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Bridging Digital Inequalities in Rural Schools in Germany: A Geographical Lottery?

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Abstract: Repeatedly, it has been argued that advancements in digitalisation could be beneficial for rural areas. However, digital inequalities persist and affect rural communities as well. Schools can play a key role in bridging digital inequalities, but little attention has been paid to the specific conditions rural schools find themselves in when facing continuous digital developments. Therefore, we apply the digital inclusion lens and explore the impact of digital developments on rural schools in the German context. In 2019, we conducted 16 in-depth interviews with heads and teachers from rural elementary and secondary schools in Baden-Wurttemberg and Lower Saxony. We found that smaller rural schools especially can experience difficulties and conclude that the contribution of schools to a digital-included society is subject to a geographical lottery. This could eventually increase existing rural–urban digital inequalities and these findings are also relevant in light of the COVID-19 pandemic, forcing a sudden switch to distance learning.

Keywords: rural schools; digital inclusion; small schools; digital developments; digital literacy; ICT equipment

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1. Introduction

Digital developments present new opportunities as well as challenges for rural communities. For example, information and communication technologies (ICT) can assist in rediscovering rural working locations or facilitate home-schooling, but can also increase competition for small and medium-sized enterprises (SMEs) [1]. In order to enable rural citizens to harvest new opportunities and face the challenges a digital society brings about, existing rural–urban digital inequalities should be addressed. Often, rural areas in Europe are still disadvantaged regarding the internet connectivity at place and these differences will not be imminently removed [2,3]. Which rural areas are better connected can be the result of a geographical lottery [3]. In terms of internet usage, Blank et al. (2018) show that demographic variables (primarily age and education) play a crucial role in rural–urban differences. These demographic differences result in geographical differences since elderly people and less educated individuals tend to be overrepresented in rural areas [4]. Still, in 2017/2018, the difference in internet usage was prevailing between German rural and urban areas. Digital competence is mentioned to be on average better in urban areas and people living in urban areas in Germany have been shown to be more open towards new digital developments. Furthermore, the usage is more diverse in urban areas and people living in rural areas tend to use them less often [5]. However, on a note of caution, internet usage rates are not to be equated with the actual level of digital literacy.

Since the level of education can have an impact on digital inequalities, the integration of ICT equipment and digital literacy training in schools is an important topic. The problems and possible solutions have been widely and internationally discussed in literature (e.g., [6]).

Yet, studies are lacking on how rural schools are particularly affected and deal with digital developments in the European context. Since rural areas are often slower in adopting

digital developments as explained previously, we argue that it is of special interest to take a closer look at rural schools. Therefore, we pose the following research question: How do schools cope with continuous digital developments, and what is their role in bridging digital inequalities in a rural context?

By undertaking in-depth interviews in the two German federal states of Baden-Wuerttemberg and Lower Saxony, we provide a broad picture of experiences made in rural primary and secondary schools. According to the ICILS (International Computer and Information Literacy Study) of 2018, we already know that there is room for improvement regarding ICT equipment in German schools [7]. This finding agrees with another study showing that German heads of schools often experience the integration of ICT equipment at their schools as insufficient both in terms of connectivity and pedagogy [8].

Suiting the research question, we selected the concept of digital inclusion to be applied throughout this study, with special regard to ICT equipment and digital literacy levels. To ensure a broad perspective on the influencing factors of digital school developments, the interview questions addressed the role of teachers, pupils and responsible public institutions alike. Furthermore, we directly addressed the technical equipment and digital literacy training in the interview questions. We found that smaller schools especially struggle to keep pace. Since these are mainly found in less populated areas, this insight is of relevance for other countries with similar geographical circumstances and educational challenges. Often, the interviewees perceive to be left alone in the implementation and are overwhelmed by the pace of digital developments. As rural schools can already experience extra pressure, for example, due to declining pupil numbers and teacher shortages, taking time for the integration of ICT equipment can be even more challenging.

Moreover, the COVID-19 pandemic has led to temporary school closures around the globe since the beginning of 2020. To compensate for cancelled classes, online schooling was often used as an alternative. However, this has posed an explicit risk for people with insufficient internet connectivity or digital devices [9,10]. In Germany, the differences in ICT equipment and digital literacy training among schools, as discussed in this paper, have become very visible since March 2020. While some schools have online platforms available and teachers are partly already used to these, others struggle more with offering teaching online or teachers had to simply provide material analogously by mail or similar means [11]. These recent developments demonstrate once more how important it is to bridge digital inequalities in schools and beyond. Even though our data collection took place before the lockdown-related home-schooling upturn, we believe that our paper will contribute to furthering the debate on rural digital education that will most likely follow.

The paper is structured as follows: Section 2 gives an overview of relatable literature and the theoretical framework applied. Section 3 describes the applied methodology and, in Section 4, the main interview results are presented. Section 5 provides the discussion, and finally, conclusions and recommendations are drawn in Section 6.

2. Literature Review and Introduction of Theoretical Framework

Academic work on all things 'digital' is characterized by a rich blend of concepts and terms. Some of these terms are field-specific, whereas others are more policy-specific. To prevent confusion over different terms, we will first provide some clarity on the terms we will use, and what these terms broadly refer to. In this study, we use the term digital developments (e.g., [12]) to refer to societal development related to digitalisation that takes place outside the influence sphere of individual citizens. We prefer digital developments over digitalisation as it underlines that it is subject to constant and fast changes. Other authors use the term digital transformation (e.g., [13]), but transformation implies a particular end-stage that can be reached. We think that, in the context of schools, the more perpetual term of digital developments is more suitable. We use digital literacy to refer to the features of individual citizens that help them to make effective use of digital developments and tools. How digital literacy and digital inclusion are related and the definition of these two terms is presented in Section 2.3.

Furthermore, we speak of ICT equipment to refer to materials that are needed to conduct digital activities. When doing so, we stress the technical perspective of it, including both internet connectivity and digital devices (hardware) in schools. When needed for clarity, we will specifically differentiate between the two.

2.1. The Role of Rural Schools

Since we focus in this study on rural schools, the potential role of schools in a rural context is to be examined first. It is argued in the literature that schools can have an important role in the local economy [14,15]. Furthermore, as meeting places are often scarce in rural areas, schools can also serve as places to socialize [16–18]. Despite their potential positive impact, many rural areas are threatened by or already experiencing school closures due to shrinking pupil numbers [19]. A study on small rural schools in Sweden found that while there is no indication that the education differs in quality, these are more likely to be closed as the expenditures per pupil are higher. It is also argued that local government bodies are left with the challenges rural schools can cause and suggests that ICT solutions should be considered as an alternative for school closings [20]. Indeed, distance education can be seen as an opportunity for rural areas [21] and this became suddenly very prominent during COVID-19 school closures around the world. Thus, ICT equipment can also offer opportunities for schools located in rural areas. In Germany, a close network of schools exist. Almost all primary and secondary schools of first grade are accessible by bike, showing that there is a dense network of schools in Germany that also serves rural areas [22]. However, in these rural areas, schools face closures or mergers [23], which potentially creates bigger distances. We argue that this results in additional pressure on remaining rural schools. Another particular issue for rural schools can be the attraction and retention of teachers [24].

Furthermore, while teaching practices are advancing, a study by Goodpaster et al. (2012) shows that adapting teaching practices can be more difficult in rural areas due to insulation effects [25]. We are therefore interested in whether this is also the case for digital literacy training. While digital developments have the potential to improve education in rural areas, for example, by making elective subjects digitally available [26], little is known about recent ICT equipment and digital literacy training in rural schools. We have found a few studies indicating there can be differences between urban and rural schools in that regard. Sundeen and Sundeen (2013) pointed out that many rural school districts in the US are found to be disadvantaged with respect to funding for ICT equipment; therefore, they can partly depend on alternative funding possibilities [27]. In this context, they discuss economies of scale playing a role for schools as well, for example, that bigger schools can find themselves in a better negotiation position due to the scope of ICT equipment orders (see also [28]). This fits to a study from Canada finding that rural schools are often in a weaker financial position and that digital literacy training options for teachers are better in urban settings. As a result, rural schools can have worse ICT equipment and less educational software available for use in various subjects than their urban counterparts [29]. Although a lack of equipment and training was identified in rural schools in Ohio, rural teachers nonetheless responded positively to the usage of ICT in education [30]. Focusing on pupils in rural areas, a study conducted in the UK reveals that pupils located in rural areas are not necessarily enthusiastic about using the internet, with some even experiencing cultural exclusion by using it. For example, being online reminded them of their distance from certain locations or like-minded people [31].

However, on a note of caution, one should be careful with generalizing and comparing rural school contexts. The challenges they are facing can be unique [27], and also Raggl (2015) shows the plurality of small rural schools existing in Austria and Switzerland [32].

As Tieken (2014) states, rural schools are often overlooked by education research [18]. This study, therefore, explores how rural schools cope with digital developments and contribute to a digitally included society. In the next chapter, we give an overview of how digital developments influence school education.

2.2. Digital Developments in Schools—Changing Teaching Practices and Digital Inequalities

In today's information society, the workforce is increasingly asked to be flexible and adaptive. To prepare pupils accordingly, changing teaching practices in favour of student-centred learning is being discussed in the field of education [33]. Gudjons and Traub (2016) argue that digital developments are also supporting these structural changes in education. To this end, teachers are increasingly seen as instructors, moderators and partners. However, the researchers also claim that this demands enhanced media competence on the part of pupils, including a critical approach as well as ethical knowledge [34]. Biesta (2013) argues that education should take an active role in confronting the changes posed by our globally networked society. A reactionary approach is possible, but a responsible approach is recommended [35].

While digital developments are finding their way into the daily lives of pupils and the classroom, this does not necessarily mean that schools are prepared to handle them. A review of digital education policies in the EU finds that although the availability of ICT equipment has progressed, digital literacy training is still to be improved. So far, this is very dependent on individual teachers [36] and the school contexts [37]. In comparison to other countries, secondary school teachers in Germany have been shown to be positioned below average regarding the attitude towards using ICT in the classroom and also in their confidence in executing various computer tasks, as well as the frequency of their own ICT usage [6]. A recent study conducted during the COVID-19 crisis demonstrates that one can also not expect early career teachers to have advanced digital skills [38]. Furthermore, the risk exists that ICT equipment is just used for the sake of technology without exploring its full potential, for example, to meet a range of different pupil needs [39]. This fits the finding of Dolan (2016), who points out that digital inequality exists among schools as they differ in their style of ICT usage. Pupils are either taught to use ICT equipment passively, as consumers, or as active users who are encouraged to create content [40]. However, it is not only schools and teachers that are affecting the usage and, subsequently, digital literacy training. While the notion has evolved that youngsters of today are growing up as digital natives, Wilkin et al. (2017) showed that young people partly still have problems accessing and using the internet. This stresses the role of schools, which are responsible for both showing pupils how to use ICT equipment cautiously while also teaching them economically valuable skills such as coding [41]. The usage among children may also differ depending on their socioeconomic status (SES). Lebens, Graff and Mayer (2009) observe that German pupils from disadvantaged socioeconomic families tend to show reservations towards computers, although they acknowledged their importance. This holds even if they have IT as a subject in school. This, the authors argue, could be since children of deprived families have fewer opportunities to interact with digital devices at home [42].

If schools then fail to teach adequate skills, this knowledge gap can impact the development of pupils' economic, academic and health statuses [43]. In sum, Dolan (2016) notes that digital inequalities in schools are shifting from 'have' and 'have nots' to 'can' and 'cannots' [40].

2.3. Digital Inclusion Framework

In this study, we focus on bridging digital inequalities and therefore introduce the concept of digital inclusion here. While digital inclusion can be defined in different ways [44], we take over the definition by Helsper (2014): "Digital Inclusion is defined [...] as an individual's effective and sustainable engagement with Information and Communication Technologies (ICT) in ways that allow full participation in society in terms of economic, social, cultural, civic and personal well-being." For digital inclusion, access to ICT and digital literacy are important building blocks, next to motivation and awareness, engagement and content [45]. Therefore, by asking to what extent ICT equipment is available, used and digital literacy trained in rural schools, we also explore the role of rural schools in fostering digital inclusion. As noted earlier, we use ICT equipment when speaking of both available internet connectivity and digital devices.

To prevent misunderstandings, we also provide a short definition of digital literacy here. Martin and Grudziecki (2006) describe digital literacy as going beyond digital competences and skills [46]; therefore, in this article, we also make use of the term digital literacy to cover a broader spectrum. Meyers et al. (2013) consider technological skills, critical thinking and being able to relate things to their context as part of digital literacy. They also stress that the definition can change rapidly since developments in this field are fast, and that digital literacy should be built on traditional literacies [47]. Secker (2018) states as well that digital literacy is a widely used term, but acknowledges that other terms such as digital skills and computer literacy are used, also by governments. She argues as well that the term 'skills' is less encompassing as it also does not cover critical thinking as literacy does [48]. Based on her digital literacy model, we define digital literacy as containing computer literacy and functional skills, but also ethics and e-safety as well as critical thinking and search skills. Furthermore, we acknowledge that digital literacy is overlapping with information literacy, media literacy and new literacies (entails multimodal learning).

In the next chapter, we give a closer overview of the educational landscape in Germany and the current status of ICT equipment, usage and digital literacy training.

2.4. Situation in Germany

In Germany, the education system falls under the purview of the federal states [49]. The Federal Republic of Germany, however, has recognised that public schools need support regarding ICT equipment. Although the federal states are normally responsible for education, a law was recently passed to enable this support in the form of the so-called 'Digitalpakt' for all schools in the country. Altogether, five billion euros were provided [50].

In terms of digital literacy, the 'Secretariat of the Standing Conference of the Ministers of Education and Cultural Affairs of the Länder in the Federal Republic of Germany' (Kultusministerkonferenz) has formulated the aim that pupils in Germany should at least acquire the following "competences in the digital world": (1) searching, processing and storing; (2) communicating and cooperating; (3) producing and presenting; (4) protecting and operating safely; (5) problem solving and acting; and (6) analysing and reflecting. The states are now responsible for ensuring that these are covered for every pupil starting elementary or secondary school in the school year 2018–19 [51]. Our review of the policy documents of the federal states of Lower Saxony and Baden-Wuerttemberg shows that these competences are mainly integrated into media literacy frameworks, alongside treating information technology (IT) as a separate subject. These frameworks are then incorporated into the curricula [52,53]. Furthermore, although the federal states are responsible for education, the Federal Republic and the federal states of Germany have passed a law to enable central financial support to all schools in Germany for ICT equipment and teaching [50].

Since our research focuses on the two federal states of Baden-Wuerttemberg and Lower Saxony, we will briefly introduce their strategies with regards to digital literacy training and ICT equipment. For this, we mainly draw on two documents: "Medienkompetenz in Niedersachsen Ziellinie 2020" [53] and "Konzeptpapier zur Umsetzung der Digitalisierungsstrategie von Baden-Wuerttemberg im Schulbereich" [52]. The policy document from Niedersachsen is the more extensive of the two since it also covers other educational areas related to media literacy. However, a comparison of the strategies of these two federal states shows that they are very similar: both promise to provide information opportunities for schools, for example, by providing legal advice or material for lessons. In general, the school authorities, i.e., mainly the municipalities, are responsible for equipping schools with ICT. In both states, schools need to produce media development plans. If needed, they can obtain state support for these. Furthermore, teachers should have training opportunities and media literacy is integrated into the curricula. In Lower Saxony, a learning platform is offered. In Baden-Wuerttemberg, a similar platform is being developed. The policy paper of Niedersachsen additionally mentions that the secondary schools will work towards the

"Bring Your Own Device" (BYOD) concept and that, furthermore, informational events are planned for parents. Additional support possibilities are indicated, such as homepage support. To date, in both the states considered, IT is not yet a mandatory subject [54,55].

As shown in this chapter, in the German educational landscape, the terms media literacy and digital competences are used. However, as discussed in Section 2.3, media literacy is overlapping with digital literacy and we therefore assume that we have a similar understanding of what digital literacy entails when discussing it with interviewees. Furthermore, interviewees were given the floor to clarify definitions and understandings.

2.5. Research Approach

We argue that it is important to better understand how rural schools (could) play a role in dealing with, and making effective use of, digital developments. Schools in Germany have been shown to face difficulties with integrating ICT equipment. Knowing that, we explore how particular rural schools face these developments, and subsequently, their role in fostering digital inclusion. The methodology to do so is described in the next chapter.

3. Materials and Methods

3.1. Sampling Approach

To grasp experiences on the work floor and in everyday school life, in-depth interviews were conducted. In order to acquire both depth and diversity, we studied two different federal states—one in the north of Germany (Lower Saxony) and one in the south (Baden-Wuerttemberg). These federal states both had an average score for ICT equipment and support among all the federal states [56]. In doing so, we aimed to select two representative states rather than a random selection [57] (p. 82). This approach was also noted by the National Research Council, arguing that, with geographical dependent data, random sampling is not necessarily the best approach [58] (p. 55). Within these two federal states, the counties characterized as 'predominantly rural' were determined with the help of the 'Landatlas'. The 'Landatlas' was provided by the 'Johann Heinrich von Thünen-Institut' [59].

As the next step, schools within these rural counties were identified using a list of schools ('Schulliste.eu' [60]) and online information provided by municipalities and counties. The grade of rurality was double-checked using GoogleMaps and from the number of inhabitants in each school's municipality. Schools located in larger towns and cities, with a population exceeding roughly 20,000 inhabitants, were subsequently excluded. Elementary and secondary schools were included in this approach. However, grammar schools were excluded since they are mostly located in larger towns and cities. Before the interviews took place, research permission was sought from the responsible state organisations. Furthermore, this research followed the university's ethical code of conduct. For instance, interviewees were guaranteed anonymity and data from the interviews has been stored safely to prevent undesired access to sensible information.

Subsequently, schools from the identified rural counties were systematically contacted. All heads of the respective schools were approached by email during spring and summer 2019. In total, this resulted in 16 semi-structured in-depth interviews of about one hour. After these, data saturation was experienced. An interview guideline was prepared and sent in advance if requested. This covered the following topics: the state and usage of ICT equipment, attitudes and (prior) knowledge of teachers and pupils, digital literacy training and support from the government. By doing so, we built on the main building blocks influencing the uptake of digital developments in schools as identified in international literature. All question were thereby formulated to be very open and we pre-tested them with a teacher from an elementary school.

3.2. Analysing the Data and Introduction of the Interviewees

The recorded and transcribed data were evaluated using Atlas.ti software. Thematic and analytical coding was applied to the transcribed interviews [61]. The initial codes were

developed by both researchers, yet the coding process in Atlas.ti was conducted mainly by the first author. The initial coding started with overarching thematic codes, coding the material directly related to the main questions. Based on that, subcategories were identified and some of these were, at a later stage, merged to one subcategory when they were too fragmented (see Table 1). Subsequently, new arising topics and recurring themes were identified and links between thematic codes were established (analytical coding). The codes can be found in Table 2.

Table 1. Initial codes and subcategories (deductive).

Technical Equipment	- Internet: internet connection/broadband, WIFI - General approach: BYOD, computer room, open computer meeting points, donations/self-help - Devices: docucam, whiteboards, touchscreens, beamer, laptops/tablets - External support - Software - Networks - Security - Choice of offers - Attractiveness of location
Role of the Teacher	- Attributes: age of teachers - Positioning: attitude, knowledge/interests of teachers, effort - Competences: advanced training, multimedia consultant, network administrator, usage, maintenance - Cooperation with other schools
Digital Literacy Training Pupils	- Approach: methods plan, media development concept, guidelines - Content for pupils: informatics subject, online research, MS office programs, critical approach - Cyber-crime related - Additional education/training - Cooperation regarding content
Existing Knowledge and Digital Media Consumption Pupils	- Overconsumption and misuse - (Differences in) prior knowledge - Differences in equipment - Knowledge related to devices (PC vs. tablet/smartphone) - Cyber mobbing
Government Support	- Resources: lack of staff/maintenance, available resources municipality, continuous support, 'Digitalpakt' - Content input government: material offered by state, curriculum, platforms (e.g., ELLA) - Monitoring
General Situation/Summary	- General impression digitalisation of schools - Reformations (e.g., closings) - Renovations

Table 2. Emerging themes and new topics addressed (inductive)

Emerging Themes	- (Missing) practical implications - Additional work vs. relief - Challenge of speed of development - Concerns about overconsumption and misuse - Lack of resources and surplus of offers
New Topics Addressed	- (Role and digital literacy level of) parents - Small school issue - Headmaster approach

Furthermore, we checked the wider context of the schools by using the 'Breitbandatlas' provided by the Federal Ministry of Transport and Digital Infrastructure [62].

Most of the interviewees were headteachers, although in some instances the interviewer was forwarded to a teacher with a special role related to the school's ICT equipment. In two instances in Baden-Wuerttemberg, two people participated in the interviews as shown in Table 3. Tables 3 and 4 give overviews of the gender, role and school type of the interviewees in Baden-Wuerttemberg and Lower Saxony, respectively. In total, 16 interviews with 18 interviewees took place.

Table 3. Interviewees in Baden-Wuerttemberg.

Identifier	School Form	Characteristics Interviewee
A	Elementary school	Male, head, multimedia consultant
B	Elementary school	Female, head
C	Elementary school	Female, head
D	Secondary school, combined with an elementary school	1. Male, head 2. Male, teacher, network administrator
E	Elementary school	Female, head
F	Secondary school, combined with an elementary school	Male, head, network and multimedia consultant
H	Secondary school, combined with an elementary school	Female, teacher, network administrator
I	Secondary school, combined with an elementary school	1. Male, teacher, multimedia consultant 2. Male, teacher
J	Secondary school, combined with an elementary school	Male, head, multimedia consultant

Table 4. Interviewees in Lower Saxony.

Identifier	School Form	Characteristics Interviewee
G	Elementary school	Female, head
K	Elementary school	Male, teacher, responsible for ICT equipment
L	Elementary school	Male, head
M	Secondary school	Male, teacher, in part-time also working as pedagogical media consultant for the federal state
N	Secondary school, combined with an elementary school	Female, teacher, responsible for ICT equipment
O	Secondary school	Male, head, previously responsible for ICT equipment
P	Secondary school	Male, head

4. Results

4.1. ICT Equipment: Differences in Internet Connectivity and Devices in Use

Most of the interviewees were waiting for better internet connectivity, either through wireless local area network (WLAN) installations or general local area network (LAN) connections. A few reported that they had recently been adequately equipped. Two schools only had a slow internet connection and WLAN in the teacher/head's room, and one specifically complained about the poor internet connectivity in the surrounding area. Furthermore, poor mobile internet was mentioned by two schools. Especially in rural areas, it seems to be more difficult to acquire a faster internet connection. At least, that is the perception of some interviewees.

> *"[. . .] therefore, we would also simply need faster internet connectivity here in the countryside, the availability of a glass fibre cable would be great"* I.

It is interesting to note that, based on the 'Breitbandatlas', the speed of the internet connectivity available did indeed vary a lot. Naturally, one also needs to take the number of pupils into account since if more pupils want to make use of the available connection at the same time, higher speeds are needed to make uninterrupted usage possible. Table 5 shows that schools with higher pupil numbers did not necessarily have better connectivity. Moreover, one can recognise a few times a clear 'misfit' between the internet connection available according to the 'Breitbandatlas' and the equipment described by the interviewees. Schools C, I, K and P all reported some deficiencies, for example, insufficient internet connectivity or WLAN coverage, whereas the atlas indicated that they should have at least 400 MBits available.

Table 5. Available broadband connectivity at participating schools.

School	Scope (According to Homepages or Specified during Interviews)	Internet Connectivity (Based on Breitbandatlas 29 May 2019) (These Maximum Speeds Have to be Shared over Several Digital Devices)
A	80 to 114 pupils in recent years, around 8 teachers	6 Mbits connectivity
B	58 pupils, 5 teachers	up to 400 Mbits possible
C	69 pupils	up to 400 MBits possible
D	670 pupils (elementary and secondary together), 85 teachers	50 MBits connectivity
E	148 pupils, 15 teachers	6 MBits guaranteed, more possible
F	592 pupils (with elementary), 36 teachers	up to 50 Mbits possible
G	66 pupils, 4 teachers	up to 30 Mbits possible
H	450 pupils, 40 teachers (elementary and secondary)	up to 50 Mbits possible
I	194 pupils, 18 teachers (elementary and secondary)	up to 400 MBits possible
J	270 pupils, 30 teachers (elementary and secondary)	up to 50 MBbits possible
K	286 pupils, 26 teachers	up to 400 Mbits possible
L	140 pupils, 10 teachers	no direct data, local houses have up to 50 Mbits available
M	357 pupils, 42 teachers	up to 200 Mbits possible
N	355 pupils, 34 teachers	30 MBits guaranteed, more possible
O	400 pupils, 44 teachers	No direct data, local houses have up to 50 MBits available
P	450 pupils, 29 teachers	up to 1 GBit possible

The digital devices available at the schools varied. Some teachers had projectors available, some a media trolley, digital whiteboards or smartboards. Many mentioned having document cameras as well, while a few did not have any of such supportive devices available. For the pupils, some had laptops available and occasionally tablets were reported. The secondary schools especially made use of computer rooms. The number of devices for the pupils also varied. Some had enough for one class, some had only a few for an entire class.

> *"We have two computer rooms, each equipped with 16 PCs [personal computers] for the pupils; we still have ten laptops on top of that for pupils to be used and for natural science subjects, we have again 17 laptops; this is more than many other schools have available"* H.

It was mentioned several times that multi-purpose or meeting rooms for pupils also offered access to PCs. Only one school made use of the BYOD approach while, at some other schools, teachers allowed the use of smartphones in class. This shows that not all the secondary schools in Lower Saxony have adopted the BYOD policy introduced by the federal state.

Despite all the schools being publicly funded, some even received equipment through donations or self-installations. A few also obtained help from former pupils, parents or other contacts.

4.2. The Teacher Perspective: Missing Competences, Extra Effort and Speed of Development Hindering the Usage of ICT Equipment

4.2.1. Dependence on Individual Teachers and Priorities of Heads

The interviewees stated several times that the usage of ICT equipment was very dependent on the knowledge, interests and willingness of the respective teacher. In other words, staff used and taught the programmes, devices or tools that they knew well and were convinced about, if any. It was also addressed that the age of a teacher can play a substantial role, as older teachers often struggle more to make use of digital equipment in class.

Several of the interviewed heads mentioned their role in the process of bringing ICT equipment and subsequently digital development within their school forward. They take an active role, often have a specific interest in digital developments and make use of that knowledge.

> *"Regarding my background, I have always already been connected to computers in school; I am also network consultant, multimedia consultant, I am really connected to these topics; I followed now also the training called advanced course IT."* F.

4.2.2. Additional Work vs. Relief

The interviews showed that the usage of ICT in class can still be contradictory for teachers. On the one hand, it can cause additional work, for example, because a teacher first needs to prepare devices before usage or because of the vulnerability of devices used by pupils in class. The ongoing digital development requires additional effort that consumes working time, for example, due to the necessity to write plans or arrange the respective projects with all stakeholders.

> *"Of course one gets support from the county media centre and such, but it is really a bureaucratic effort too, that is not to be neglected as if it were just a walk in the park, to equip a school and then also of course to work with the staff on it [. . .] My 45-h week was previously already full and now. . . this all adds to it."* E.

On the other hand, it was stressed that ICT equipment can offer new opportunities and work relief. On several occasions, the interviewees commented that they selected devices or software based on their ease of use. Furthermore, they gave examples of how, for example, new feedback or reflection possibilities are created using digital devices during the lessons. According to the interviewees, discovering the extra benefits also played a crucial role in the adoption of digital devices by teachers. It was also mentioned that teachers not using digital devices had yet to discover their advantages.

Some also stressed the added value brought by the meaningful use of digital devices to the lesson itself, and not just for the teacher. If used the right way, a more individual approach can be achieved, while many still let their pupils use the internet for research purposes only. As such, the potential of ICT equipment in class has still to be fully exploited.

4.2.3. Speed of Development and Attractiveness of Schools

Especially in the secondary schools in Baden-Wuerttemberg, it was pointed out that the speed of digital development can prove to be challenging, along with long negotiation or acquisition processes. Accompanying security or legal concerns were also mentioned. The interviewee from school J reported that schools were falling behind recent digital developments, and school F expressed the view that one cannot expect teachers to be permanently up-to-date with these.

At the same time, a few interviewees saw their ICT equipment as adding to the attractiveness of the school.

> *"[the school authority] also shares the view that we have to stay attractive as a school and that one part of this attractiveness indeed stems from being equipped with digital media [devices]."* D.

The interviewee from the small school C indicated that they were already concerned about a decline in pupil numbers and that they struggled with insufficient ICT equipment, and related this, among other factors, to the limited attractiveness of the school.

4.3. Pupils and Parents: Differences in Digital Literacy and Concerns about the Usage

4.3.1. Overview of Digital Literacy Training Offered

What is remarkable is how the interviewees perceived the scope of digital literacy. On purpose, we did not directly ask for a definition but asked which digital literacy components are (not) trained in the respective schools. A broad range of topics was discussed throughout the interviews, illustrating how digital literacy is increasingly influencing various domains and topics and intertwining with other literacies. To illustrate this, the interviewees touched on the following topics: (very basic) technical competences (for example, how to switch on a PC or tablet), touch system typing, various software skills, which also includes applying acquired knowledge virtually such as drawing, writing, calculating, working with audio programmes, creating presentations, and image and video editing. Furthermore, media literacy, information literacy (especially how to retrieve information online), privacy, cybercrime, gaming skills and coding/programming were discussed.

The elementary schools in this study mostly provided initial contact with PCs or similar devices, some internet searching, and a part of the pupils were already acquainted with Microsoft (MS) Office. The interviewed secondary schools mostly covered internet research, security issues and MS Office programs. Sometimes, topics beyond these were offered, such as programming or IT (as an elective subject).

Most interviewees said they could cover what was asked for in the curriculum. The exceptions were elementary schools C and L, which did not have sufficient equipment or had no devices for pupils to address everything they should or would like to. Some schools integrated content beyond the required measures, for example, by offering project groups or additional basic training. On several occasions, it was reported that the training covered depended on the teacher. Although the integration of digital literacy training related to different school subjects was under development, many asked for a more encompassing digital literacy training or IT as a mandatory subject, covering, for example, data literacy as shown in the following quote.

> *"In my view, that needs to be a mandatory lesson, which is not yet the case in Lower Saxony. . . yes, and when I do not understand such basic systems, then of course at one point I no longer understand where my data goes and, in my opinion, then we have a problem when talking about such topics like fake news or where data ends up, data security, data protection on the internet"* M.

Many mentioned that they tried to cover threats associated with the internet and similar topics as well, for example, by inviting the police to provide an understanding of cybercrime.

4.3.2. Concerns about Overconsumption and Misuse

Teachers themselves were concerned about the overconsumption and misuse of digital devices. For example, that even pupils in elementary schools were already exposed to excessive periods in front of screens or that they had obtained a smartphone without any guidance or supervision from their parents was a concern.

Furthermore, cyberbullying played a role in secondary schools, and other threats such as game-addiction were discussed, even among elementary schools. As such, teachers were critical about exposing pupils to even more screen time in school and stressed that they tried to raise awareness about it to some extent.

> *"When they [the pupils] tell me about their weekend, they have spent 20 h in front of their machine [digital device], and I do not think they should additionally sit in school the whole time in front of it, even if one uses it of course mainly for learning, because I think that this screen time should not be boosted artificially."* G.

How pupils make use of digital devices was also a reoccurring topic, stressing that many pupils are advanced users of, for example, specific games. At the same time, these pupils often lack digital literacy regarding other usages not related to entertainment.

> *"Sometimes, one is absolutely disappointed about what they cannot do, I think that they are a lot busy in the world wide web but very aimed, playing their games, in the corners of the internet where they feel comfortable and where they do not necessarily learn the competences how to make use of it in a responsible way."* J.

4.3.3. Insufficient Digital Literacy Levels among Parents

Some interviewees were not only concerned about the lack of digital literacy and awareness of possible threats among their pupils, but also with their parents. Here, the relevance of their socioeconomic status was central, and literacies overlapping with digital literacy, namely information and media literacy, were addressed.

> *"At this moment, it is still the case that parents, as well as pupils, believe what they read on the internet, they just take it for granted, "I've read that on the internet". [. . .] when we want to guide pupils in the context of a democratic society to be responsible human beings, who can also make an election decision, then we have to sensitise them to this. . . "* O.

> *". . . the classical approach, where one searches for information on the internet and so on, that [the knowledge] is indeed, as one always says, again better in more educated families than in less educated ones."* B.

Some parents were open and grateful for advice; for example, the interviewed teacher from school K helped some parents to use an email address to make use of a newly introduced lunch registration system. Many teachers also tried to discuss with parents issues such as excessive time spent on digital devices, but it seemed to be difficult to reach the ones targeted.

Additional to the digital literacy differences among families, the interviewees mentioned equipment differences among the pupils' families, meaning that not everyone has equal access to digital devices at home. A few teachers mentioned that financial issues were also an issue when expecting pupils, or rather their parents, to purchase a digital device for use in class.

4.4. Government Support: Lack of Resources and a General Feeling of Abandonment

4.4.1. Main Theme of Limited Financial and Personal Resources

All the interviewees talked about limited resources, both financial and in terms of personnel. It was emphasised that the integration of ICT equipment put additional pressure on, for example, already tight time schedules, as some teachers had to maintain the technical equipment themselves and did not receive sufficient hourly compensation for this. In one interview specifically, it was extensively discussed what a challenge it can be to attract staff at a rural elementary school. Smaller schools especially seemed to struggle with financial and personnel shortcomings:

> *"Especially in the smaller elementary school, where I also often attend, it's really a problem because they are totally overwhelmed by it and get none or only very little support, and maybe twice a month someone comes for two hours and does something. . . "* M.

> *"For us small schools, that will soon no longer be feasible, where one has something like five programs and then, when we only have a budget of €3000 for the whole school year and then [. . .] to pay such a charge for every single program annually, that really adds up"* G.

Many complained that the money for ICT equipment and infrastructure was so far not delivered reliably and that it was often a struggle to get the money needed from the responsible municipalities. Several pointed out that the equipment in schools was therefore very dependent on the financial situation and the priorities of the municipality itself.

> *"In direct comparison actually, the school in the neighbouring town B. already has document cameras and projectors in all their classrooms, so how can their school authority, so to speak, already implement that while our school authority does not even manage to equip one classroom with it; this financial injustice is what also, in principle, damages the education at this specific location"* K.

Although at the time of the interviews, the 'Digitalpakt' had been approved by the federal government and money would be made available soon, the interviewees were very sceptical about it. Since the 'Digitalpakt' is project-based and mainly focused on improving internet connectivity, the interviewees expected that it would not provide a long-term solution to the financial struggles. In the case of schools C and L, at the time of the interviews, the introduction of 'Digitalpakt' had in effect delayed planned investments since the municipalities now wanted to wait for the promised funding. To summarise, digital developments have put additional pressure on already scarce finances, staff and time, and the initiated measures were not seen as sufficient.

4.4.2. Missing Practical Implications and Feelings of Abandonment

Overall, the interviewees particularly wished for more support from the state. Several times, they mentioned that guidelines were missing, for example, regarding the media development plan or the 'Digitalpakt'. Sometimes, it was even directly mentioned that they felt abandoned.

Furthermore, mainly due to the speed of development and the abundance of offers on the market, some found it challenging to make decisions on ICT equipment.

> *"Once, a head from a very small elementary school, who is also a friend of mine, approached me [. . .] she said "I have €20,000 but I have to spend that in one year otherwise the amount expires, what shall I do with that?" [. . .] and I believe this often then leads to inappropriate and panic-fuelled purchases. . . "* I.

Advanced training possibilities for teachers were available but these were also often criticised, specifically, that they were not sufficiently practical or not applicable for individual school solutions. Therefore, the interviewees sometimes suggested a change towards more internal teacher training. Teaching material and convenient platform solutions were lacking, especially in Baden-Wuerttemberg. However, the county media centres, which offer support and material, were highlighted positively. Overall, we would summarise the situation as that our interviewees expressed the need for more practical and school-specific support by the responsible federal authorities. Already existing financial and personal shortcomings were being exacerbated by the demand to integrate digital developments, and small schools are especially struggling.

5. Discussion

Conrads et al. (2017) and Dolan (2016) show that the education sector moved from accessibility divides to usage divides, yet this study demonstrated that substantially differing development stages still exist at German rural schools regarding the ICT equipment [36,40]. Accessibility issues sustain and coexist with usage divides. Additionally, we found that the size of the school does not necessarily correlate with the available speed of the internet connectivity. Some interviewees were dissatisfied with the internet connectivity despite the 'Breitbandatlas' implying that it should be available at high speed on the spot. This could suggest that the infrastructure inside the school buildings is outdated, hindering the exploitation of the potential speeds available.

Another interesting finding from our study is that small schools especially seem to struggle with the integration of ICT equipment in general. These struggles are not necessarily dependent on the available speed of the internet connectivity. A few times, it was mentioned that these are particularly vulnerable to a lack of support possibilities in terms of either financial resources to purchase new ICT equipment or advice to ensure they make reasonable purchases. Since some schools are able to attract pupils based on

the technical equipment they have to offer, such small schools could experience even more pressure in trying to attract sufficient pupil numbers. This fits with the findings of Mårell-Olsson and Bergström (2018), who showed that heads and school organisations can be motivated to increase their ICT integration in an attempt to enhance school ratings [63]. Eventually, small schools could lose out to other, better-equipped schools, fuelling school closings. Such closings are already a threat to many rural areas [19] and this trend towards scaling up can have negative consequences for the residential attractiveness of a rural location [14,15]. This is an important finding from our study since smaller schools tend to be located in less populated areas [64,65]. Especially in such places, meeting spaces and institutions are already scarce [18] and as schools are often seen as the centre of the rural community, losing these could have dramatic effects [16,18]. Furthermore, it can be expected that the sorting out—i.e., parents taking their children to better (equipped) schools—will take place along socioeconomic lines.

Additionally, we find that digital developments caused a feeling of being overwhelmed among our interviewees. Furthermore, the interviewees felt left on their own and they experienced developing and integrating ICT equipment into the classroom as an 'extra effort' on top of a workload that is already quite heavy. Although some took a proactive stance by, for example, mobilizing digital devices via donations (see also [27]) or inviting the police to address misuse, one cannot clearly say that the schools in our sample react rather responsibly, but also responsively [35]. Probably, this is fostered by the fact that the schools in our sample experienced insufficient support from the respective governmental bodies.

Some of the study results match with the findings from earlier research about digital inequalities in schools. Our interviewees pointed out that the usage of ICT equipment and digital literacy training is very much teacher-dependent. Hayes (2007) has already mentioned how crucial the role of the head can be in fostering ICT integration [66]. As many of the interviewees showed a specific interest in digital developments, this leads to questions regarding how schools without such supportive staff are coping. Our research suggests that they struggle even more, with one school having almost no equipment at all, and some interviewees reporting that other schools were struggling. Additionally, our interviewees supported the previous findings that the socioeconomic status of a pupil seems to have a big influence on ICT usage and digital literacy in general (e.g., [42]).

Limited resources were a reoccurring theme during the interviews as well. In accordance with the findings of the Wübbenstiftung (2018) [8], we found that schools generally experience financial and personnel shortcomings, hampering the integration and usage of ICT equipment. As Klemm (2010) notes, German schools experience a shortage of teachers [67]. In addition to that, rural schools can experience extra pressure in attracting and retaining teachers [24]. This can be problematic when it is difficult to attract younger teachers, who were at least by our interviewees often expected to enhance the usage of ICT equipment in class. This could also explain why the interviewees stressed time as a limiting factor. As the integration of new teaching practices requires time, for example, for visiting an additional training session or just to get familiar with a digital device, interviewees mentioned extra effort related to digital developments. We claim that a shortage of staff enhances that. Overall, no interviewee doubts the importance and possible advantages of integrating digital developments in the classroom, although the approaches to achieving this may vary. Still, our findings show that clearly there is an adoption gap by some teachers. We therefore propose that the teacher shortage and the lack of time further inhibits digital developments in schools.

Concerning financial issues, Weishaupt (2016) show that the federal states mainly distribute financial resources based on the scope of a school [68]. As stressed by our interviewees, this contrasts with the differences in the availability of money based on the economic and social circumstances of a local authority. As a consequence, some relatively poorly equipped municipalities are responsible for schools in deprived areas that require extra investment. Wirth et al. (2016) note that especially relatively small

school organisations are struggling, often resulting in the closure or merging of schools [23]. Overall, one cannot speak of equally equipped schools, especially since financial income also depends on the school form [68]. This in part explains the scepticism towards the 'Digitalpakt' expressed by interviewees in this study. All schools, together with the school authorities, can apply for funding, yet the programme is not designed in a way to deal with existing (financial) inequalities.

Finally, our findings also suggest another factor playing a role in hampering the usage of ICT equipment in schools and consequently limit their contribution to digital inclusion. The overconsumption and misuse of digital devices concerns our interviewees. This aligns with the findings of Livingstone and Helsper (2008), presenting that teenagers are exposed to online risks, and although parents try to limit these, they are not necessarily successful in doing so [69]. We find that this can lead to the situation that teachers do not want to expose pupils to more contact with digital devices in school, even though this contradicts the argument that digital literacy training needs to be improved, also for the digital empowerment of children and youth.

6. Conclusions and Recommendations

While some of our findings might not be limited to rural schools, some rural-specific challenges seem to be further exacerbated by efforts to keep ICT equipment and digital literacy training updated.

Rural schools are vital institutions for empowering rural young people in dealing with digital developments. Neglecting (small) rural schools in the broader digital agenda could even increase existing rural–urban (digital) inequalities [4,5].

While there are various contextual differences to be taken into account when looking at rural schools in other European countries, we suggest that it is worth further investigating how far the issues found play a role internationally.

Within the German context, it seems that one-size-fits-all solutions can be problematic, as these neglect the different development stages and capacities of rural schools [27,32]. Since in Germany the municipalities are largely responsible for ICT equipment and maintenance, one could consider providing more support for financially constrained municipalities. The interviewees suggested that support should be offered on a long-term basis to be able to upgrade and maintain equipment, linking to the issue with the speed and continuity of digital developments raised throughout this study. Additionally, offering advanced training tailored to the individual situation of a school and involving all staff members can help teachers to learn about the benefits of using ICT equipment in class. This is specifically a recommendation for education systems in which both ICT equipment and pedagogical concepts are very heterogeneous, such as in federal states such as Germany [70], Belgium [71] and Switzerland [72]. Furthermore, the management of schools could benefit from clear guidelines in which they can position themselves and benchmark their decisions. Legal and data security guidelines seem to be most needed.

Interestingly, and unprompted, the interviewees often mentioned the role of parents and their digital literacy levels. Moreover, the interviewees noted equipment differences regarding digital devices available at home, which probably directly impacted the possibilities of distance learning during the COVID-19 school closures. A lack of digital literacy on the side of the parents can, furthermore, lead to accessibility and knowledge differences among pupils. This shows the importance of digital inclusion efforts in schools, including extensive digital literacy training. Indirectly, the importance of digital literacy training was stressed throughout the interviews as a broad range of topics were addressed when discussing digital literacy training and digital developments in schools. Increasingly, these play a role in other subjects taught and topics addressed in school, showing how it is also intertwined with other literacies and how digital literacy is not a static concept [47]. Based on our observations, we would recommend to further explore training possibilities for parents, and adults in general, to improve their digital literacy and foster awareness of digital developments.

This qualitative study was carried out in two federal states in Germany, both with an average score for the integration of ICT equipment among the federal states. We have provided an initial impression of how digital developments are perceived in rural schools and how teachers deal with them. As a next step, it would be valuable to examine the perceptions of public authorities since we have noted from our interviews that their attitudes and financial capabilities play an important role in the process.

To sum up, our results indicate that both the ICT equipment and digital literacy training in rural schools are very much dependent on luck: pupils depend on their socioeconomic status and on the teachers they encounter throughout their school career, while schools themselves depend on the (financial) support of local authorities, on change-oriented heads and staff, and the deployment of good internet connectivity. Thus, offline circumstances play a very important role, resulting in a geographical lottery [3]. This means that one cannot solely rely on schools to solve digital inequalities among children and adolescents in rural areas. Nevertheless, rural schools could play an important role in fostering digital inclusion. We argue that the differences identified among schools could perpetuate and potentially increase unequal rural development patterns. This should be both a lesson and a warning for countries facing similar educational, urban–rural challenges.

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