and the survey data rather ordinal for simplified measurement.

# Appendix 1: Results of the Online Survey for Public Schools (Original)

## EdTech in Deutschen Grundschulen

Jede Art der Technologie, die im Schulkontext verwendet wird, wird im Englischen als „Educational Technology“ bezeichnet. In der folgenden Online-Umfrage steht diese im Vordergrund und wird als „EdTech“ abgekürzt. Der Zweck von EdTech ist es, die Organisation und die Durchführung des Unterrichts, wie auch das Lernen und das Erledigen von Hausaufgaben durch die Bereitstellung technologischer Lösungen zu unterstützen. Beispiele für EdTech-Systeme sind E-Mail, Kombinationsprodukte wie Microsoft Teams, Videokonferenzsysteme wie Zoom, Lernplattformen wie Moodle oder auch ganz einfach physische EdTech Produkte wie Tablets oder Whiteboards.

Sollten Sie weitere Informationen für ein besseres Verständnis von EdTech benötigen, finden Sie hier weitere Erklärungen: <https://www.km.bayern.de/eltern/meldung/7167/digitale-werkzeuge-unterstuetzen-den-distanzunterricht.html>

Das Anliegen der Online-Umfrage ist, Informationen über die EdTech-Akzeptanz und -Nutzung in Deutschen Grundschulen herauszufinden. Wir interessieren uns für die Meinung der Grundschullehrer\*Innen, da diese eine der Hauptnutzergruppen von EdTech-Systemen sind. Die Online-Umfrage befasst sich besonders mit Themen rund um die persönliche Einstellung zu EdTech so wie zur Akzeptanz und Verinnerlichung von EdTech-Systemen.

Das Ausfüllen der Umfrage dauert lediglich 2-5 Minuten.

Die Teilnahme an der Online-Umfrage ist freiwillig und kann jederzeit und ohne Angabe von Gründen abgebrochen werden. Die Daten werden selbstverständlich anonymisiert verarbeitet und vertraulich behandelt und ausschließlich für die Erfüllung des Zwecks dieser wissenschaftlichen Arbeit verwendet.

### Datenschutz:

Nehmen Sie an der Online Umfrage teil, stimmen Sie Art, Umfang, Ziel und Bedeutung der Studie zu. Sie haben ausreichend Informationen über diese Aspekte erhalten und hatten genug Zeit, sich für oder gegen die Teilnahme zu entscheiden. Gesammelte Daten werden ausschließlich anonymisiert verarbeitet und nur zum Zweck der Studie verwendet. Ein Rückschluss auf einzelne Teilnehmer ist nicht möglich. Die Daten werden zudem nicht an Dritte weitergegeben.

Die Teilnahme an dieser Umfrage ist ohne die Nennung Ihres Namens möglich.

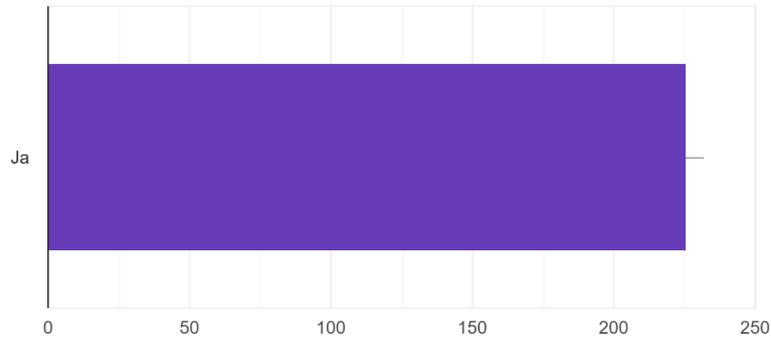
Eine Registrierung ist für die Teilnahme nicht erforderlich.

Auch bei einer Umfrage haben Sie gemäß Datenschutz gegenüber dem Informationsträger das Recht auf Auskunft sowie Löschung Ihrer personenbezogenen Daten. Sie können diese Einwilligungserklärung jederzeit widerrufen. Nähere Informationen finden Sie unten auf dieser Seite unter dem Link "Datenschutz".

\* **Erforderlich**

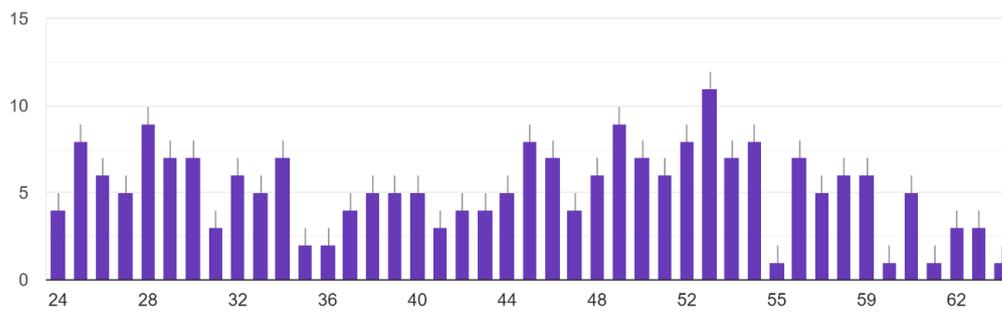
Ich habe die Informationen zum Datenschutz gelesen und verstanden und erkläre mich zur Teilnahme an der Umfrage bereit.

226 Antworten



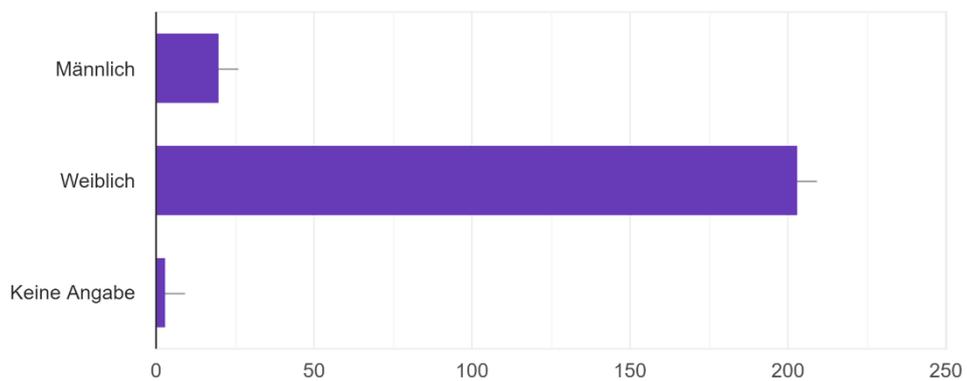
Wie alt sind Sie?

226 Antworten



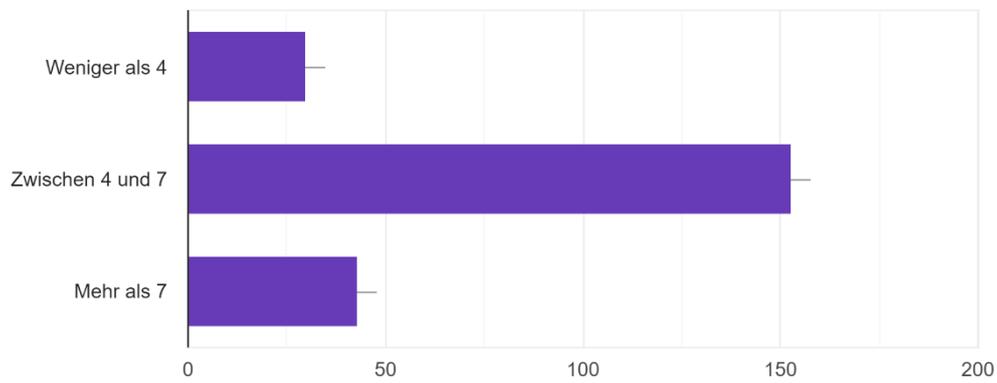
Wie ist Ihr Geschlecht?

226 Antworten



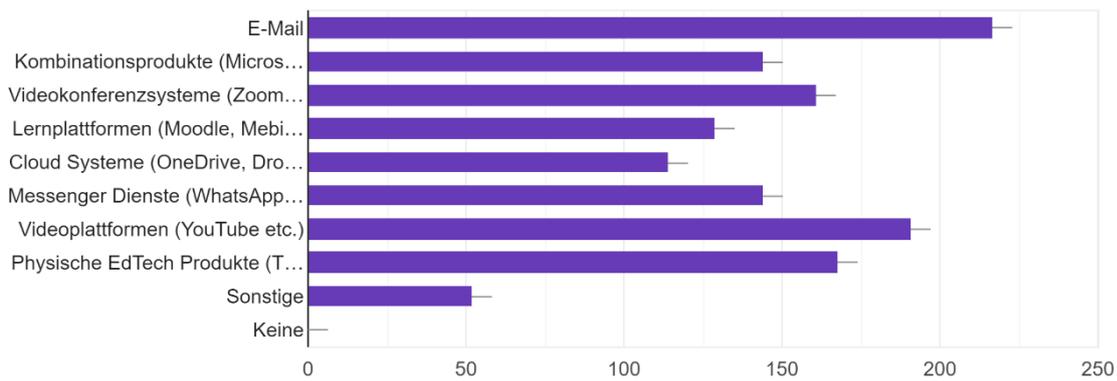
Wie viele verschiedene EdTech Systeme nutzen Sie regelmäßig?

226 Antworten



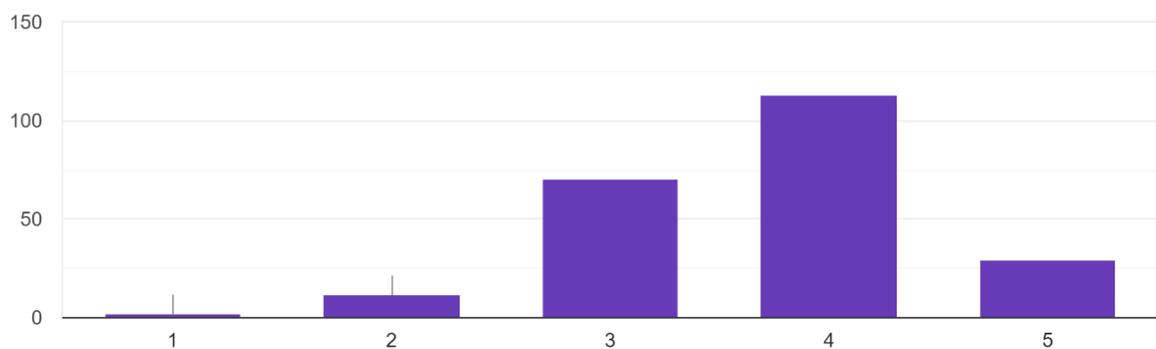
Welche EdTech Systeme nutzen Sie?

226 Antworten



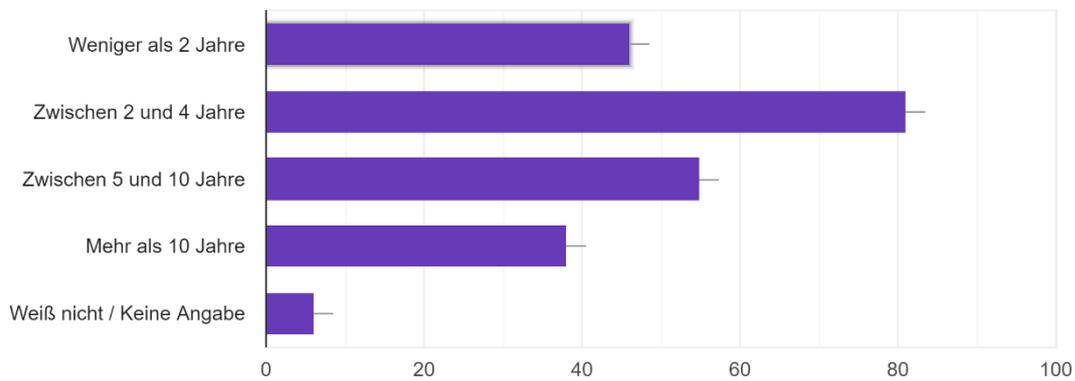
Wie sicher fühlen Sie sich im Umgang mit den EdTech Systemen die Sie nutzen?

226 Antworten



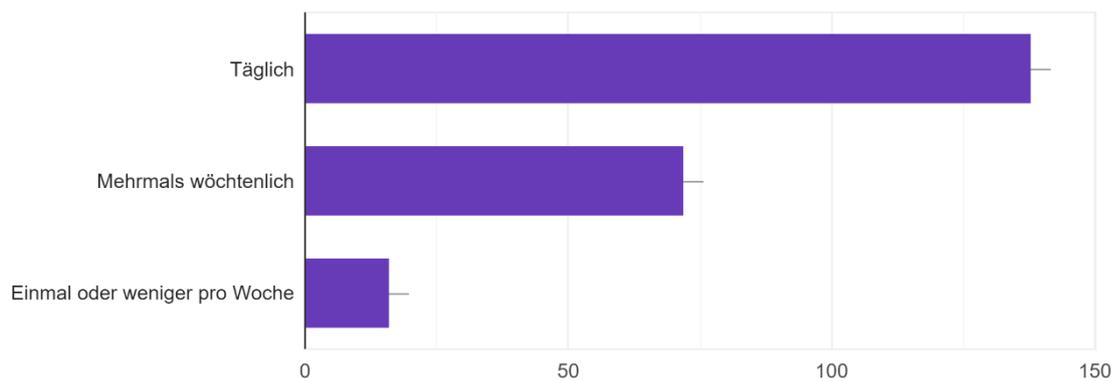
## Wie viele Jahre Erfahrung im Umgang mit EdTech haben Sie?

226 Antworten



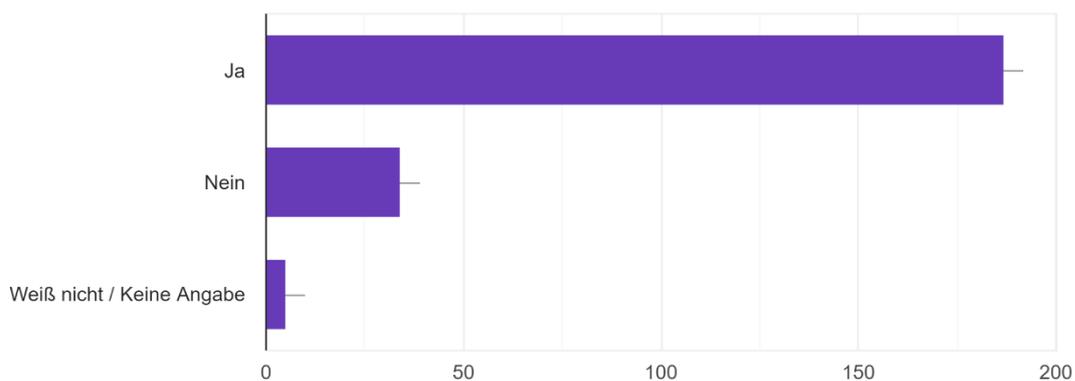
## Wie häufig verwenden Sie EdTech im Unterricht?

226 Antworten



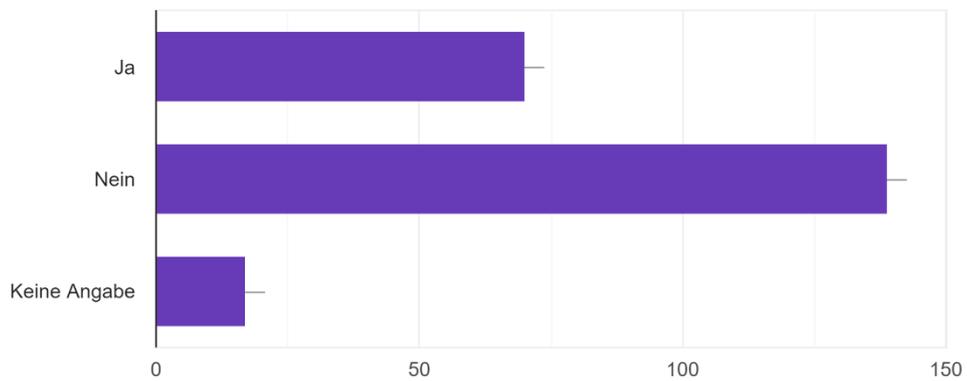
## Haben Sie bereits an EdTech Schulungen teilgenommen?

226 Antworten



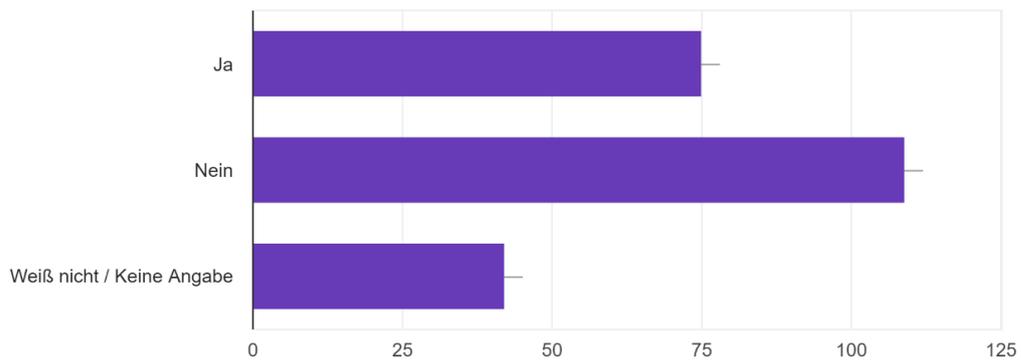
Fühlen Sie sich von anderen unter Druck gesetzt, EdTech zu verwenden?

226 Antworten



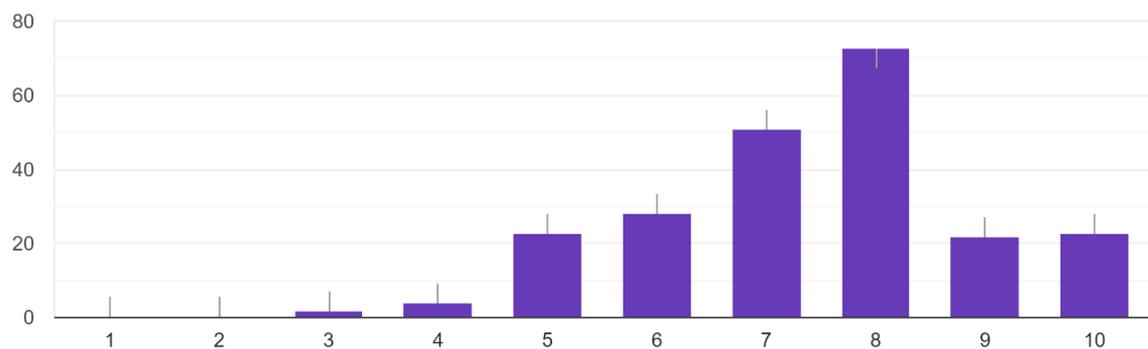
Wird Ihnen für die Verwendung von EdTech technische Unterstützung (z.B. in Form einer Hotline) bereitgestellt?

226 Antworten



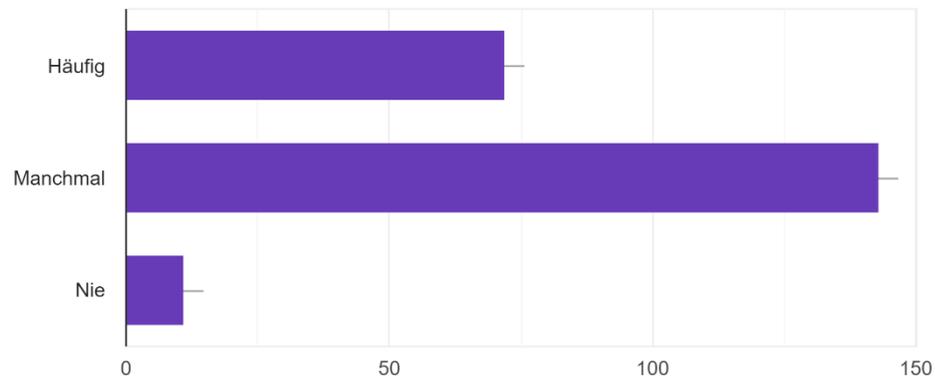
Wie Schätzen Sie die Wirkung von EdTech auf Ihren Unterricht ein?

226 Antworten



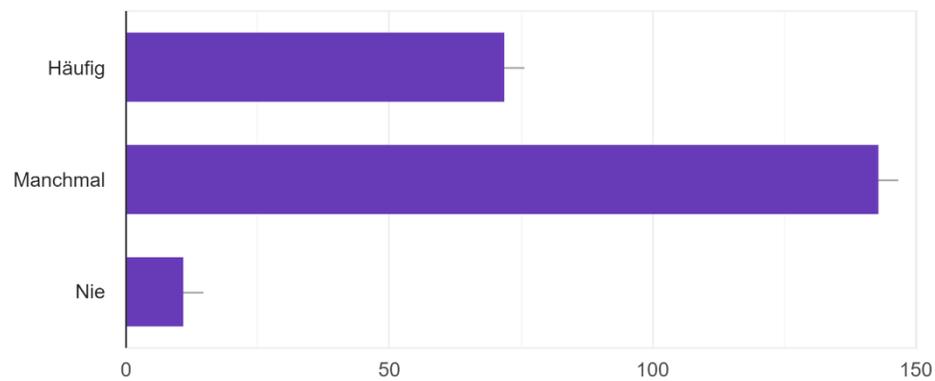
Kommt es vor, dass Sie privat technische Lösungen an Stelle eigentlich vorgesehener EdTech Systeme anwenden müssen?

226 Antworten



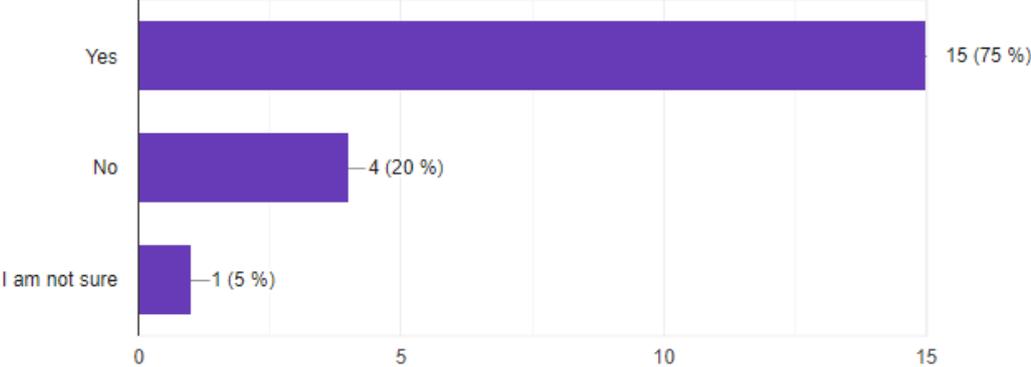
Kommt es vor, dass Sie privat technische Lösungen an Stelle eigentlich vorgesehener EdTech Systeme anwenden müssen?

226 Antworten



Assume Covid-19 would not exist any longer and schooling would be back to normal and classes would be held on site as usual from now on. Would you continue to use EdTech in your classes?

20 responses



## Appendix 2: Pre-Survey Information of the Online Survey for Public Schools (Translated)

### EdTech in German Primary Schools

Any type of technology used in a school context is referred to in English as "Educational Technology". In the following online survey, this is the main focus and is abbreviated as "EdTech". The purpose of EdTech is to support the organization and delivery of education as well as the learning and completion of homework by providing technological solutions. Examples of EdTech systems include email, combinatory products such as Microsoft Teams, video conferencing systems such as Zoom, learning platforms such as Moodle, or simply, physical EdTech products such as tablets or whiteboards.

The purpose of this online survey is to gather information about EdTech acceptance and usage in German primary schools. Therefore, we are interested in the opinion of primary school teachers as they are one of the main user groups of EdTech systems. The online survey focuses on topics around personal attitudes towards EdTech, acceptance and adaption of EdTech systems.

Participation in the online survey is voluntary and can be withdrawn at any time without giving reasons. The data will of course be processed anonymously and treated confidentially. The data will only be used to fulfill the purpose of this scientific research.

#### Data protection:

If you take part in the online survey, you agree to the nature, scope and significance of the study, aim and length. You have received sufficient information about these aspects and had enough time to decide for or against participation. Collected data will be processed anonymously and used only for the purpose of the study. It is not possible to draw conclusions about individual participants. Furthermore, the data will not be passed on to third parties.

Participation in this survey is possible without mentioning your name.

Registration is not required for participation.

Even in the case of a survey, you have the right to information as well as deletion of your personal data in accordance with data protection vis-à-vis the information provider. You can revoke this declaration of consent at any time. Further information can be found at the bottom of this page under the link "Data protection".

Translated with [www.DeepL.com/Translator](https://www.DeepL.com/Translator) (free version)

\* Required

## Appendix 3: Content Analysis Categories and Codes

<b>CATEGORY</b>	<b>CATEGORY ABBREVIATION</b>
<b>NEED FOR MORE/BETTER EQUIPMENT AND INFRASTRUCTURE</b>	equipment
<b>PUSH BY COVID-19</b>	covid-19
<b>POSITIVE PERCEPTION OF EDTECH</b>	positiveEdTech
<b>NEED FOR TAILORED EDTECH SOLUTIONS</b>	customizedEdTech
<b>DISSATISFACTION WITH DIGITALIZATION STRATEGY</b>	negativeStrategy
<b>ADDITIONAL WORK LOAD FOR TEACHERS</b>	workload
<b>NEED FOR PROFESSIONAL SUPPORT</b>	support
<b>SATISFACTION WITH DIGITALIZATION STRATEGY</b>	positiveStrategy
<b>NEED FOR ADEQUATE TRAINING</b>	training
<b>COMMUNICATION WITH PARENTS</b>	parents

## Appendix 4: Content Analysis of the Qualitative Survey Data (Public Schools)

#	ORIGINAL DATA	TRANSLATION OF ORIGINAL DATA INTO ENGLISH	CATEGORY
C1	Ausstattung mit Hardware bzw. WLAN ist noch immer unzureichend (Bayern)	Equipment with hardware or wifi is still insufficient (Bavaria)	equipment
C2	Durch Corona hat EdTech einen Schub bekommen, der hoffentlich auch nach der Pandemie weiter wirkt.	Corona has given EdTech a boost that will hopefully continue to work even after the pandemic.	covid-19, positiveEdTech
C3	Schule sollte weitestgehend analog stattfinden, mit Teams Elementen , um die Schüler auf die Berufswelt vorzubereiten.	School should be mostly analogue, with [Microsoft] Teams elements to prepare students for work.	customizedEdTech, positiveEdtech
C4	Als Handarbeitslehrein gibt es zu wenig Material zu kaufen, alles muss selbst hergestellt werden. Es gibt nur 10 Tablet s für alle 200 Schüler. Um den Unterricht mit den Geräten zu gestalten bräuchte ich ständig 3 Tablets in meinem Klassenzimmer.	As a handicraft teacher, there are too few materials to buy, everything has to be made by oneself. There are only 10 tablets for all 200 students. I would need 3 tablets in my classroom at all times to organise lessons with the devices.	equipment
C5	Dienstgeräte, schülergeräte, wlan an schulen	Teacher devices, student devices, wifi at schools	equipment
C6	Die Corona-Pandemie hat die Digitalisierung massiv beschleunigt.	The Corona pandemic has massively accelerated digitalisation.	covid-19

<b>C7</b>	Wir sind weit hintendran! Da muss noch viel passieren!	We are far behind! A lot has to happen!	negativeStrategy
<b>C8</b>	Die Digitalisierung an Schulen bringt viele Vorteile, die auch nach Corona genutzt werden sollten.	Digitalisation in schools brings many advantages that should also be used according to Corona.	positiveEdTech
<b>C9</b>	Die momentane Situation hat uns in Beziehung auf EdTech einen großen Schub gebracht. Interessant wird es sein, was und in welcher Form wir es in "normalen Zeiten" verwenden werden. Das wird sich zeigen und muss sich dann entwickeln.	The current situation has given a big boost for EdTech. It will be interesting to see what and in what form we will use it in "normal times". That remains to be seen and must then develop.	covid-19
<b>C10</b>	Mir wäre es wichtig, dass alle Kinder die gleichen technischen Voraussetzungen haben (Endgeräte) und wir im Unterricht hier einführen, arbeiten, üben können, um einen selbstständigen Umgang auch zu Hause zu ermöglichen.	It would be important to me that all children have the same prerequisites (technical devices) and that we can introduce, work on, and practice in class to enable independent use at home as well.	equipment
<b>C11</b>	Ich denke, fast jeder Lehrer würde die Fragen ähnlich beantworten, denn mittlerweile sind alle Schularten technisch gut fortgebildet und die Digitalisierung schreitet so voran, dass kein Lehrer mehr daran vorbeikommt.	I think almost every teacher would answer the questions in a similar way, because by now all types of schools are well trained in technology and digitization is advancing in such a way that no teacher can avoid it anymore.	positiveEdTech
<b>C12</b>	Die Unterstützung für Systembetreuer in Form von Ermäßigungsstunden fehlen auf ganzer Linie. Der Aufwand für die Pflege/ Betreuung der mittlerweile vielzähligen Geräte nimmt enorm viel Zeit in Anspruch, die bisher nicht als Arbeitszeit gilt bzw es	Support for system administrators in the form of reduced hours is missing completely. The effort for the maintenance / support of the now many devices takes up an	workload, support

	hierfür keinen Ausgleich in Form von Erlass von Unterrichtsstunden gibt. Das wäre dringend notwendig!	enormous amount of time, which so far does not count as working time or there is no compensation for this in the form of reduction of teaching hours. This would be urgently necessary!	
<b>C13</b>	Große Unterstützung für ansprechenden Unterricht und deren Aufbereitung	Great support for good lessons and their preparation	positiveEdTech
<b>C14</b>	Videokonferenzen würde ich nicht mehr nutzen, wenn die Kinder wieder täglich Präsenzunterricht in unserer Grundschule hätten. In Bezug auf diese Konferenzen wurden wir natürlich auch unter Druck gesetzt, sie einzuführen. Das hat sich aber in Zeiten des sehr langen Lockdowns sehr bewährt und war äußerst hilfreich.	I would no longer use video conferencing if the children had daily face-to-face classes in our primary school again. In terms of these conferences, we were of course also pressured to introduce them. However, this has been very beneficial and extremely helpful in times of very long lockdown.	covid-19
<b>C15</b>	Systembetreuung muss in externe professionelle Hand - Überlastung und Überforderung des Kollegen, der pro Schule in der Woche dafür (in Bayern GS) nur 1 Std. zur Verfügung hat	System support must be in external professional hands - overload and excessive demands on the colleague, who has only 1 hour per school per week for this (in Bavarian primary schools).	workload, support
<b>C16</b>	Durch Corona herrscht gerade eine ganz andere Situation. Allerdings würde ich sehr gerne EdTech im Unterricht häufiger verwenden, allerdings fehlt die Ausstattung (kein Tablet, Whiteboard, Beamer, Dokumentenkamera...). Dies erschwert den Einsatz sehr und man überlegt es sich, ob es wirklich nötig	Due to Corona, the situation is quite different right now. However, I would very much like to use EdTech more often in class, but the equipment is missing (no tablet, whiteboard,	covid-19, equipment

	<p>ist, für einen dreiminütigen, passenden Kurzfilm 20 Minuten lang das benötigte Equipment auf- und abzubauen.</p>	<p>beamer, document camera...). This makes it very difficult to use and you think about whether it is really necessary to spend 20 minutes setting up and taking down the necessary equipment for a three-minute, suitable short film.</p>	
<b>C17</b>	<p>Ich verwende im Moment täglich EdTech im Unterricht, aber nur weil wir im Distanzunterricht sind. Bei Präsenzunterricht ist in meinem Klassenzimmer keine EdTech-Nutzung möglich. Es fehlt an der dafür nötigen Ausstattung. Leider! Dieser Mangel geht meines Erachtens zu Ungunsten der Schüler. Die Kinder heute wachsen in einer sehr technisierten Welt auf. Sie denken anders als ich, gehen mit anderen Sachen um und sind mehr in der digitalen Welt unterwegs. Und diesen Umständen müssen wir uns anpassen, ansonsten reden Lehrer und Schüler aneinander vorbei.</p>	<p>I currently use EdTech on a daily basis in class, but only because we are in distance learning. EdTech use is not possible in my classroom for face-to-face classes. There is a lack of the necessary equipment. Unfortunately! In my opinion, this lack is to the disadvantage of the students. Children today are growing up in a very technological world. They think differently than I do, deal with different things and are more in the digital world. And we have to adapt to these circumstances, otherwise teachers and students will talk past each other.</p>	<p>covid-19, equipment</p>
<b>C18</b>	<p>Es wäre schön, wenn die Schulen so ausgestattet wären, dass man sich zumindest auf die grundlegenden Dinge wie Internet, funktionierende Drucker und PCs verlassen könnte.</p>	<p>It would be nice if the schools were equipped to rely on at least the basic things like internet, working printers and PCs.</p>	<p>equipment</p>

<b>C19</b>	Die vorletzte Frage (... privat technische Lösungen ...) ist unklar formuliert.	The penultimate question (... private technical solutions ...) is unclearly worded.	nonUtilizable
<b>C20</b>	Ich arbeite seit Dezember überwiegend im Distanzunterricht, vereinzelt auch im Wechselunterricht.	Since December, I have been working mostly in distance learning, with occasional rotational teaching.	nonUtilizable
<b>C21</b>	Corona hat die Digitalisierung sehr vorangebracht.	Corona pushed digitization massively.	covid-19
<b>C22</b>	Mehr technischer Support an den Schulen würde die Arbeit enorm erleichtern.	More technical support at schools would make the work a lot easier.	support
<b>C23</b>	Datenvolumen ist zu gering	Data volume is too low	equipment
<b>C24</b>	Die Ausstattung vieler Schulen lässt leider zu wünschen übrig. Oft streikt das W-LAN. Einige KollegInnen müssen sich nach wie vor mit uralten Overheadprojektoren begnügen. Dokumentenkameras sind nicht in allen Klassenräumen installiert. White- oder Smartboards gibt es bei uns an der Schule kein einziges. PCs gibt es in der Regel 2 in jedem Klassenzimmer. Viele EdTech Systeme werden häufig, wenn vorhanden, nur durch eine freiwillige Mehrarbeit engagierter KollegInnen am Laufen gehalten. Die Bereitstellung angemessener Ausstattung und Zeitanrechnung für Betreuer wäre ein ganz großes Anliegen.	Unfortunately, the equipment in many schools leaves a lot to be desired. W-LAN often goes on strike. Some colleagues still have to make do with ancient overhead projectors. Document cameras are not installed in all classrooms. There are no whiteboards or smartboards at our school. There are usually 2 PCs in each classroom. Many EdTech systems, when available, are often kept running only through voluntary extra work by dedicated colleagues. Providing adequate equipment and time credit for supervisors	equipment, workload

		would be a very big concern.	
<b>C25</b>	Die Nutzung von EdTech in allen Schulen variiert je nach technischer Ausstattung eklatant.	The use of EdTech in all schools varies strikingly depending on the technical equipment.	equipment
<b>C26</b>	Durch Covid-19 wurde der Umgang forciert und die Ausstattung zunehmend entsprechend eingerichtet, was dringend notwendig war. Ich hoffe aber dass sich nach Covid 19 wieder ein gewisses Gleichgewicht einspielt, das zur Zeit der Umgang mit digitalen Medien für alle Beteiligten zu viel ist - auch die ständige Erreichbarkeit (z.B. über E-Mail mit Eltern).	Covid 19 forced the use of digital media and the equipment was increasingly set up accordingly, which was urgently needed. However, I hope that after Covid 19 a certain balance will be restored. At the moment, dealing with digital media is too much for everyone involved - including constant accessibility (e.g. via e-mail with parents).	covid-19, equipment, workload, parents
<b>C27</b>	Staat sollte Lehrkräfte besser ausstatten (Laptop wurde vom Staat bezahlt, zusätzliche Hardware (Maus, Tastatur, usw.) sowie sämtliche Software (Office-Paket, usw.) muss von der Lehrkraft selbst bezahlt werden! Zum Vergleich: Das ist wie wenn einem LKW-Fahrer der LKW gestellt wird, er aber das Diesel selbst bezahlen müsste).	The state should better equip teachers (laptop was paid by the state, additional hardware (mouse, keyboard, etc.) as well as all software (office package, etc.) had to be paid by the teacher himself! For comparison: This is just like when a truck driver is provided the truck, but he would have to pay for the diesel himself).	equipment, negativeStrategy
<b>C28</b>	Die Ausstattung mit technischen Geräten ist an unserer Schule gegeben. Leider ist es für die Kinder schwierig, mit Lernprogrammen,	The equipment with technical devices is given at our school. Unfortunately, it is	customizedEdTech, parents

	Teams usw. umzugehen, selbst wenn ich es als Lehrkraft erkläre. Von den Eltern erfahren einige keine Unterstützung, da diese auch nicht alle Programme verstehen oder sehr schlecht Deutsch sprechen und so nicht alles verstehen.	difficult for the children to deal with learning programs, Teams, etc., even if I explain it as a teacher. From their parents, some experience no support, because they also do not understand all the programs or speak German very poorly and so do not understand everything.	
<b>C29</b>	Die Einarbeitung in die neue Technik war hart und hat mich viele Nerven gekostet!	Learning the new technology was hard and cost me a lot of nerves!	workload
<b>C30</b>	EdTech in der Grundschule, besonders in den ersten beiden Jahren, finde ich problematisch, da die Schüler*innen ja erstmal die Kernkompetenzen erlernen müssen. Ich finde es jedoch hilfreich bei der Differenzierung und als mögliches Ergänzungsangebot zu Hause.	I think EdTech in elementary school is problematic, especially in the first two years, because the students have to learn the core competencies first. However, I find it helpful for differentiation and as a possible supplement at home.	customizedEdTech
<b>C31</b>	Unsere Schule ist technisch sehr gut ausgestattet (digitale Tafeln, Ipad). Deshalb sind wir schon mehr in diesem Thema geschult und integrieren es in den Unterricht.	Our school is technically very well equipped (digital boards, Ipad). Therefore, we are already more trained in this topic and integrate it into the lessons.	positiveStrategy
<b>C32</b>	Häufig wirken sich die strengen Datenschutzbestimmungen lähmend aus.	The strict data protection regulations have oftentimes a paralyzing effect.	negativeStrategy
<b>C33</b>	Während EdTech viele Vorteile und Erleichterungen für die Vor- und Nachbereitung des Unterrichts	While EdTech offers many advantages and facilitates the	positiveEdTech, workload, parents

	<p>bietet, muss dem gegenüber gestellt werden, dass durch die einfachere Kommunikation über die verschiedenen Kanäle auch eine höhere Belastung der Lehrkräfte besteht. Man ist jederzeit erreichbar und fühlt sich verpflichtet rund um die Uhr für Eltern und Kollegen erreichbar zu sein. Meist arbeitet man dadurch mehr als 15 Stunden und dabei wird das Wochenende nicht ausgeklammert.</p>	<p>preparation and follow-up of lessons, it must be put in contrast to this the fact that there is also a greater workload for teachers due to the simplified communication via the various channels. One can be contacted at any time and feels obliged to be available around the clock for parents and colleagues. In most cases, this means working more than 15 hours, not excluding the weekend.</p>	
<b>C34</b>	<p>Klassenzimmer brauchen auch in der Grundschule Interactiveboard und ausreichende Internetkapazität samt Lehrer-PC!!!</p>	<p>Classrooms need interactive boards and sufficient internet capacity including teacher PC also in elementary school!!!</p>	<p>equipment</p>
<b>C35</b>	<p>Fragen des Datenschutzes (z.B. links von Youtube Erklärfilme für die Kinder teilen) müssten noch klarer kommuniziert werden.</p>	<p>Data protection issues (e.g. sharing explanatory films for the children from YouTube) would have to be communicated more clearly.</p>	<p>negativeStrategy</p>
<b>C36</b>	<p>EdTechnik ist zu Zeiten von Corona unersetzbar, zu normalen Zeiten sehe ich das tatsächliche Begreifen im wörtlichen Sinne als oberstes Unterrichtsziel zur Durchdringung der verschiedenen Inhalte. Ich glaube auch, dass sie das Transfervermögen durch den tatsächlichen Umgang mit Anschauungsmaterial erhöht. Meine Erfahrung aus dem Distanzunterricht ist, dass Erklärvideos etc. als Einstieg sehr gut sind, um einen</p>	<p>EdTech is irreplaceable during times of Corona, during normal times I see the actual grasping in the literal sense as the primary instructional goal for the penetration of the various contents. I also believe that it increases transferability through</p>	<p>customizedEdTech</p>

	bleibenden Effekt zu erzielen, ich aber die Schüler der Reihe nach anrufen muss und mir die Inhalte von ihnen selbst erklären lassen muss. Da zeigen sich dann große Defizite bei der digitalen Wissensgewinnung.	actual exposure to visuals. My experience from distance teaching is that explanatory videos etc. are very good as an introduction to achieve a lasting effect, but I have to call the students in turn and have them explain the content to me themselves. This reveals major weaknesses in the acquisition of digital knowledge.	
<b>C37</b>	Eine gewisse Ausstattung wäre bei uns an der Schule zum Glück da (Whiteboard mit Beamer und DokuKamera, 2 Laptops für Schüler:innen etc) aber leider technisch sehr störanfällig. Dienstlaptops lange versprochen, aber noch nicht da. Leider kein Wlan und keine Tablets im Klassensatz.	A certain amount of equipment would fortunately be available at our school (whiteboard with beamer and docu-camera, 2 laptops for students, etc.), but unfortunately it is technically very prone to failure. Service laptops promised for a long time, but not yet there. Unfortunately, no wifi and no tablets in the class set.	equipment
<b>C38</b>	EdTech kann eine gute Unterstützung für den Unterricht sein.	EdTech can be a good support for teaching.	positiveEdTech
<b>C39</b>	Es fehlt an professioneller Unterstützung z.B. beim Einrichten von Office365, hier kommen die schulintern eingesetzten Systembetreuer an ihre Grenzen.	There is a lack of professional support, for example, in setting up Office365; this is where the system administrators employed by the school reach their limits.	workload, support

<b>C40</b>	Die tägliche Nutzung hat auch mit dem Distanzunterricht zu tun, da ich mit meinen Schulkindern über Teams verbunden bin.	The daily usage also has to do with distance learning, as I am connected to my school children via teams.	covid-19
<b>C41</b>	Alles im Homeschooling findet über meine privaten Geräte statt. Nur im Klassenzimmer steht ein PC und das Whiteboard.	Everything in homeschooling takes place on my personal devices. Only in the classroom there is a PC and the whiteboard.	equipment
<b>C42</b>	Ich brauche Erklärungen, wie die Systeme funktionieren. Bitte nicht von einem Informatiker, sondern von einem Pädagogen, der geschult ist, wo Schwierigkeiten beim Verständnis auftreten können. Es ist nämlich gar nichts "selbsterklärend".	I need explanations of how the systems work. Not from a computer scientist, please, but from an educator who is trained in where difficulties in understanding can occur. Because nothing is "self-explanatory" at all.	Support, training
<b>C43</b>	Leider wurde die technische Entwicklung erst durch Covid-19 vorangetrieben, oft gibt es Notlösungen, veraltete Hardware	Unfortunately, the technical development was driven only by Covid-19, often there are temporary solutions, obsolete hardware	covid-19, equipment
<b>C44</b>	Das meiste genutzte EdTech Equipment ist privat bezahlt und Wartung etc erfolgt auf eigene Kosten. Das ist 2021 die Arbeitsrealität.	Most EdTech equipment used is privately paid for and maintenance etc is at own expense. This is the working reality in 2021.	equipment
<b>C45</b>	Wir GS-Lehrerinnen brauchen unbedingt (!!!) regelmäßige IT-Kompetenz vor Ort! Bessere Ausstattung! Und gezielte Fortbildungsangebote vor Ort (an der Schule), damit man sich wirklich	We female primary school teachers absolutely (!!!) need regular IT expertise on site! Better equipment! And targeted in-	Support, equipment, training

	weiterbilden kann und nicht ständig frustrieren muss.	service training offers on site (at the school), so that you can really develop further and do not have to frustrate constantly.	
<b>C46</b>	Die technischen Voraussetzungen sind leider nicht an jeder Schule gleich gegeben. Das ist sehr schade. Auch an den Endgeräten bei den Schülern mangelt es, wodurch der Einsatz eher bedingt ablaufen kann, um jedem Schüler die Möglichkeit zu geben, die gleichen Chancen zu erhalten.	Unfortunately, the technical requirements are not the same at every school. This is a great pity. There is also a lack of devices for the students, which means that the use is rather limited in order to give every student the opportunity to have the same chances.	equipment
<b>C47</b>	Es fehlt an ausreichender technischer Ausstattung für alle Klassenzimmer. Lehrer ohne Klassenführung, die ausschließlich zur Förderung eingesetzt werden haben oft das Nachsehen.	There is a lack of sufficient technical equipment for all classrooms. Teachers without classroom control, who are deployed exclusively for special education, are often left out in the cold.	equipment, negativeStrategy
<b>C48</b>	Unsere Schule ist digital nicht besonders gut ausgestattet, deswegen fallen viele EdTech Lösungen weg, außer ich nutze meinen privaten Rechner.	Our school is not very well equipped digitally, so a lot of EdTech solutions fall away, unless I use my personal computer.	equipment
<b>C49</b>	Der bayerische Staat hätte in der Pandemie schneller ein funktionierendes Meeting-Tool bereit stellen müssen. Hier sind viele Lehrer-Arbeitsstunden verschwendet worden auf der Suche nach einem geeigneten, möglichst kostenlosen, System. Die Schule wird bei IT-Problemen zu wenig von externer, professioneller Seite unterstützt. Hier kommt es öfter zu technischen	The Bavarian state should have provided a functioning meeting tool more quickly during the pandemic. Here, many teacher working hours have been wasted in the search for a suitable, preferably free, system. The school	negativeStrategy, support, equipment

	Ausfällen, so dass Unterricht nicht wie geplant ablaufen kann.	receives too little support from external, professional sources when it comes to IT problems. Technical failures occur more often, so that lessons cannot run as planned.	
<b>C50</b>	Den Schulen müssten mehr Gelder zur Verfügung gestellt werden, um sowohl Schüler*innen als auch Lehrer*innen besser auszustatten.	More funds would have to be made available to schools to better equip both students and teachers.	equipment
<b>C51</b>	Im Referendariat erhält man tolle Anregungen.	You get great ideas during your clerkship.	nonUtilizable
<b>C52</b>	Ich wünsche mir endlich Wlan und digitale Ausstattung im Klassenzimmer!	I wish to finally have wifi and digital equipment in the classroom!	equipment
<b>C53</b>	Uns fehlt besonders der technische Support in der Schule. Dieser müsste eine stabil greifbare Person sein.	We particularly lack technical support in the school. This would have to be a stable tangible person.	support
<b>C54</b>	Die Ausstattung der Lehrkräfte mit Notebooks oder Tablettis ist zu langwierig.	It takes too long to equip teachers with notebooks or tablets.	negativeStrategy
<b>C55</b>	Mehr Segen als Fluch!	More blessing than curse!	positiveEdTech
<b>C56</b>	Einziges Positives an Corona: Endlich schneller, enormen Fortschritt im Bereich EdTech.	The only positive thing about Corona: Finally faster, enormous progress in the field of EdTech.	covid-19
<b>C57</b>	Präsente Fortbildungen statt digitaler wären für mich sehr hilfreich.	On-site training instead of digital would be very helpful for me.	negativeStrategy, training

<b>C58</b>	Mehr Unterstützung durch Hotline oder externe Personen ,die vor Ort helfen können, wäre wünschenswert.	More support through hotlines or external persons, who can help on site, would be desirable.	support
<b>C59</b>	Grundschul Kinder sind im Homeschooling oft völlig überfordert und können EdTech meist nur im Beisein von Erziehungsberechtigten nutzen.	Primary school children are often completely overwhelmed in homeschooling and can usually only use EdTech in the presence of a responsible parent or guardian.	customizedEdTech
<b>C60</b>	Unsere Schule ist digital nicht besonders gut ausgestattet, deswegen fallen viele EdTech Lösungen weg, außer ich nutze meinen privaten Rechner.	Our school is not very well equipped digitally, so a lot of EdTech solutions fall away, unless I use my personal computer.	equipment
<b>C61</b>	Grundschüler brauchen handlungsorientiertes und lebenspraktisches Lernen, EdTech kann das nicht ersetzen aber bereichern.	Primary school students need action-oriented and practical learning. EdTech cannot replace this, but it can enrich it.	positiveEdTech
<b>C62</b>	<p>Ich finde die Nutzung dieser Systeme sehr wichtig. Unsere Kinder wachsen in eine Zeit, in der sie in Zukunft täglich damit konfrontiert werden. Ich musste mir vieles aneignen. Für die Kinder ist es so die Chance, hineinzuwachsen und sie effektiv zu nutzen.</p> <p>Manchmal hätte ich mir eine bessere Schulung gewünscht</p>	<p>I think the use of these systems is very important. Our children are growing into a time where they will be exposed to them on a daily basis in the future. I've had to acquire a lot of things. It's such an opportunity for the kids to grow into it and use it effectively.</p> <p>Sometimes I had wished for a better training.</p>	positiveEdTech, training

<b>C63</b>	<p>Jede Schule oder ein Kreis von Schulen bräuchte einen Systembetreuer, der sich auskennt und angerufen werden kann bei Problemen. Dieser sollte auch Schulungen geben und Einweisungen. Ein technischer Systembetreuer soll kein Lehrer sein, der Ermäßigungsstunden bekommt. Diese kennen sich zu wenig aus. So kommt die digitale Bildung nicht weiter und wird keine Digitalisierung an Schulen möglich sein.</p>	<p>Each school or group of schools would need a system administrator who knows the system and can be called in case of problems. This person should also provide training and instruction. A technical system supervisor should not be a teacher who receives discount hours. They know too little about the subject. Digital education will not progress in this way, and digitization will not be possible at schools.</p>	<p>support, training, negativeStrategy</p>
<b>C64</b>	<p>Lehrerdienstgeräte wären wichtig</p>	<p>Teacher devices would be important</p>	<p>equipment</p>
<b>C65</b>	<p>Es wäre schön, wenn mehr technische Geräte (Laptop, Tablet) etc. von der Schule gestellt würden, da man häufig den privaten Laptop nutzen muss. Sind Endgeräte vorhanden, funktionieren sie zu 50 % nicht oder sind zu langsam.</p> <p>Ich würde gerne mehr über verschiedene Technologien und deren Einsatz im Unterricht lernen und dies natürlich im Unterricht anwenden. Ich befinde mich z.Z. im Vorbereitungsdienst und bin der Ansicht, dass wir auf das Thema in der ersten und zweiten Phase unzureichend vorbereitet werden. Man lernt überwiegend aus eigenen Recherchen und Erfahrungen.</p>	<p>It would be nice if more technical devices (laptop, tablet) etc. were provided by the school, as one often has to use the private laptop. When devices are available, 50% of them do not work or are too slow.</p> <p>I would like to learn more about different technologies and how to use them in the classroom and of course apply this in the classroom. I am currently in the preparatory service and am of the opinion that we are insufficiently prepared for the subject in the first and second phase.</p>	<p>equipment, negativeStrategy</p>

		You learn mainly from your own research and experience.	
<b>C66</b>	Verwendung unterstützt nicht nur Unterricht sondern auch Verwaltung der Klasse	The usage not only supports teaching but also the management of the class	positiveEdTech
<b>C67</b>	Ich habe zwar an EdTech-Fortbildungen teilgenommen, diese waren aber leider lächerlich. Inhalt war die Veränderung der Schriftart und die banalste Form der Verwendung. Für Lehrende, die sich bereits durch private Einarbeitung sehr gut auskennen, aber mehr lernen wollen, gibt es kein qualifiziertes Fortbildungsangebot. Das bedeutet noch einmal mehr Arbeit. Auch die Werbung für EdTech, die wir an der Schule bei älteren oder abweisenden Lehrkräften leisten ist recht zermürend. Außerdem ist meine gesamte technische Ausstattung (auch ArbeitsPC) privat. Wir erhalten keinerlei Ausstattung von unserem Arbeitgeber, dem Staat. Somit ist von manchen Lehrkräften die Abwertung von EdTech auch verständlich.	I have participated in EdTech training courses, but they were unfortunately ridiculous. The content was the change of font and the most banal form of use. For teachers who already know a lot through private training, but want to learn more, there is no qualified training offer. That means more work once again. Also, the promotion of EdTech that we do at the school to senior or dismissive faculty is quite grueling. In addition, all of my technical equipment (including work PC) is private. We do not receive any equipment from our employer, the state. So the devaluation of EdTech by some teachers is understandable.	Training, workload, equipment, negativeStrategy
<b>C68</b>	An unserer Schule gibt es noch nicht überall die Möglichkeit, das Internet zu nutzen. Displays sind seit 3 Monaten vorhanden, aber nur wenige.	At our school it is not yet possible to use the Internet everywhere. Displays have been available for 3 months, but only a few.	equipment

<b>C69</b>	Nun gilt es zu bewahren, was sich im Hinblick auf EdTech entwickelt und bewährt hat.	The task now is to preserve what has been developed and proven with regard to EdTech.	positiveEdTech
<b>C70</b>	Für uns Lehrerinnen in der Grundschule fehlen hier Optionen. Wir müssen immer die Eltern mit im Boot haben. Außerdem wäre es wichtig, dass die Kinder Lerninhalte auch oft haptisch erfassen. Hier müsste man genauer nachfragen, welche Technik sich für welchen Lerninhalt eignet und welche in unserer Schulart so gar nicht geeignet ist. Wir nutzen manche Systeme zurzeit, ohne damit zufrieden zu sein. Die Vermittlung der Lerninhalte ist ohne die Begegnung mit dem Lehrer und ohne Material sehr schwierig.	For us teachers in primary school, there are no options. We always have to have the parents on board. It would also be important for the children to grasp learning content haptically. Here, we would have to ask more precisely which technology is suitable for which learning content and which is not suitable at all in our type of school. We are currently using some systems without being satisfied with them. It is very difficult to convey the learning content without the encounter with the teacher and without material.	parents, customizedEdTech
<b>C71</b>	Ausstattung der Schule für inhaltlich gewinnbringende Nutzung im Unterricht weiterhin suboptimal, Ausstattung der Familien variantenreich, Nutzungsdauer der Bildschirmzeit von SchulanfängerInnen zeitlich begrenzt sinnvoll, enaktives Lernen nicht durch e- Lernen ersetzbar...	Equipment of the school for profitable use in the classroom remains suboptimal, equipment of the families varied, use of screen time of school beginners limited in time makes sense, enactive learning not replaceable by e-learning ...	equipment
<b>C72</b>	In der Zeit der Pandemie ist EdTech sehr hilfreich. Ansonsten möchte ich nur so viel wie nötig, z.B. mail	In the time of the pandemic, EdTech is very helpful.	covid-19, parents

	Kontakte mit Eltern, Erklärfilme..., EdTech nutzen.	Otherwise, I would like to use EdTech only as much as necessary, e.g. mail contacts with parents, explanatory films....	
<b>C73</b>	EdTech hat viele Vorteile und kann den Unterricht sehr gut ergänzen und es eröffnen sich viele neue Möglichkeiten. Trotzdem halte ich es vor allem in der Grundschule für absolut notwendig, dass die Kinder mit Gegenständen hantieren, Dinge anfassen und ihre Hände benutzen und nicht vorrangig an Bildschirmen arbeiten.	EdTech has many advantages and can complement teaching very well, opening up many new possibilities. Nevertheless, I think it is absolutely necessary, especially in primary school, that the children handle objects, touch things and use their hands and not primarily work on screens.	positiveEdTech, customizedEdTech
<b>C74</b>	Hardware muss vorhanden sein und funktionieren, das darf nicht mein Problem sein	Hardware must be present and working, this must not be my problem	equipment
<b>C75</b>	Ich empfinde es als Bereicherung und bin der Meinung, dass es auch in Zukunft ergänzen zu vielen weiteren Elementen eines guten Unterrichts in der Grundschule dazugehören sollte.	I view it as an enrichment and believe that it should be added to many other elements of good teaching in primary schools in the future.	positiveEdTech
<b>C76</b>	Leider müssen wir oft unsere Privatgeräte nutzen.	Sadly, we often have to use our private devices.	equipment
<b>C77</b>	Da in Deutschland erst in den zurückliegenden Monaten seit Covid-19 verstärkt in EdTech investiert wird und Fortbildungen angeboten werden, muss diese Investition und der enorme Zeitaufwand, mit dem sich viele in diese Art des Arbeitens hineingewühlt haben, unbedingt auch in einen hoffentlich	Since there has only been increased investment in EdTech in Germany in the past few months since Covid-19 and training courses have been offered, it is imperative that this investment and the	covid-19, positiveEdTech

	irgendwann wieder stattfindenden Präsenzunterricht einbetten lassen. Die Kompetenzen, die sich sogar schon Erstklässer im Umgang mit EdTech angeeignet haben, dürfen keinesfalls in der Schublade verschwinden!	enormous amount of time that many have invested in this type of work can also be embedded in classroom teaching, which will hopefully take place again at some point in the future. The skills that even first graders have acquired in dealing with EdTech must not be allowed to disappear!	
<b>C78</b>	Gute Ergänzung, ersetzt jedoch in keinsten Weise den Präsenzunterricht sowie die Arbeit mit physischen Büchern, Papier und Stift	Good supplement, but in no way does it replace face-to-face classes and work with physical books, paper and pencil	positiveEdTech
<b>C79</b>	Langsame aber deutliche Fortschritte der Rahmenbedingungen werden gemacht!	Slow but concise progress of the general conditions is happening!	positiveStrategy
<b>C80</b>	Es fehlt an Software die speziell für Grundschulen und Grundschüler angepasst ist. Mebis ist für Grundschüler absolut ungeeignet. Jede Schule bzw. jeder Lehrer muss eigene Systeme suchen....Solange ich als Grundschullehrer Schulbücher "einscannen" muss um online Unterricht vorzubereiten sind wir leider noch sehr weit von nachhaltigem und effizientem Lehren und Lernen entfernt...	There is a lack of software that is specially adapted for primary schools and primary school pupils. Mebis is absolutely unsuitable for primary school students. Every school and every teacher must look for their own systems....As long as I, as a primary school teacher, have to "scan" textbooks in order to prepare lessons online, we are unfortunately still very far away from sustainable and efficient teaching and learning...	customizedEdTech

<b>C81</b>	Ich bin noch eher analog unterwegs. Ich bräuchte mehr support beim Einrichten der Tools. Wenns mal läuft, ist es gut.	I am still working rather analog. I would need more support for installing the tools. Once it is up and runs, it is good.	support
<b>C82</b>	<p>Obwohl ich fast alles nutze, verwende ich aber nicht alles für den Unterricht. Messengerdienste außerhalb der Schulcloud (Kombinationsprodukt) sowie die Dropbox werden ausschließlich für den Austausch mit Kollegen verwendet.</p> <p>Die genannten Lernplattformen nutze ich nur im Rahmen der Ausbildung. Für den Materialaustausch mit den Kindern verwende ich aber das Padlet (war mir nicht sicher, ob das ebenso in diese Kategorie gehört).</p>	<p>Although I use almost everything, I do not use everything for teaching. Messenger services outside the school cloud (combination product) and Dropbox are used exclusively for exchanges with colleagues.</p> <p>I use the aforementioned learning platforms only in the context of education. For the exchange of material with the children, however, I use the Padlet (was not sure whether that also belongs in this category).</p>	nonUtilizable
<b>C83</b>	EdTech meint nur die technischen Anwendungen, die ich im direkten Kontakt mit Schülern nutze? Also nicht für den Datenaustausch mit Kollegen?!	EdTech means only the technical applications that I use in direct contact with students? So not for data exchange with colleagues?!	nonUtilizable

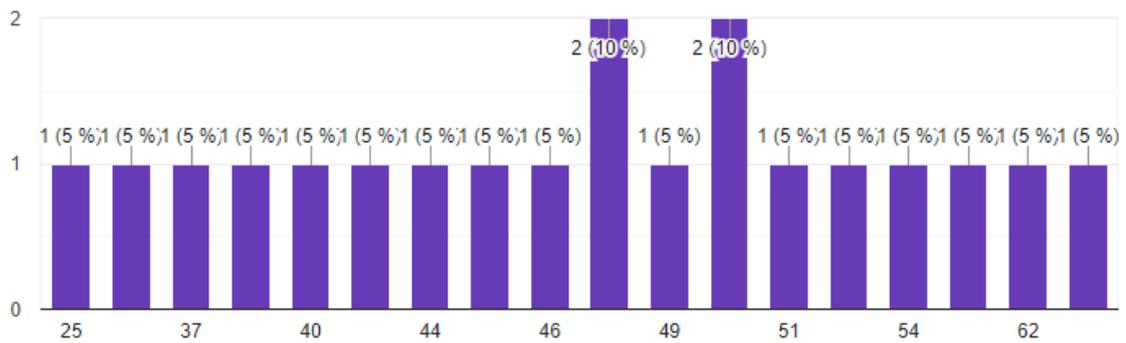
## Appendix 5: Content Analysis of the Qualitative Survey Data (Private Schools)

#	ORIGINAL DATA	TRANSLATION OF ORIGINAL DATA INTO ENGLISH	CATEGORY
C84	Microsoft Teams ist sehr gut	Microsoft Teams is very good	positiveEdTech
C85	Negativ: Vermischung - am privaten Gerät werden Arbeiten für die Schule erledigt will heißen: kein PC und Mobil wird von der Schule zur Verfügung gestellt. Dies ist bei privatwirtschaftlichen Unternehmen und z.B. auch anderen städtischen Einrichtungen (Jugendamt etc.) üblich.	Negative: Mixing - work for the school is done on the private device. This means: no PC or mobile is provided by the school. This is common practice in private companies and also in other municipal institutions (youth welfare office, etc.).	equipment

## Appendix 6: Results of the Online Survey for Private Schools (Translated)

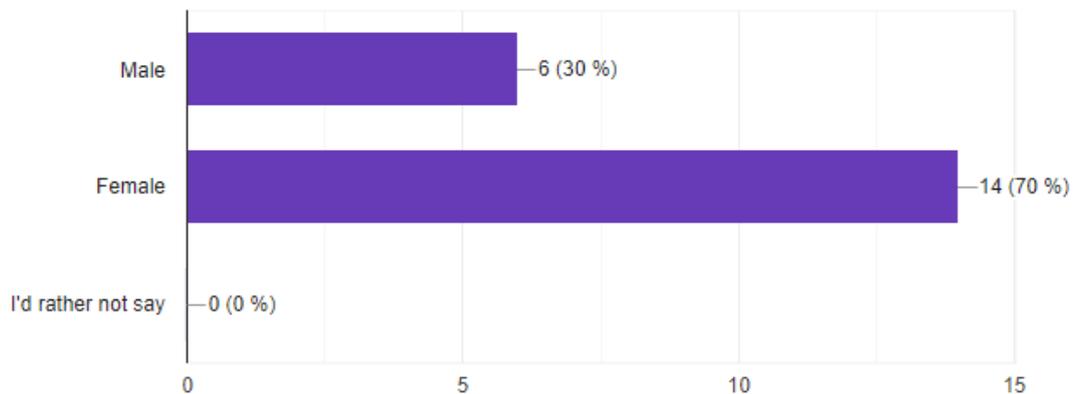
What's your age?

20 responses



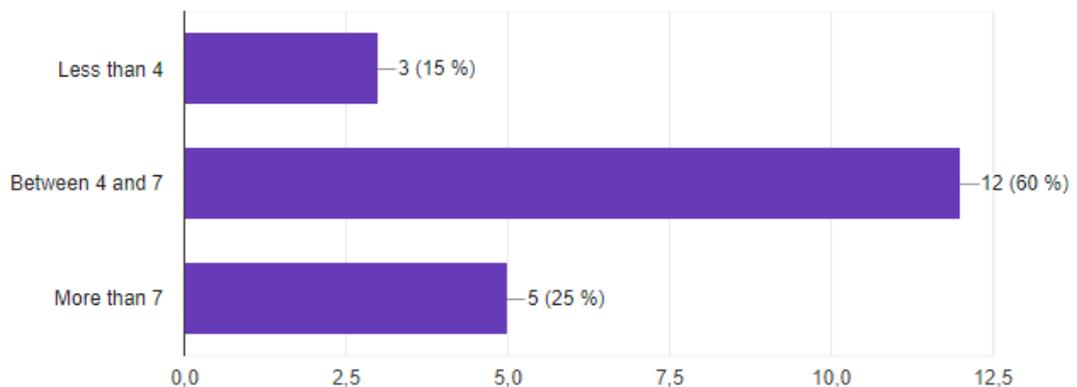
What's your gender?

20 responses



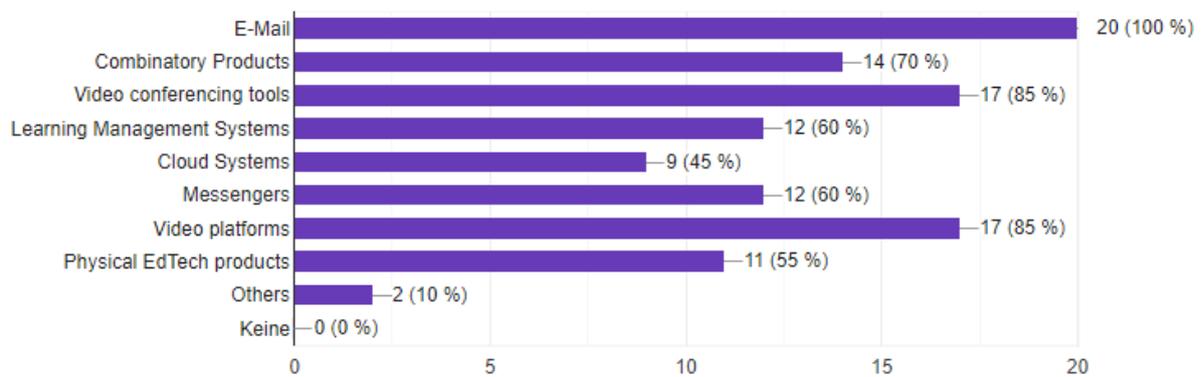
How many different EdTech Systems do you use on a regular basis?

20 responses



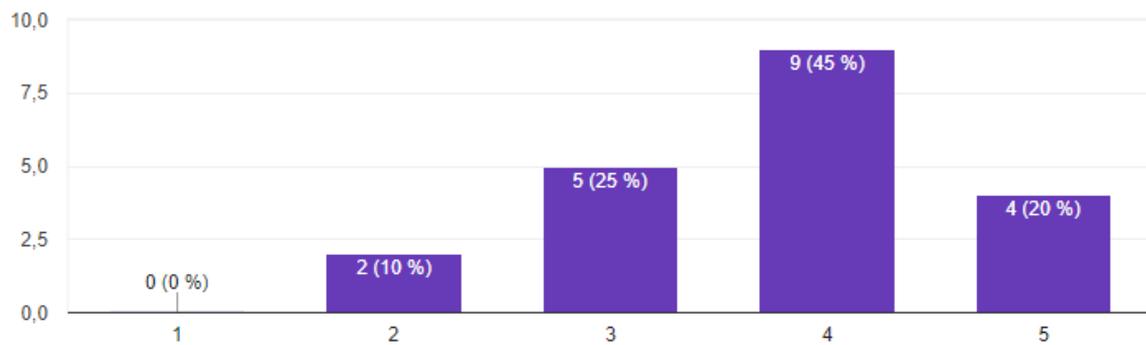
## Which kinds of EdTech Systems do you use?

20 responses



## How confident do you feel about EdTech?

20 responses



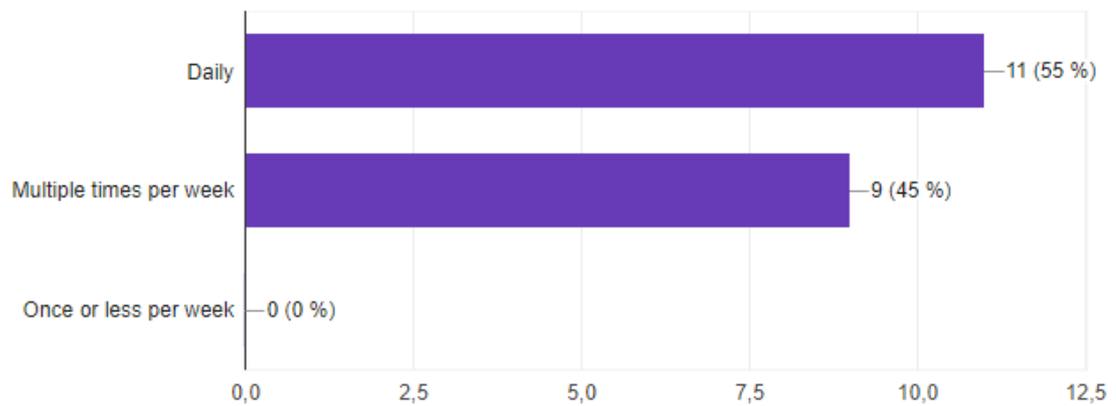
## How many years of experience with EdTech do you have?

20 responses



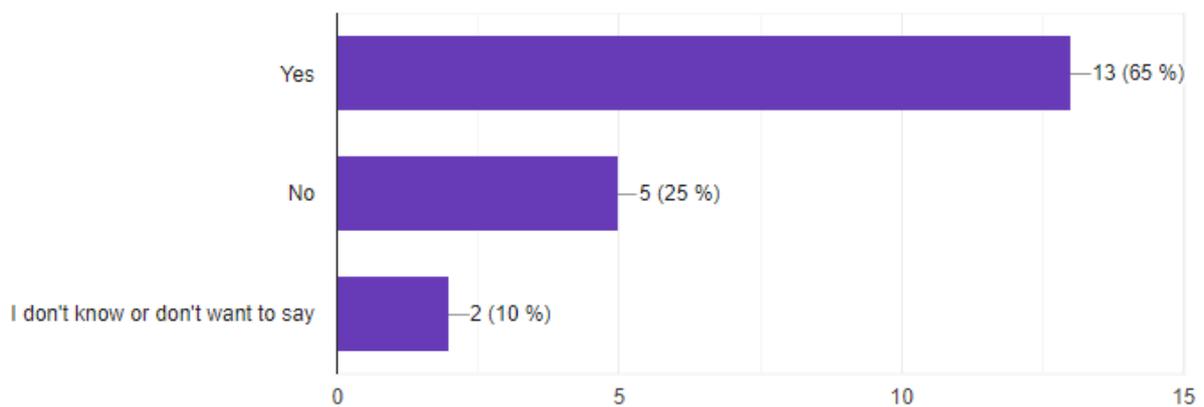
## How frequently do you use EdTech in class?

20 responses



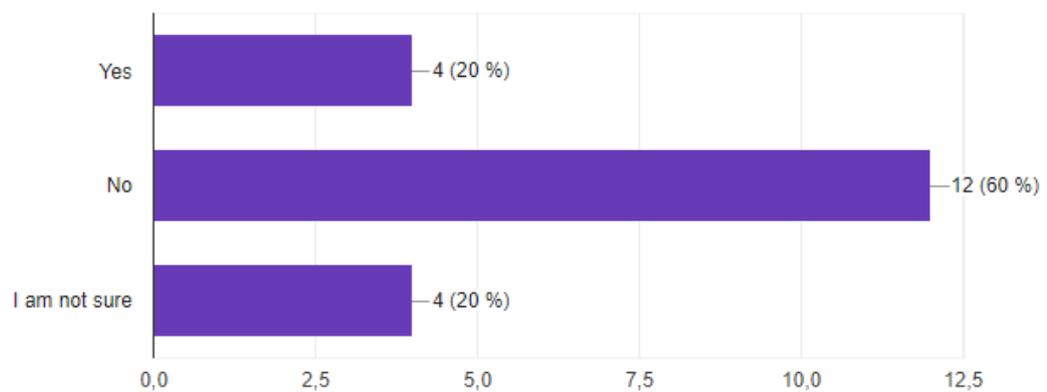
## Have you already participated in EdTech trainings?

20 responses



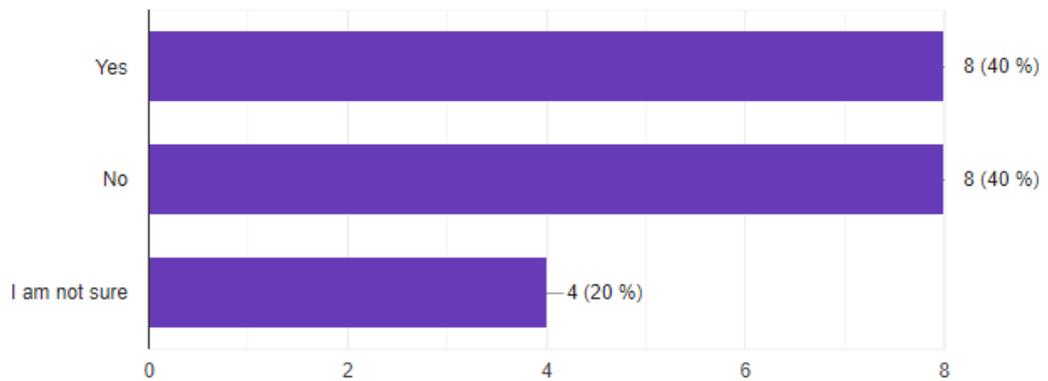
## Do you feel pressured by others to use EdTech?

20 responses



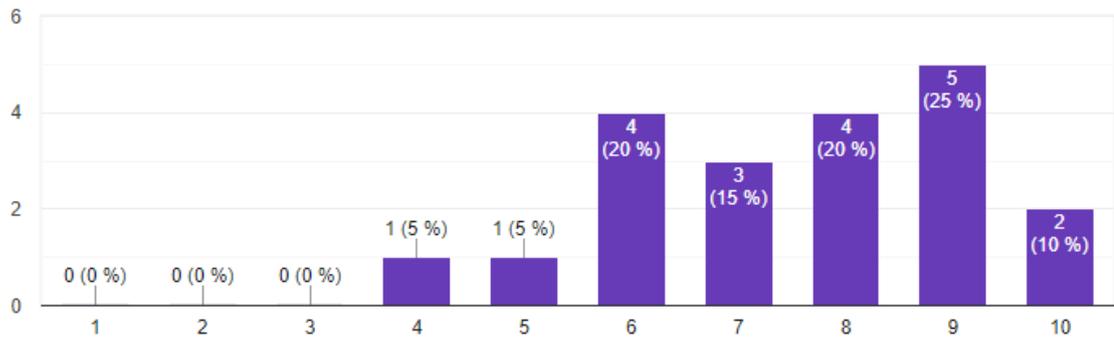
Is technical support for problems with EdTech (e.g. in form of a hotline) provided to you?

20 responses



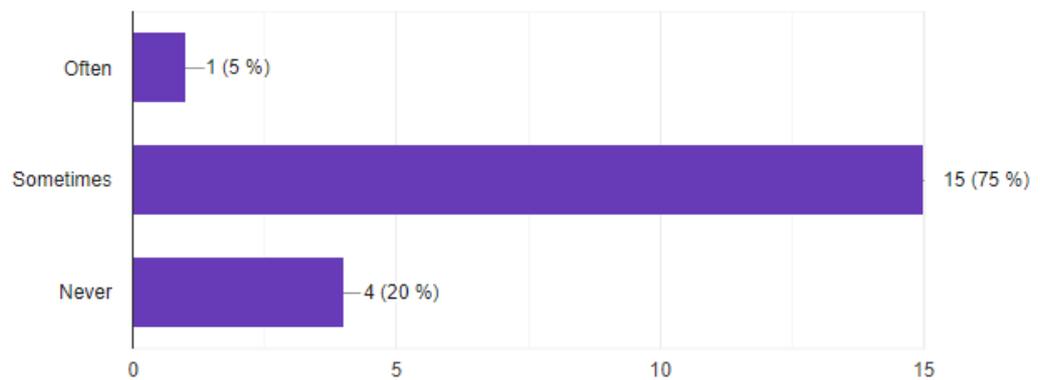
How would you rate the impact of EdTech on your classes?

20 responses



Do you ever have to use private technical solutions instead of provided EdTech Systems?

20 responses



## References

- Afonso, A., Schuknecht, L. & Tanzi, V. (2005). Public Sector Efficiency: An International Comparison, *Public Choice*, vol. 123, no. 3–4, pp.321–347.
- Bannon, L. (2011). Reimagining HCI: Toward a More Human-Centered Perspective, *Interactions*, [e-journal] vol. 18, no. 4, pp.50–57, Available Online: <https://doi.org/10.1145/1978822.1978833>.
- Bayerisches Staatsministerium für Unterricht und Kultus. (2021a). Alle Schulen in Bayern Suchen Und Finden, Available Online: <https://www.km.bayern.de/ministerium/schule-und-ausbildung/schulsuche.html> [Accessed 5 March 2021].
- Bayerisches Staatsministerium für Unterricht und Kultus. (2021b). Alle Schulen in Bayern Suchen Und Finden, Available Online: [https://www.km.bayern.de/ministerium/schule-und-ausbildung/schulsuche.html?s=&u=0&r=9999&t=1001&o=1&p2=0&p25=0&p1=0&p26=0&p3=0&p4=0&p5=0&p6=0&p7=0&p23=0&p24=0&p29=0&p11=0&p12=0&p13=0&p14=0&p27=0&p15=\\_&p28=0&p16=\\_&p30=0&p19=0&p20=0&p21=0&p22=0&p9=0](https://www.km.bayern.de/ministerium/schule-und-ausbildung/schulsuche.html?s=&u=0&r=9999&t=1001&o=1&p2=0&p25=0&p1=0&p26=0&p3=0&p4=0&p5=0&p6=0&p7=0&p23=0&p24=0&p29=0&p11=0&p12=0&p13=0&p14=0&p27=0&p15=_&p28=0&p16=_&p30=0&p19=0&p20=0&p21=0&p22=0&p9=0) [Accessed 5 March 2021].
- Bayerisches Staatsministerium für Unterricht und Kultus. (2021c). Grünewald-Grundschule Aschaffenburg, Available Online: <https://www.km.bayern.de/schule/7505.html> [Accessed 5 March 2021].
- Becker, G. S. (1962). Investment in Human Capital: A Theoretical Analysis, *Journal of Political Economy*, [e-journal] vol. 70, no. 5, pp.9–49, Available Online: <http://www.jstor.org/stable/1829103>.
- Bhattacharjee, A. (2012). Social Science Research: Principles, Methods and Practices, [e-book] Global Text Project, Available Online: [https://scholarcommons.usf.edu/oa\\_textbooks/3/?utm\\_source=scholarcommons.usf.edu%2Foa\\_textbooks%2F3&utm\\_medium=PDF&utm\\_campaign=PDFCoverPages](https://scholarcommons.usf.edu/oa_textbooks/3/?utm_source=scholarcommons.usf.edu%2Foa_textbooks%2F3&utm_medium=PDF&utm_campaign=PDFCoverPages).
- Biggemann, S., Williams, M. & Kro, G. (2014). Building in Sustainability, Social Responsibility and Value Co-Creation, *The Journal of Business and Industrial Marketing*, vol. 29, no. 4, pp.304–312.
- Blackwell, C. K., Lauricella, A. R., Wartella, E., Robb, M. & Schomburg, R. (2013). Adoption and Use of Technology in Early Education: The Interplay of Extrinsic Barriers and Teacher Attitudes, *Computers & Education*, [e-journal] vol. 69, pp.310–319, Available Online: <https://www.sciencedirect.com/science/article/pii/S0360131513001917>.
- Bocksch, R. (2020). Digitaler Schulunterricht Noch Ausbaufähig, Available Online: <https://de.statista.com/infografik/22661/probleme-beim-homeschooling-waehrend-der-corona-pandemie/> [Accessed 20 May 2021].
- Bozkurt, A. & Sharma, R. (2020). Emergency Remote Teaching in a Time of Global Crisis

- Due to CoronaVirus Pandemic, *Asian Journal of Distance Education*, [e-journal] vol. 15, pp.i–vi, Available Online: [https://www.researchgate.net/publication/341043562\\_Emergency\\_remote\\_teaching\\_in\\_a\\_time\\_of\\_global\\_crisis\\_due\\_to\\_CoronaVirus\\_pandemic](https://www.researchgate.net/publication/341043562_Emergency_remote_teaching_in_a_time_of_global_crisis_due_to_CoronaVirus_pandemic).
- Christakis, D. A., Zimmerman, F., Giuseppe, D. L. & Mccarty, C. (2004). Early Television Exposure and Subsequent Attention Problems in Children, *Pediatrics*, [e-journal] vol. 113, no. 4, pp.708–713, Available Online: <https://pediatrics.aappublications.org/content/113/4/708>.
- Clark, L. S. (2009). Digital Media and the Generation Gap, *Information, Communication & Society*, [e-journal] vol. 12, no. 3, pp.388–407, Available Online: <https://doi.org/10.1080/13691180902823845>.
- Cuban, L. (1986). *Teachers and Machines: The Classroom of Technology Since 1920*, [e-book] Teachers College Press, Available Online: <https://books.google.se/books?id=-ou4DgAAQBAJ>.
- Culp, K. M., Honey, M. & Mandinach, E. (2005). A Retrospective on Twenty Years of Education Technology Policy, *Journal of Educational Computing Research*, [e-journal] vol. 32, no. 3, pp.279–307, Available Online: <https://doi.org/10.2190/7W71-QVT2-PAP2-UDX7>.
- Davies, T. (2000). Confidence! Its Role in the Creative Teaching and Learning of Design and Technology, *Journal of Technology Education*, [e-journal] vol. 12, no. 1, pp.18–31, Available Online: <https://doi.org/10.21061/jte.v12i1.a.2%0A>.
- Diener, E. & Crandall, R. (1978). *Ethics in Social and Behavioral Research.*, Oxford, England: U Chicago Press.
- Earle, R. S. (2002). The Integration of Instructional Technology into Public Education: Promises and Challenges, *Educational Technology*, [e-journal] vol. 42, no. 1, pp.5–13, Available Online: <http://www.jstor.org/stable/44428716>.
- European Commission. (2020). *Education and Training Monitor 2020*, Available Online: <https://op.europa.eu/en/publication-detail/-/publication/0b2b1170-2499-11eb-9d7e-01aa75ed71a1/language-en/format-PDF/source-171316678> [Accessed 16 June 2021].
- Fathema, N., Shannon, D. & Ross, M. (2015). Expanding The Technology Acceptance Model ( TAM ) to Examine Faculty Use of Learning Management Systems ( LMSs ) In Higher Education Institutions, vol. 11, no. 2, pp.210–232.
- Friedewald, M. & Raabe, O. (2011). Ubiquitous Computing: An Overview of Technology Impacts, *Telematics and Informatics*, [e-journal] vol. 28, no. 2, pp.55–65, Available Online: <https://www.sciencedirect.com/science/article/pii/S0736585310000547>.
- Friedman, D., Pommerenke, K., Lukose, R., Milam, G. & Huberman, B. A. (2007). Searching for the Sunk Cost Fallacy, *Experimental Economics*, [e-journal] vol. 10, no. 1, pp.79–104, Available Online: <https://doi.org/10.1007/s10683-006-9134-0>.
- Hermans, R., Tondeur, J., van Braak, J. & Valcke, M. (2008). The Impact of Primary School

- Teachers' Educational Beliefs on the Classroom Use of Computers, *Computers and Education*, vol. 51, no. 4, pp.1499–1509.
- Ifenthaler, D. & Schweinbenz, V. (2013). The Acceptance of Tablet-PCs in Classroom Instruction: The Teachers' Perspectives, *Computers in Human Behavior*, vol. 29, no. 3, pp.525–534.
- Jennings, N., Hooker, S. & Nichols, D. (2009). Educational Television as Mediated Literacy Environments for Preschoolers, *Learning Media & Technology*, [e-journal] vol. 34, no. 3, pp.229–242, Available Online: <https://doi.org/10.1080/17439880903141513>.
- Jenson, J. & Rose, C. B. (2003). Women@Work: Listening to Gendered Relations of Power in Teachers' Talk about New Technologies, *Gender and Education*, [e-journal] vol. 15, no. 2, pp.169–181, Available Online: <https://doi.org/10.1080/09540250303854>.
- Johannesson, P. & Perjons, E. (2014). An Introduction to Design Science, [e-book] Springer International Publishing, Available Online: <https://www.springer.com/gp/book/9783319106311>.
- Keegan, D. (1995). Distance Education Technology for the New Millennium Compressed Video Teaching, [e-journal] pp.3–41, Available Online: <https://files.eric.ed.gov/fulltext/ED389931.pdf>.
- Klein, H. K. & Myers, M. D. (1999). A Set of Principles for Conducting and Evaluating Interpretive Field Studies in Information Systems, *MIS Q.*, [e-journal] vol. 23, no. 1, pp.67–93, Available Online: <https://doi.org/10.2307/249410>.
- Kugel, P. (1993). How Professors Develop as Teachers, *Studies in Higher Education*, [e-journal] vol. 18, no. 3, pp.315–328, Available Online: <https://doi.org/10.1080/03075079312331382241>.
- Lathan, J. (2021). What Is Educational Technology? [Definition, Examples & Impact], Available Online: <https://onlinedegrees.sandiego.edu/what-is-educational-technology-definition-examples-impact/> [Accessed 12 April 2021].
- Lee, Y., Kozar, K. & Larsen, K. (2003). The Technology Acceptance Model: Past, Present, and Future, *Communications of the Association for Information Systems*, [e-journal] vol. 12, Available Online: <https://aisel.aisnet.org/cais/vol12/iss1/50/>.
- Leu, D., Kinzer, C., Coiro, J. & Cammack, D. (2004). Toward a Theory of New Literacies Emerging From the Internet and Other Information and Communication Technologies, *Theoretical Models and Processes of Reading*, no. 5th edn, pp.1570–1630.
- Lin, P. C., Lu, H. K. & Liu, S. C. (2013). Towards an Education Behavioral Intention Model for E-Learning Systems: An Extension of UTAUT, *Journal of Theoretical and Applied Information Technology*, vol. 47, no. 3, pp.1200–1207.
- Liu, S. (2012). The Impact of Forced Use on Customer Adoption of Self-Service Technologies, *Computers in Human Behavior*, [e-journal] vol. 28, no. 4, pp.1194–1201, Available Online: <https://www.sciencedirect.com/science/article/pii/S0747563212000337>.

- Margulis, A., Boeck, H. & Laroche, M. (2020). Connecting with Consumers Using Ubiquitous Technology: A New Model to Forecast Consumer Reaction, *Journal of Business Research*, [e-journal] vol. 121, pp.448–460, Available Online: <https://www.sciencedirect.com/science/article/pii/S0148296319302619>.
- Mascarenhas, N. (2020). To Win Post-Pandemic, Edtech Needs to Start Thinking Big, Available Online: <https://techcrunch.com/2020/12/22/to-win-post-pandemic-edtech-needs-to-start-thinking-big/> [Accessed 12 April 2020].
- Mathews, J. G. & Guarino, A. J. (2000). Predicting Teacher Computer Use: A Path Analysis, *International journal of instructional media*, vol. 27, p.385.
- Murphy, G. & Siedschlag, I. (2013). Human Capital and Growth of Information and Communication Technology-Intensive Industries: Empirical Evidence from Open Economies, *Regional Studies*, vol. 47, no. 9, pp.1403–1424.
- Newsted, P. R., Huff, S. L. & Munro, M. C. (1998). Survey Instruments in Information Systems, *MIS Quarterly: Management Information Systems*, vol. 22, no. 4, pp.553–554.
- Nieswand, M., Geschwill, R. & Zimmermann, V. (2019). EdTech in Unternehmen, [e-book] Gabler Verlag, Available Online: <https://www.springer.com/de/book/9783658268435#aboutBook>.
- Nistor, N., Gogus, A. & Lerche, T. (2013). Educational Technology Acceptance across National and Professional Cultures: A European Study, *Educational Technology Research and Development*, [e-journal] vol. 61, pp.733–749, Available Online: <https://link.springer.com/article/10.1007/s11423-013-9292-7>.
- Nistor, N., Lerche, T., Weinberger, A., Ceobanu, C. & Heymann, O. (2014). Towards the Integration of Culture into the Unified Theory of Acceptance and Use of Technology, *British Journal of Educational Technology*, vol. 45, no. 1, pp.36–55.
- Patton, M. Q. (2014). *Qualitative Research & Evaluation Methods: Integrating Theory and Practice*, SAGE Publications.
- Pinsonneault, A. & Kraemer, K. (1993). Survey Research Methodology in Management Information Systems: An Assessment, *Journal of Management Information Systems*, vol. 10, no. 2, pp.75–105.
- Radovan, M. & Kristl, N. (2017). Acceptance of Technology and Its Impact on Teacher's Activities in Virtual Classroom: Integrating UTAUT and CoI into a Combined Model, *Turkish Online Journal of Educational Technology*, vol. 16, no. 3, pp.11–22.
- Rasinen, A., Virtanen, S., Endepohls-Ulpe, M., Ikonen, P., Ebach, J. & Stahl-Von Zabern, J. (2009). Technology Education for Children in Primary Schools in Finland and Germany: Different School Systems, Similar Problems and How to Overcome Them, *International Journal of Technology and Design Education*, vol. 19, no. 4, pp.367–379.
- Recker, J. (2012). *Scientific Research in Information Systems: A Beginner's Guide*, Springer Publishing Company, Incorporated.

- Reiser, R. A. (2001). A History of Instructional Design and Technology: Part I: A History of Instructional Media, *Educational Technology Research and Development*, [e-journal] vol. 49, no. 1, p.53, Available Online: <https://doi.org/10.1007/BF02504506>.
- Richey, R. C. (2008). Reflections on the 2008 AECT Definitions of the Field, *TechTrends*, vol. 52, no. 1, pp.24–25.
- Rodríguez, P., Nussbaum, M. & Dombrovskaja, L. (2012). ICT for Education: A Conceptual Framework for the Sustainable Adoption of Technology-Enhanced Learning Environments in Schools, *Technology, Pedagogy and Education*, vol. 21, no. 3, pp.291–315.
- Rohaani, E. J., Taconis, R. & Jochems, W. M. G. (2008). Reviewing the Relations between Teachers' Knowledge and Pupils' Attitude in the Field of Primary Technology Education, *International Journal of Technology and Design Education*, vol. 20, no. 1, pp.15–26.
- Rohaani, E. J., Taconis, R. & Jochems, W. M. G. (2012). Analysing Teacher Knowledge for Technology Education in Primary Schools, *International Journal of Technology and Design Education*, vol. 22, no. 3, pp.271–280.
- Rudnicka, J. (2019). Ist an Ihrer Schule in Allen Klassen- Und Fachräumen Ein Zugang Zu Schnellem Internet Und WLAN Verfügbar?, Available Online: <https://de.statista.com/statistik/daten/studie/1004594/umfrage/umfrage-zur-verfuegbarkeit-von-schnellem-internet-und-wlan-in-klassenzimmern/> [Accessed 20 May 2021].
- Rudnicka, J. (2020a). Anteil Der Lehrkräfte Ab 50 Jahren an Allgemeinbildenden Schulen in Deutschland Im Schuljahr 2019/2020 Nach Schulart, Available Online: <https://de.statista.com/statistik/daten/studie/1129961/umfrage/anteil-der-lehrerinnen-ab-50-jahren-nach-schulart/> [Accessed 20 May 2021].
- Rudnicka, J. (2020b). Anzahl Der Allgemeinbildenden Schulen in Deutschland Im Schuljahr 2019/2020 Nach Schulart, Available Online: <https://de.statista.com/statistik/daten/studie/235954/umfrage/allgemeinbildende-schulen-in-deutschland-nach-schulart/#:~:text=Die Statistik zeigt die Anzahl,in Deutschland 32.332 allgemeinbildende Schulen> [Accessed 23 May 2021].
- Rudnicka, J. (2021). Bildungsausgaben Je Schüler Für Öffentliche Schulen Nach Bundesländern 2019, Available Online: <https://de.statista.com/statistik/daten/studie/155241/umfrage/ausgaben-fuer-oeffentliche-schulen-je-schueler/> [Accessed 16 May 2021].
- Salavati, S. (2016). Use of Digital Technologies in Education : The Complexity of Teachers' Everyday Practice.
- Schacter, J. (1999). The Impact of Education Technology on Student Achievement: What the Most Current Research Has to Say, *Milken Exchange of Education Technology*, pp.1–13.
- Shashaani, L. (1997). Gender Differences in Computer Attitudes and Use among College Students, *Journal of Educational Computing Research*, vol. 16, no. 1, pp.37–51.

- Soman, D. (2001). The Mental Accounting of Sunk Time Costs: Why Time Is Not like Money, *Journal of Behavioral Decision Making*, vol. 14, no. 3, pp.169–185.
- Spiteri, M. & Chang Rundgren, S. N. (2020). Literature Review on the Factors Affecting Primary Teachers' Use of Digital Technology, *Technology, Knowledge and Learning*, vol. 25, no. 1, pp.115–128.
- Statista Research Department. (2020a). Anteil Der Weiblichen Lehrkräfte an Allgemeinbildenden Schulen in Deutschland Im Schuljahr 2019/2020 Nach Schulart, Available Online: <https://de.statista.com/statistik/daten/studie/1129852/umfrage/frauenanteil-unter-den-lehrkraeften-in-deutschland-nach-schulart/> [Accessed 20 May 2021].
- Statista Research Department. (2020b). Anzahl Der Lehrkräfte an Allgemeinbildenden Schulen in Deutschland Im Schuljahr 2019/2020 Nach Altersgruppen, Available Online: <https://de.statista.com/statistik/daten/studie/1129928/umfrage/lehrerinnen-in-deutschland-nach-altersgruppen/> [Accessed 15 May 2021].
- Stenbacka, C. (2001). Qualitative Research Requires Quality Concepts of Its Own, *Management Decision*, [e-journal] vol. 39, no. 7, pp.551–556, Available Online: <https://doi.org/10.1108/EUM0000000005801>.
- Tenzer, F. (2021). Anteil Der Haushalte in Deutschland Mit Internetzugang von 2002 Bis 2020, Available Online: <https://de.statista.com/statistik/daten/studie/153257/umfrage/haushalte-mit-internetzugang-in-deutschland-seit-2002/> [Accessed 20 May 2021].
- Teräs, M., Suoranta, J., Teräs, H. & Curcher, M. (2020). Post-Covid-19 Education and Education Technology 'Solutionism': A Seller's Market, *Postdigital Science and Education*, vol. 2, no. 3, pp.863–878.
- Thaler, R. (1980). Toward a Positive Theory of Consumer Choice, *Journal of Economic Behavior & Organization*, [e-journal] vol. 1, no. 1, pp.39–60, Available Online: <https://www.sciencedirect.com/science/article/pii/0167268180900517>.
- Tognazzini, B. (2005). Why Engineers Own User Experience Design, *Interactions*, [e-journal] vol. 12, no. 3, pp.32–34, Available Online: <https://doi.org/10.1145/1060189.1060212>.
- Tondeur, J., Forkosh-Baruch, A., Prestridge, S., Albion, P. & Edirisinghe, S. (2016). Responding to Challenges in Teacher Professional Development for ICT Integration in Education, *Educational Technology & Society*, [e-journal] vol. 19, no. 3, pp.110–120, Available Online: <https://www.jstor.org/stable/jeductechsoci.19.3.110>.
- Trust, T. & Whalen, J. (2020). Should Teachers Be Trained in Emergency Remote Teaching? Lessons Learned from the COVID-19 Pandemic, *Journal of Technology and Teacher Education*, [e-journal] vol. 28, no. 2, pp.189–199, Available Online: <https://www.learntechlib.org/p/215995>.
- UNESCO. (2011). UNESCO ICT Competency Framework for Teachers, Available Online: <https://iite.unesco.org/publications/3214694/> [Accessed 23 May 2021].

- UNESCO. (2020). COVID-19 Impact on Education, Available Online: <https://en.unesco.org/covid19/educationresponse> [Accessed 17 April 2020].
- van Braak, J., Tondeur, J. & Valcke, M. (2004). Explaining Different Types of Computer Use among Primary School Teachers, *European Journal of Psychology of Education*, [e-journal] vol. 19, no. 4, p.407, Available Online: <https://doi.org/10.1007/BF03173218>.
- Van Braak, J., Tondeur, J. & Valcke, M. (2004). Explaining Different Types of Computer Use among Primary School Teachers, *European Journal of Psychology of Education*, vol. 19, no. 4, pp.407–422.
- Venkatesh, V. & Davis, F. D. (1996). A Model of the Antecedents of Perceived Ease of Use : Development and Test \*, *Decision Sciences*, [e-journal] vol. 27, no. 3, pp.451–481, Available Online: <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1540-5915.1996.tb00860.x>.
- Venkatesh, V., Morris, M. G., Davis, G. B. & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View, *MIS Quarterly*, [e-journal] vol. 27, no. 3, pp.425–478, Available Online: <http://www.jstor.org/stable/30036540>.
- Vladova, G., Ullrich, A., Bender, B. & Gronau, N. (2021). Students' Acceptance of Technology-Mediated Teaching – How It Was Influenced During the COVID-19 Pandemic in 2020: A Study From Germany, *Frontiers in Psychology*, [e-journal] vol. 12, p.69, Available Online: <https://www.frontiersin.org/article/10.3389/fpsyg.2021.636086> .
- Wang, J. & Keil, M. (2007). A Meta-Analysis Comparing the Sunk Cost Effect for IT and Non-IT Projects, *Information Resources Management Journal (IRMJ)*, vol. 20, no. 3, pp.1–18.
- Wartella, E., Huston, A. C., Rideout, V. & Robb, M. (2009). Studying Media Effects on Children: Improving Methods and Measures, *American Behavioral Scientist*, vol. 52, no. 8, pp.1111–1114.
- Wartella, E., Schomburg, R., Lauricella, A., Robb, M. B. & Flynn, R. M. (2010). Technology In the Lives of Teachers and Classrooms: Survey of Early Childhood Teachers and Childcare Providers, 2010, Fred Rogers Center for Early Learning and Children's Media.
- Weiser, M. (1993). Hot Topics-Ubiquitous Computing, *Computer*, vol. 26, no. 10, pp.71–72.
- Welch, F. (1975). Human Capital Theory: Education, Discrimination, and Life Cycles, *The American Economic Review*, vol. 65, no. 2, pp.63–73.
- Weller, M. (2018). Twenty Years of Edtech, *Educause Review Online*, [e-journal] vol. 53, no. 4, pp.34–48, Available Online: <https://er.educause.edu/articles/2018/7/twenty-years-of-edtech>.
- Williams, D., Coles, L., Wilson, K., Richardson, A. & Tuson, J. (2002). Teachers and ICT: Current Use and Future Needs, *British Journal of Educational Technology*, vol. 31, pp.307–320.