

How Videoconferencing and its Affordances Transformed Teaching in Schools During COVID-19 Pandemic

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Abstract

The COVID-19 pandemic has brought about major changes in digitization in many areas of life and professions. New areas were digitized almost overnight, the school system in Germany was no exception leading to a demand for videoconferencing tools and communication platforms. These technologies have many different functionalities that need to be discovered, explored, and exploited by the user. Given the disruptive events that the COVID pandemic brought to us, this paper aims to shed light on how the dynamics of discovery, exploration, and exploitation unfolds. We use a functional affordance theory perspective to analyze and understand how user learn to use new technologies. To do this, we conducted an exploratory case-study-based research design including interviews with teachers from various schools to analyze how they appropriate new technologies to develop an explanatory theoretical model.

Keywords: Videoconferencing, affordance theory, schools, covid-19.

1. Introduction

The COVID-19 pandemic changed many areas of life and professions through digitization. In addition to the technical equipment, the way in which users acquire technologies also plays a decisive role in their ultimate use. Schools in general (Pettersson, 2021; Spitzer & Musslick, 2021), but in specific in Germany, are often a negative example of digitization (Ikeda, 2020). The introduction of technologies for teaching purposes is a complicated process (Pettersson, 2021), and teaching adheres still to a traditional model of mainly frontal teaching while using blackboards and paper-based exercises. The reasons for this are often seen as a lack of financial resources, a lack of a didactic concept, but often lack of willingness to engage with technologies (Pettersson, 2021).

However, the COVID-19 pandemic has changed as a disruptive event the way schools teach virtually overnight (Cao et al., 2020). In a very short time,

distance learning and homeschooling were introduced (Spitzer & Musslick, 2021). Videoconferencing tools such as Microsoft Teams gained enormous importance to enable exchange between teachers and students (Kaplan-Rakowski, 2020) and were utilized “overnight” for mapping the entirety of teaching, learning processes, and organizational matters (Sanz-Labrador et al., 2021).

Video conferencing tools as rather complex information systems (Tennant et al., 2014) have many different functionalities that need to be discovered, explored, and exploited by the user (Schmitz et al., 2016). Nonetheless, theory lacks the important understanding how of these dynamics in discovery, exploration, and exploitation unfold, especially given the disruptive events that the COVID pandemic brought to us.

We consider a functional affordance theory perspective (Markus & Silver, 2008; Norman, 1988) can help us to analyze and understand how user appropriate new technologies. Affordance theory discloses the perception of inherent values and meanings of certain things in the environment to possible actions available to an organism. Affordances are inherent properties of an IT artifact that suggest possible features which can be utilized by users. In our case, we analyze Microsoft Teams (we use TEAMS as a shortcut throughout the paper) as an exemplary video conferencing tool and which inherent properties impact how teachers decide to use it.

Thus, the goal of our study is to analyze how videoconferencing affordances unfold within a teacher-centric perspective. Therefore, we analyze in our study the integration of TEAMS in German schools. To do this, we conducted an exploratory case-study-based research design including interviews with teachers to analyze how they appropriate new technologies. The guiding research question (RQ) for our study is as follows:

RQ: How do videoconferencing and team collaboration affordances in the COVID-19 pandemic unfold and impacted German schools teaching and work organization?

With our research, we expect to provide answers to our overall research question as well as a more detailed understanding of technology appropriation through affordances when considering the exogenous shock of the COVID-19 pandemic. Our paper is organized as follows. First, we provide an overview of the theoretical background. Next, we shed light on the overall case we investigate. Afterwards, we present our emergent findings. Finally, we discuss implications, limitations, and future research.

2. Related Work and Theoretical Foundations

2.1 Videoconferencing and Virtual Team Collaboration during COVID-19

While both video conferencing systems and the concept of virtual team collaboration are nothing new (Sanz-Labrador et al., 2021). However, both have gained enormous importance in recent years due to the COVID-19 pandemic (Kaplan-Rakowski, 2020). Our social and work lives abruptly changed due to lockdowns or social distancing (Waizenegger et al., 2020). For the first time, many people were required to work from home and had to face many social and technical challenges almost daily (Engzell et al., 2021). Collaboration technologies and especially online videoconferencing systems have become the standard in many areas, which previously did not even remotely consider relying on any online tools. One such example resides in the domain of public education (Wang et al., 2022). Within the K-12 education systems, while there have been considerable advances in applying digital learning curriculum in selected schools, up until the pandemic there have still been only limited progress in digitalizing schools at large (Petry et al., 2021).

During the COVID-19 pandemic, work environments had to change and adapt, naturally affecting the way people worked, but also how they approached the use of technologies (Bartsch et al., 2021; Borup et al., 2012). This results in various challenges regarding communications, home space negotiations, separation of work and life, and wellbeing (Marabelli et al., 2021; Waizenegger et al., 2020). In these situations, individuals typically only have very limited time and resources to plan and prepare for the new situation, further complicated by new challenges of proper mental preparations (Walker et al., 2020). The result of this rapid adaption was mockup workspaces at home in kitchens, living rooms, and/or the sharing of the workspace with other family members (Waizenegger et al., 2020).

Initiated by the external stressors of the pandemic, the new emerging work situation impacts work-related communication and vice versa (Bartsch et al., 2021). Not only internal and external communication now takes place exclusively online, but also team collaboration or school lessons. For instance, if a company's management is well prepared for the pandemic by implementing technical solutions, Kellner et. al (Kellner et al., 2021) show that employees tend to communicate more often than before the pandemic. As companies had little time to prepare the virtual work environment, the change means that new ways of working must be discovered rapidly, with some buffer for experimentation and necessary phase of trial and error, while considering various forms of resource restrictions (Sanz-Labrador et al., 2021; Waizenegger et al., 2020).

Interestingly, while struggling with the pandemic and constantly being subject to various decisions to change their work mode, sometimes without a week's notice, the K-12 public education system's schools have embraced new technologies in a much more sustainable fashion than one might have expected.

This paper focuses on studying the extreme conditions, which German schools faced during the last two years of the pandemic. Initially, teachers in Germany were left with a transition period of only three days to shift from traditional classrooms to digital classrooms. The theoretical lens of affordances is key to understanding how individuals and the K-12 school system overcame and embraced its technological challenges and started to employ technologies creatively.

2.2 Functional Affordances Theory

To understand the emerging effects and utilization of our IT artifact under investigation, we use an affordance perspective. Affordances with their roots in ecological psychology link the perception of inherent values and meanings of certain things in the environment to possible actions available to an organism (Benbunan-Fich, 2019; Şahin et al., 2007). When considering the impact of affordances on technology, Norman's (1988) work was groundbreaking for understanding human-computer interaction and for explaining how affordances influence the use of IT artifacts (Norman, 1999). According to the original notion of Norman (1988), affordances are certain properties of an IT artifact that manifest through design decisions (e.g., the user interface design of a video conferencing software), that in turn suggest possible features which could be utilized by users. This rather techno-centric interpretation neglects the original organism-environment relationship of affordances and rather

emphasizes the designed-in affordances of technology (Benbunan-Fich, 2019) that typically relate to the spirit of a technology (DeSanctis et al., 2008; Markus & Silver, 2008).

We utilize affordance theory for our case study video conferences in schools during the COVID-19 pandemic because analyzing the affordances of a single technology is particularly useful for providing rich information to describe an emergent technology-in-use (Benbunan-Fich, 2019; Lindberg et al., 2014). Today, the affordance concept is also widely used in IS research (cf. the following reviews concerning an overview of the affordance concept in IS research: Pozzi et al. (2014), Stendal et al. (2016) and Wang et al. (2022) has also been proven to provide a useful lens for analyzing team collaboration in the COVID-19 pandemic (Waizenegger et al., 2020).

In the IS discipline, the concept of functional affordances emerged through the proposition by Markus and Silver (2008) to generate generalizable insights concerning the IT artifact under investigation. By also considering how IT artifacts not only enable actions of users but also actively shape IT outcomes as individual “actors” (Markus & Silver, 2008), explanations for the evolving and dynamic developments in complex environments such as the school systems can be found. Functional affordances are defined as “the possibilities for goal-oriented action afforded to specified user groups by technical objects” (Markus & Silver, 2008, p. 622). This definition highlights the concept of the technical object, i.e., in our case a video conference tool, as it relates to the IT artifact and its components including the user interface, while also taking into account the goals and actions of specific user groups, i.e., in our case teachers at schools. Referring to such user groups, functional affordances and the action possibilities they offer may vary depending on how the user group perceives the values and norms of the technical object.

These communicated values and norms are also described as symbolic expressions (Markus & Silver, 2008) that are related to a technical object.

3. Research Context

To understand the findings of this study, we contextualize our research in the historical evolution of the COVID-19 pandemic against the backdrop how schools in Germany coped with the events. In this context, it is important to delineate that the German school system is governed by the partly sovereign federated states, nonetheless the overall the afterwards described evolutionary timeline is nearly applicable to all federated states. Figure 1 illustrates the timeline of the evolution and highlight the significant events that shape the focus of this study.

The German education system (K-12) has long been criticized for its unrealized potential of digitization (Petry et al., 2021). In 2018, the OECD surveyed schools worldwide to determine whether an online learning support platform is available. Germany is in the bottom quarter here and far below the OECD average (Ikeda, 2020). Before COVID-19, teaching took mainly place with traditional, frontal teaching approaches, such as utilizing blackboards in presence classes. In addition, there were worksheets and tasks to work on either alone or in groups. The use of technology was sporadic, mostly such as replacing the traditional blackboard with a smartboard or smart TV.

The first COVID-19 case was detected in Germany on January 27, 2020. However, widespread impact on schools and school closings were often seen as just an extension of the holidays (such as the easter holidays). For the expected transition period, teachers prepared work plans, which they either sent digitally by mail or paper-based by post. However, in the high school graduating classes, the written high school exams were scheduled 6 days after the school closings. Suggestions such as rescheduling, canceling the exams

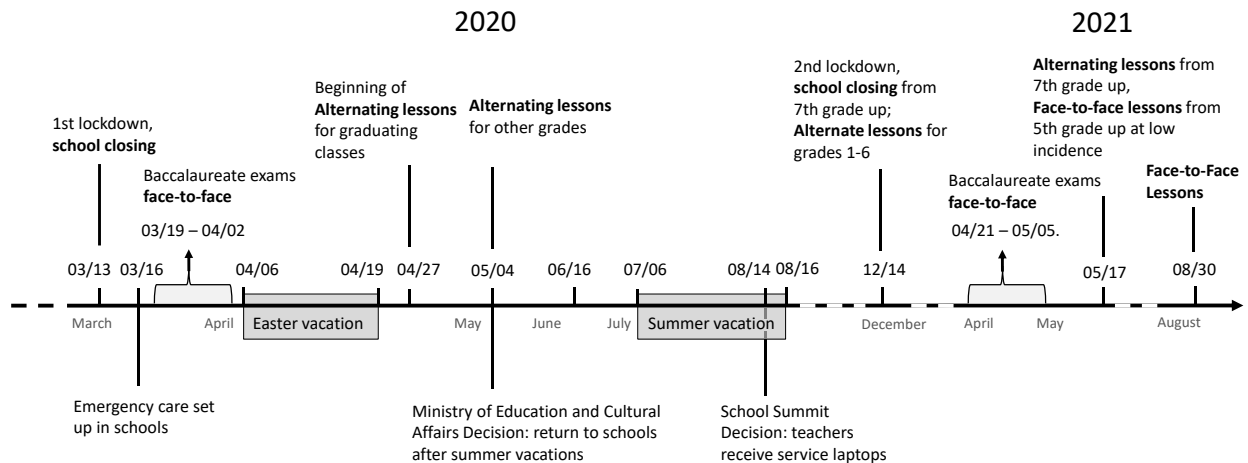


Fig. 1 Timeline of the Evolution of COVID-19 in German Schools

without replacement, or an alternate form were rejected. The exams were written under the observance of a hygiene concept.

The two-week Easter break led to great uncertainty and further discussions about school closures. Distance learning was mandated to last longer than anyone initially expected. At the end of the Easter holidays, it was announced that distance learning will continue. The pandemic was gaining momentum and contact restrictions are coming up in Germany. Teachers began to try out technologies and find ways to map their lessons in an online scenario. While before the Easter holiday tasks were sent out to be worked on at home and checked by teachers, video conferencing gained interest. Virtual face-to-face contact and interaction helped teachers and students to stay connected.

Beginning April 27, classes were divided in half and taught in a daily rotation at school, while the other group worked on assignments at home during that time. Therefore, teachers were increasingly concerned with possible technologies and how they can best be used for teaching. The second lockdown does not hit schools nearly as hard or unexpectedly as the first. Schools were using videoconferencing for face-to-face instruction with students.

To date, there have been no further area-wide school closures at German schools. In isolated cases, individual school classes were sent into quarantine or isolated schools are temporarily closed. In these cases, teachers used increasingly video conferencing tools to integrate students.

However, compared to the pre-COVID-19 era, there have been tremendous changes in the schools. The technical equipment in the schools is significantly better, teachers mostly have a service laptop or tablets, and teaching material is available digitally. Video conferencing tools and their inherent functionalities such as data storage, chat functions, the possibility to create a continuous digital script remain an integral part of face-to-face teaching.

4. Research Approach and Methods

We used an exploratory case-study-based research design (Yin, 2018) as an overall approach for studying the case. We interpreted and structured the interview analysis in light of both contextual factors and prior theorizing to develop our theoretical model (Ozanne et al., 1992).

4.1 Research Procedures and Data Sources

We analyzed the work context and perception of German schools using technologies during the COVID-19 pandemic. To be more precise, we

investigated how teachers use technologies to conduct their lessons and how they unfold new ideas to improve the distance learning setting.

The primary data source contains of 15 semi-structured interviews to understand the socio-technological context of technology use in German schools (see Table 1) and data access provided by the federal government. The interviews lasted 55 minutes (min=42 minutes; max=01:10 hours) on average and were conducted in person or virtual via ZOOM due to the COVID-19 pandemic collected between October 2022 and December 2022. We interviewed teachers from six different schools. Subsequently, the interviews have been transcribed verbatim, coded, and analyzed by using the analysis software QCAmap.

Tab. 1 Demographics and Descriptive Results of Participants

ID	Gender	Age	Working Experience (years)	Interview Duration (hours)
1	w	25	1,5	00:58
2	w	46	17	00:49
3	m	35	7	01:03
4	m	32	5	01:02
5	w	36	10	00:50
6	m	36	13	00:53
7	m	56	24	00:49
8	w	47	15	00:59
9	m	54	19	00:44
10	m	54	19	00:54
11	m	57	17	01:05
12	w	35	7	00:42
13	m	54	20	00:54
14	m	53	19	00:59
15	m	49	17	01:10

Since we aim to provide an unbiased data basis, we interviewed participants who view the focal phenomena from diverse perspectives, such as experienced teachers, novice teachers and school administrators. Thus, we select respondents who differ regarding the duration of working experience and technical affinity. Our closeness to teachers bears the risk of sticking to their view and not reaching the required abstraction level for theorizing afterwards (Gioia et al., 2013). We balance this trade-off by assigning two roles: A so-called insider who is very close to the data, conducted the interviews and was instrumental in the data analysis. With the exception of three interviews, the interviews were conducted by one person who was also involved in the evaluation. This person afterwards informed the other role - the outsider - which in our case were two people who were not actively involved in the data collection and analysis of the data. Gioia (2013) recommends the

outsider to keep distance, question interpretations of the insider that seemed too trivial and leverage his experience as a researcher to try to get on the bottom of the data interpretations. Overall, in this way, we ensured a theoretical and abstract perspective while trying to discover a theory that attempts to explain the appropriation of new functionalities in technologies.

A semi-structured interview guide was used for the interviews. Consists of a demographic survey that collects information from the participants, questions about the delivery of instruction before COVID-19, the transition of instruction through the first lockdown, the technologies used, and how instruction has changed over the COVID-19 period. There is a large focus on eliciting what technologies were used, how the selection of those technologies came about, and how such technologies were appropriated.

4.2 Observations and Additional Data

In addition to gathering the interviews, we monitored the German media coverage of COVID-19 in general as well as the impact on schools. There were constantly new regulations regarding privacy concerns of used technologies. To understand the impact of the appropriation and use of technology on the school, we accompanied periodic exchanges with responsible ministry participants for schools. We used this data (see Figure 1) to consider teachers' context and challenges during our analysis. For example, prohibitions on certain technologies have a direct impact on instructional adaptation and can inhibit the re-selection of a new (replacing) technology.

4.3 Analytical Approach

We apply the approach of Gioia et al. (2013) to analyze our qualitative data. In the first iteration, we use an inductive approach to analyze first-order codes. A myriad of terms, codes, and concepts emerged in the analysis process within the first analysis. We reduced the initial number of codes to a manageable amount by relating them to overarching concepts. To do so we look for similarities and relations among our codes. We tied the focus on concepts and relationships emerging from our interview data and the ministry exchange. Gioia et al. (2013) describe the first-order concepts as vaguely specified terms that capture the grasp of the underlying properties of an investigated phenomenon. In a second step, we followed an iterative process aggregating the second-order constructs into second-order themes which explain the qualitative observed phenomena. We used the second-order themes to aggregate them into overarching dimensions. The approach of forming first-order and second-order structures initially, which are brought

into an aggregated form allows a deep insight into the data structure and makes the subsequent theory development transparent. Thus, we provide a presentation of our process from raw data to terms and themes in conducting the analysis.

5. Emergent Findings

This study investigates how schools explore and apply video conferencing and collaboration platforms during the COVID-19 pandemic. How teacher appropriate new technologies and strategies to adapt non-digital courses was pivotal in understanding the events we observed. We outline our data structure in Figure 2 which was used to develop a theoretical model of structures and concepts that emerged from the data. The first row shows first-order categories, which summarizes the findings using the informant's point of view. Based on the first-order categories, the concepts within the ovals represent second-order categories and theoretical themes. The second-order analytical categories and themes culminate in six overarching dimensions. Phrases in the boxes on the left and right sides of the figure show the first-order categories (terms adequate at the level of meaning of the informants); the concepts contained in the ovals show the assembly of these first-order concepts into second-order analytical/theoretical themes; and the four boxes in the center show the overarching dimensions that emerged from the analysis.

The data structure represents a rather static view of the investigated phenomena. However, it is the dynamic evolution and mapping of change over the course of the COVID-19 pandemic that is fascinating to demonstrate how technology appropriation occurred and how new affordances emerged. Therefore, we analyze our data with a temporal lens and illustrate the temporal view on the evolutions in Figure 3.

5.1 Pre-COVID-19

The most important theme in our interviews and the data structure is the discovery of new functionalities in TEAMS and using them in the teaching-learning context. Before the COVID-19 pandemic German schools use technologies sporadically in lessons. Most of the teaching happen via frontal instruction on the blackboard. Thus, teachers rarely come into contact with technologies up to this point. Teaching material is mainly paper-based and developed by the teacher herself or himself. There is less knowledge and teaching material exchange. Statements such as "I didn't even think about using technologies" (interviewee 1) or "We had no idea how we could use technologies in a meaningful way"

(interviewee 2) illustrate the low relevance of technologies. The lessons on the blackboard are combined pre-COVID-19 with group work and the processing of tasks.

Our interview participants report time-consuming consultation processes within the school and outside the school with parents. If there are agreements or decisions in which all teachers are involved, inquiries and agreements often lead to long feedback times due to complicated processes, which are often paper based.

5.2 First Lockdown

The first lockdown changes conducting lessons overnight which encountered resistance from many teachers. As is the case worldwide, there is uncertainty in Germany as to whether this is only a transitional phase or whether COVID-19 will have long-term effects. First, the focus in class is on completing and submitting assignments that are made available to students in advance. Teaching is mainly carried out through self-study and the completion of assignments. This results in asynchronous communication way which makes it hard to communicate with students and parents. Teachers often hardly know if students have difficulties in completing assignments or even do not complete assignments on their own. It takes a long time to receive replies to letters or emails. Since the first lockdown comes up three weeks before Easter

vacation, the closure of schools is often seen as only a transitional period. *"I didn't think it would go this long and didn't bother to learn possible technologies"*¹ (interviewee 4) talk about the need to invest time in instructional adjustment. *"And I know that not all of my colleagues did it because they said *Nope, I'm not going to learn a new system*"* (interviewee 15). Instead, tasks are sent to students either by mail or even paper-based by post. The time needed to get to know new technologies was seen as a burden and the time was rather invested in preparing asynchrony teaching material – *"so I would have double work with lesson preparation"* (interviewee 7).

Towards the end of the first lockdown and the ongoing pandemic teachers increasingly engage with new technologies. The reasons differ from personal reasons such as *"The personal contact was missing a little bit, that's why we had a video conference so that we could at least see each other or talk to each other"* (interviewee 8) to didactic reasons *"I hardly reached the students, and I did not even know where there were problems with the tasks or even if the tasks were done independently"* (interviewee 10).

For the actual appropriation of TEAMS affordances, different mechanisms arise depending on the technical equipment and the expertise on possible technologies at schools. At schools that already used technologies sporadically or have a certain infrastructure (consisting of financial resources,

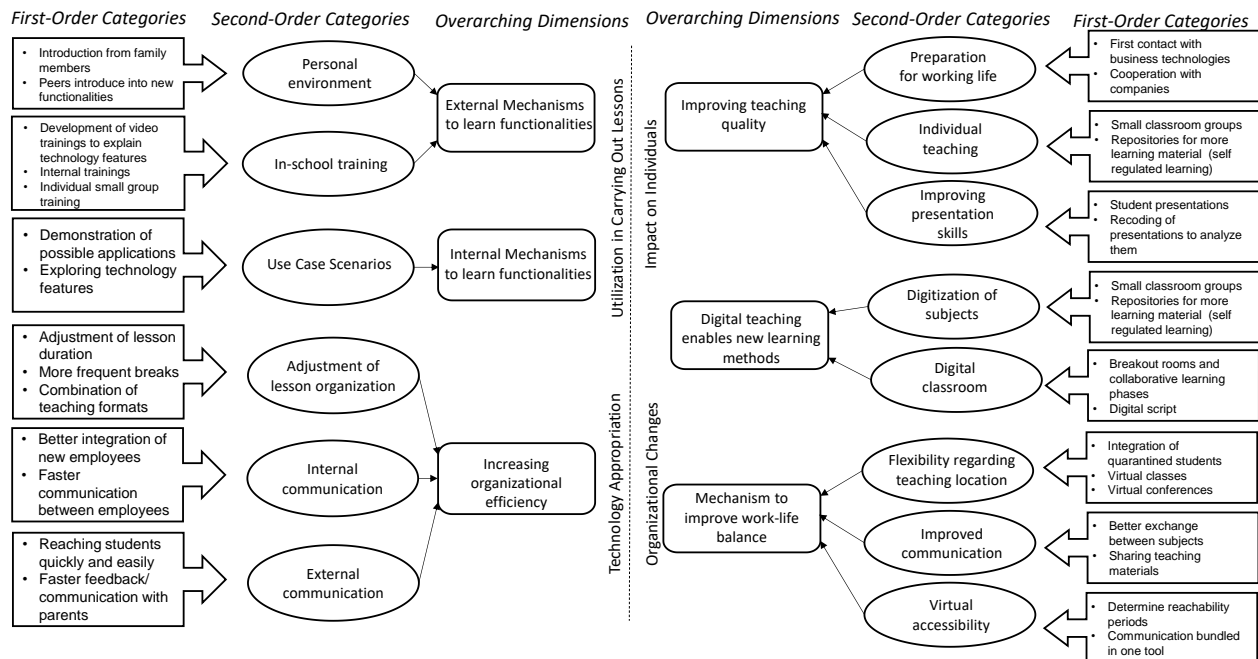


Fig. 2 Data Structure

¹ All quotes were translated from German to English.

hardware, software, and the associated software licenses), the school-wide roll-out occurs in a short time, mostly around two weeks. In these schools, technology appropriation is driven by the school as an organization top-down approach to the individual user, i.e., teachers. Thus, oftentimes an expert team develops video training to explain the technology features and share the videos with their colleagues. The expert team emerges through a combination of technical affinity teachers or teachers who have experience with videoconferencing tools or collaboration platforms. Thus, individual small groups emerge for exploitation of the new technology and provide idea exchange for the implementation of the technology in lessons. Statements such as *"Then a biology teacher told me how he conducts experiments virtually, and I used the knowledge to conduct experiments in my chemistry class as well,"* (interviewee 2) demonstrate the dynamic that arises through the exchange among teachers. This contrasts with the schools that have not specified TEAMS of their own accord. Here, technology appropriation at some schools is primarily driven by the private environment to compensate for the lack of instruction input. *"My husband also used TEAMS in his job and then I knew he already knew his way around here and had some functions shown to me"* (interviewee 3). These teachers learn technology features by an introduction from family members who are better accustomed to novel technology. They often spend time together in their free time looking at the technology and trying out functionalities. This can be the husband/wife, friends, acquaintances, or the children.

While very little teaching material is available digitally before COVID-19, the first lockdown leads to teaching material being extensively digitized. This simplifies the digital distribution of the material. Digital resources are shared with each other and cooperation and peer support increase enormously. Teachers talk about how they started giving each other digitized materials and tips for delivering digital lessons. *"We suddenly exchanged ideas not only within the school but also beyond the school [...] because we were all in the same boat and we were just overwhelmed"* (interviewee 10). Presumably due to the exceptional situation, silos within the departments break down, and communication increases.

5.3 Second Lockdown

After the schools were reopened during summer 2020, the interest in spending time on appropriating new technologies decreased. Many teachers went to old habits and conducted lessons similar to pre-COVID-19. Others, however, have sporadically

continued to implement new digital teaching ways. For example, interviewee 5 reported that he now continues to replace blackboard writing with a digital script to save time and it allows students to learn with more comprehensive material.

However, a lockdown occurred again in the winter of 2020 with the consequence of school closures. At the beginning of the second lockdown, teachers become increasingly concerned with the use of technology in the classroom. While assignment distribution is now digital, TEAMS are becoming established in our interviewed schools. In particular, TEAMS is used for exchanges and interactions and provides a tool to improve the reachability and communication with students. We observed that the teachers initially try to reproduce the lessons one-to-one via TEAMS but realize that adjustments are necessary. For example, to circumvent concentration difficulties, the duration of frontal instruction is often interrupted, and breakout rooms are used for group assignments (interviewee 9). As a result, teachers experience the functionalities, on the one hand, previous tasks are digitally mapped in a similar way, but also completely new possibilities, such as the recording and analysis of presentations, are carried out that were not seen pre-COVID (interviewee 9).

After a while, TEAMS is being used for much more than just conducting video conferences. The more teachers try out new technologies, the newer creative approaches emerge. This is partly due to the mechanisms of appropriation with the help of the personal environment or through the exchange within the school. For example, mobile devices with appropriate software are used as musical instruments in music lessons, or physics experiments are conducted virtually. *"A whole new set of possibilities come up to conduct lessons and impart knowledge"* reports a music teacher (interviewee 14). Users are discovering new functionalities that help them to conduct lessons digitally. In addition to the possibility of digitally storing files, an automatically generated attendance list is used (interviewee 12, interviewee 15), or collaborative work is done in small groups through breakout rooms (interviewee 10).

5.4 Back to School

To date (and the submission of this paper in June 2022), there have been no further area-wide school closures in Germany. Accordingly, the use of TEAMS for pure videoconferencing to replace synchronous lectures in all schools will remain absent for the time being. However, isolated schools report the use of TEAMS to allow quarantined or sick students to

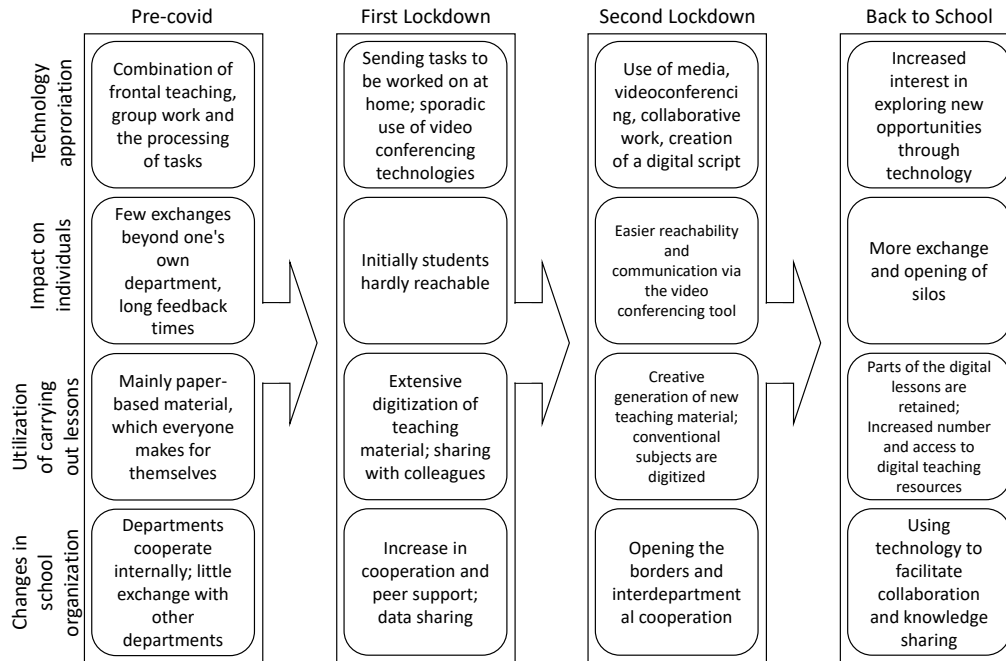


Fig. 3 Key Dynamics in Affordance Actualization

participate in class. Nevertheless, our interviewees do not want to give up the use of TEAMS in the classroom and beyond.

Thus, the benefits of TEAMS have been established, which in turn has improved the willingness to explore new technologies. *“So many things now run better and, above all, faster [...] I can now invest all the time I save elsewhere. Even if the changeover was really time-consuming at first.”* (interviewee 3). Interviewees who were skeptical at the beginning of the TEAMS and were reluctant to engage with the technology, especially in the first lockdown, reflect positively on the changeover in retrospect: *“Without the pandemic, the digital transformation and digitization would not have progressed nearly as quickly”* (interviewee 15).

The participants interviewed reported improvements and benefits from using TEAMS. Notably, there were significantly more interactions and exchanges across silos, enabling learning from each other and increasing cohesion. *“In the end, the students also benefited from this exchange, because the exchange of best practice leads to the desire to try it out for oneself”* (interviewee 8). *“You are happy when you can tell others about new successes [...] I divided my English class into small groups and integrate speaking practices in English for 30 minutes in each small group, which made me realize that the students could speak so much better when we got back to school. This would never have been possible in the large group individually.”* (interviewee 8). Such

experiences have now been adapted from digital into practice.

6. Discussion and Implications

Our study has several important findings. First, our study highlights how disruptive events like the COVID-19 pandemic enforced digitalization of organizations, in our case complete systems like the K-12 system in Germany. By focusing on a teacher-centric perspective, we shed light on how a given user groups appropriates given affordances when being confronted with an exogenous force and how this group certainly adapts. Thus, our findings provide a nuanced view on aspects such as overcoming task-technology misfits through appropriation when considering longer periods of time (Fuller & Dennis, 2009) and the affordances of complex information systems.

6.1 Implications for Theory and Practice

Our study results contribute to the body of knowledge concerning the understanding of technology appropriation. In essence, these aspects also contribute to the more in-depth understanding of how affordances unfold over time when considering the case of complex information systems. By researching the case of German K-12 schools, we also enrich affordance theory by considering how affordance actualization is fostered by the individual but also through formal and informal group actions and processes.

Our study has practical contributions that can help to support the introduction and embedding of technologies in (German) schools. Our interviews provide insights regarding the discovery of new affordances by teachers over time. We show, how teachers appropriate new technologies largely on their own initiative. These unique insights of our case study allow us to derive practical conclusions to support schools. The data show how teachers gradually acquire new functionalities of the technology. Starting with one functionality and using it repeatedly, the technology is explored more and more. In this process, internal sharing within a school, as well as external sharing across schools, has enormous importance for technology appropriation. Communication about best-practices and the recognition of new implementation opportunities leads teachers to further explore technology. These insights can have practical application in introducing new technologies to schools by first introducing some of the technology and successively enabling the possibility of exploring further use cases.

Initially, TEAMS was introduced as a videoconferencing system, but eventually many other functionalities, such as shared storage for filing files, chat as a communication medium, collaborative editing, and creation of documents, and many more have been solidified in schools. Our study illustrates the importance of communication about technology on the discovery of new functions and thus the establishment of a technology. The more teachers communicated with each other and across schools the more functionalities were discovered.

As a practical conclusion, schools should place significantly more emphasis on communicating about technologies and sharing knowledge with each other (Engzell et al., 2021). Space and time should be made available for this, such as small group workshops, discussion groups, or the formation of expert teams. Input in the form of best practices or the outlining of application scenarios can help to break down the complexity of a new, unknown technology and make it possible to get started. Once users are familiar with the technology and willing to explore new things, more and more new affordances will emerge.

This paper extends the body of knowledge on *affordance of TEAMS and provides novel* insights into the appropriation mechanisms of digital transformation in public schools.

6.2 Limitations and Future Research

We acknowledge several limitations to this study that then underline a demand for future research. The study is limited to the investigation of investigating technology appropriation in one country, we might be

limiting the transferability of our findings. Even if Germany scores poorly in a global comparison of the digitization of schools, the practical findings may not be transferable to other countries without adjustments. We believe, however, that both the specific findings and especially the theoretical model are applicable to many similar cases, not only in schools but also in companies.

A qualitative study has its advantages and disadvantages, while we had the opportunity to provide a deep, unique insight into technology adoption through the study selection, qualitative data needs to be analyzed extensively. By including three researchers and following Gioia et al. (2013) guidelines, we tried to control for these limitations as best we could. Nevertheless, further studies using quantitative data can support our findings due testing our findings through hypotheses.

A limitation of this research is that many participants were new to digital teaching. The majority of the test subjects have been teaching for many years and are very used to non-digital teaching. These years of experience also play a role in technology adoption. Therefore, future research should expand the sample of participants to include young teachers as well. In addition, participants were under a particular stress situation at the time of the survey, as well as during the pandemic. There is already research (Cao et al., 2020; Engzell et al., 2021; Waizenegger et al., 2020). on the psychological effects of the COVID-19 pandemic, which should be put into relation with our results in future research.

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