British Journal of Educational Studies

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/rbje20

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To cite this article: Sandra Leaton Gray, Jutta Mägdefrau & Martina Riel (2021): LIFE IN THE DIGITAL SLOW LANE: HOW DEPRIVED YOUNG PEOPLE ARE SET UP TO FAIL, British Journal of Educational Studies, DOI: 10.1080/00071005.2021.1919596

To link to this article: https://doi.org/10.1080/00071005.2021.1919596

Published online: 27 Apr 2021.

British Journal of Educational Studies
2021, pp. 1–20

LIFE IN THE DIGITAL SLOW LANE: HOW DEPRIVED YOUNG PEOPLE ARE SET UP TO FAIL

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ABSTRACT: The phenomenon of digital differentiation, or stark variations in ability to access Internet hardware and/or infrastructure, has been a feature of provision since its early days. This article explores the impact of digital differentiation on two groups of young people, in England and Germany. It is based on fieldwork that took place during the academic year 2018-2019, just before the global pandemic threw the issue of equality of Internet access into sharp relief. The article begins by describing the empirical design of the My Life Online project, including background, sampling, instruments, ethical aspects and the initial data analysis approach taken to ensure reliability and validity. It then develops a further analysis drawing on Halford and Savage's hybrid Bourdieu/Actor Network Theory model (2010) to map out the socio-technical network surrounding the young people in our study. In this way we identify areas of change and conflict that compound existing social deprivation. We conclude by making a case for a better education policy awareness of the key issues, and more equitable distribution of national infrastructure moving forwards.

Keywords: algorithm, technology, discrimination, digital identity, learning, time, pandemic

The phenomenon of digital differentiation, or stark variations in ability to access the Internet hardware and/or infrastructure, has been a feature of provision since its early days. This article explores the impact of digital differentiation on two groups of young people, in England and Germany. It is based on fieldwork that took place during the academic year 2018–2019, but since then, the global pandemic has thrown the issue of equality of Internet access into sharp relief.

Until the 2020 Covid-19 pandemic and the associated school closures that took place across numerous countries and regions, schooling was generally seen as taking place in a physical building amongst a clearly delineated age cohort, with associated daily rituals of life and culture marking out the times and spaces in which people learn. These ranged from registration and lesson timetables to lunch queues, school theatrical performances and competitive sports fixtures.

ISSN 0007-1005 (print)/ISSN 1467-8527 (online)

https://doi.org/10.1080/00071005.2021.1919596
http://www.tandfonline.com

However, there are times when these structures and rhythms are disrupted, as we saw during the Covid-19 crisis. Almost overnight, large numbers of schools were forced to convert to an online remote learning model at minimal notice and with minimal additional investment for training or equipment. This conversion provides us with an ongoing example of what has been termed a temporal-spatial shift (Sullivan *et al*., 2016) or time-space distanciation (Giddens, 1990). When such a phenomenon occurs in education, cohorts suddenly become fragmented, with learners being physically separate and learning at different times as well as using different methods. If not managed carefully, educational paths rapidly diverge as students try to access education online in different ways, using the resources they have to hand.

The risks of leaving online access to education to develop in this relatively ad hoc, unplanned way soon became apparent globally, as lockdowns in different countries highlighted numerous problems surrounding equality of access and opportunity that had been predicted earlier by many (Eynon and Geniets, 2012; Fadel *et al*., 2019; Holmes *et al*., 2018; Jarke and Breiter, 2019; Mohammed and Watson, 2019). This article reports what has turned out, with hindsight, to be something of a one-minute-to-midnight study. It mapped the experiences of two groups of young people in England and Germany in the academic year just before the Covid-19 crisis hit, when it was becoming increasingly clear that differential regional investment and training in online education was leading to seriously fragmented access for some groups. It also became apparent that the problem was geographically determined as well as frequently linked to social deprivation, creating new inequalities.

New Barriers to Learning

One of the fundamental inequalities we addressed in the study is concerned with regional infrastructure investment. Many deprived young people in Western Europe live in areas where, even if they have everyday access to a good quality computer or smartphone, inadequate regional telecommunications infrastructure can present a barrier to effective use. If superfast fibre optic broadband is not readily available in an area, or usage heavily capped by providers, and if local mobile phone signals are unreliable, there are going to be limitations to how effectively young people can use telecommunications equipment. This is sometimes attributable to being in a rural area, for example the Zones Blanches ('white zones' without high-speed broadband in most areas) in rural France. However, it is not necessarily just related to a rural/urban divide, as some deprived urban or metropolitan areas have also suffered historically from this problem, for example the British cities of Hull and Aberdeen, the London boroughs of Bethnal Green, Tower Hamlets and Westminster North (Hern, 2015; Johnson, 2016; Office for Communications [OFCOM], 2019), and the German capital city Berlin (Nicholson, 2019). In these areas, there is a notional

time penalty for users as they seek to engage with technology in a fruitful way. Online engagement can take a lot longer and be a lot more difficult and expensive than in better-connected places. Such a barrier may in turn limit educational use amongst young people, if their only access to the Internet outside school is via mobile phone, or via a shared device, which can often be the case (European Commission, 2020).

This problem of differential access and its impact on education is linked to the problem of unhelpful personalisation for young people in certain deprived social groups. Advertisers use technical[1] and behavioural information to determine which type of materials appear to individuals in a personalised media stream, via a process known in the industry as social listening, or psychographics, and in a research context as persuasive technologies. These data, combined with information about personal preferences or 'likes' on social media platforms, potentially influence how users make particular decisions about everything from media consumption to political views (Kosinski *et al*., 2013). As we describe later in this article, the use of such persuasive technologies can potentially make the difference between whether a young person is invited to sign up for a university open day, as opposed to being invited to open an online betting account, to give one example. In these contexts, young people represent a group with minimal agency in terms of influencing their external environment, combined with heavy use of social media platforms, and significant value to advertisers. It is here, in the opaque world of persuasive technologies, that social differences and bias are most prominent.

Affluent areas (indicated by a user's IP address, and cookies tracking the type of Internet connection and browser version in use) means that users are regarded as 'targets' (Turow, 2011) with enhanced access to the infrastructure that facilitates good communication and individual educational improvement, such as cheap high speed broadband, good quality 3G and 4G mobile phone signals, and even in some cases public transport that allows students to build effective personal networks within relatively dense populations and in a relatively time-efficient manner. Typical profiles of group members are linked together in the databases of commercial systems. Those from disadvantaged areas may be classified as 'waste' (Turow, 2011). 'Waste' users must work a lot harder to find the opportunities that are not immediately presented to them.

Schools and colleges frequently encourage proactive behaviour on the part of young people to use their technological devices carefully, with an eye to educational engagement. However educational institutions themselves can suffer from differential resourcing and provision, as well as inherent network design problems, as became clear during the Covid-19 pandemic. This can further compound existing disadvantage for deprived groups. Consequently,

the precise nature of young people's individual online experiences in relation to education cannot be taken for granted.

The next section of the article explains the theoretical framing of our investigation into young people's digital engagement in the context of education, then discussing the research design, and finally aligns the research findings with our theoretical framework. We use the term 'digital literacy' throughout the article in accordance with the American Library Association definition, namely 'the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills' (American Library Association, 2021).

Mapping the Social

Key to understanding the role of technology in the lives of young people is mapping the complex networks of relationships surrounding its use. This article explores the way students engage in multi-layered actions and processes as they navigate life online. Central to our analysis is the idea of technology being an essential aspect of 21st century life and fundamental to daily social relations. Aligning to Bakhtiar's 'third way' view of the role of technology in digital education (2020), we position ourselves as neither technology sceptics nor advocates. Instead, drawing on the work of Halford and Savage (2010), we consider a number of questions in relation to the My Life Online empirical research project:

(1) What happens when such networks are created?
(2) Are there sites of consensus and resistance during network formation?
(3) Are fresh inequalities distinct from established ones within such networks?
(4) Are any established inequalities compounded?
(5) How does this crystallise new forms of social relations?
(6) What differences are there between England and Germany in this respect?

My Life Online – Research Design

Our research took place from 2018–2019, just prior to the Covid-19 pandemic that was about to throw the issue of computer access for education into such sharp relief. It explored the lived experience of high-speed broadband, mobile phone signals and public transport use amongst 15–18 year olds, an age when usage habits are being laid down for adult life. This article focuses on the role of telecommunications infrastructure.

Recruiting Strategy and Samples

Building a sample in the two countries diverged in approach. Data protection rules in the Federal State of Bavaria in Germany, where our study took place, are extremely rigid, and state-maintained schools were not permitted to be involved. This is in contrast to England, where it was at the discretion of the head teacher. Here, the researchers contacted state-maintained schools and colleges systematically in the target areas until they managed to acquire consent from the head teacher. In Germany, participants had to be recruited through personal professional contacts, neighbours, and friends, with attempts made to ensure as good a demographic spread as possible in terms of geography and school type.

The regions chosen varied in terms of population size and distribution, but both suffered from varying broadband provision, as well as pockets of deprivation, measured as being in the bottom 30% using the respective Governments' Indices of Multiple Deprivation[2] at the time of the study. Although some students lived in areas with relatively good broadband speeds and mobile phone signals, download and upload broadband speeds in both areas could be poor in comparison with the local area, in terms of the 50 Mbps or higher which might be required to benefit fully from multimedia online learning, including sharing materials via cloud-based services (Fox and Jones, 2016, p. 10). The two countries have broadly similar GDP and educational outcomes as measured by PISA (Programme for International Student Assessment), TIMSS (Trends in International Mathematics and Science Study) and PIRLS (Progress in International Reading Literacy Study). They also have relatively easy public access to infrastructure mapping data.

English Sample

Kingston-upon-Hull (usually abbreviated to Hull) has a population of around 260,000. It suffered extremely heavy damage during WW2 and subsequently went through a period of post-industrial decline, as well as the decline of the local fishing industry.

More recently, companies such as BP, Reckitt Benckiser and Siemens have established facilities there. Hull has a number of large educational institutions, including a university with 16,000 students and four large sixth form colleges. Students travel in from the small market towns and villages both north and south of the River Humber.

We interviewed five groups of students in Hull (n = 40 participants with eight students in each group). These students were based in a large sixth form college which drew from an extremely large catchment area of around 25 miles, spreading across East Yorkshire and North Lincolnshire. We recruited participants by asking for volunteers, and used purposive sampling to ensure a reasonable balance between genders, different types of educational setting, and urban/rural home

locations. The students were studying on vocational courses (e.g. Health and Social Care, Art) as well as for A Level examinations with a view to university entrance. The students were 16–18 years old, and each interview lasted around 30–45 minutes. In order to establish the likelihood of students belong to a socially deprived group, we worked from postcode data. Using the postcodes, it was possible to align each student to official Government data sources for what are termed lower-layer super output areas[3] to identify the quality of their broadband speeds and compare it with the experiences the students reported in the group interviews. Average broadband speeds in the English sample at the time of the study were low, ranging from 16.73 Mbps to 54.57 Mbps with speeds under 25 Mbps being classified by the UK Government's OFCOM (Office for Communications) as being in the bottom 30% of available speeds at the time in the local area analysed for the study during Q1 2019. Some of the postcodes were classified by us as suffering from what we termed a double disadvantage, in that they were classified as being in the bottom 30% both in the UK Government's Index of Multiple Deprivation[1] as well as average broadband speed at the time.

German Sample

Bavaria is the biggest Federal State in Germany with more than 12 million inhabitants. It is divided into eight administrative districts, of which Lower Bavaria is one of the most heterogeneous, having on the one hand regions characterized by global industrial players like BMW and on the other hand rural areas with lots of small villages in the Bavarian Woods near the border to the Czech Republic. Nine out of ten Bavarian communities have a population under 10,000 inhabitants. The biggest cities of Lower Bavaria are Landshut (71,000 inhabitants), Passau (51,000), and Straubing (47,000 inhabitants). The unemployment rate in Lower Bavaria is unevenly distributed: the regions in the north-east (Bavarian Woods) over the years have a significantly higher unemployment rate than the western areas, which are characterised by the car and engineering industries, and benefit from their proximity to Munich.

In Germany we interviewed five groups of students (n = 20 participants with three to five students in each group) from two different school types (two groups from a vocational school for future nursery teachers, and three groups from academic secondary schools). The students were 15–18 years old, and each interview lasted 30–45 minutes. As in England, we recruited participants by asking for volunteers, and used purposive sampling to ensure a reasonable balance between genders, different types of educational setting, and urban/rural locations.

Available broadband speeds are classified differently from the UK by the various German Governments, with categories for the percentage of households receiving at least 16 Mbps, 30 Mbps and 50 Mbps given. For the purposes of analysis, we categorized those with only 60% of households or fewer receiving at

least 50 Mbps as being in the bottom 30% of typical speeds. In our group interviews we identified those suffering a double disadvantage via postcode, in that they were in the bottom 30% both in the Bavarian Index of Multiple Deprivation as well as typical broadband speed based on official Government sources, as a measure of comparable local digital deprivation (Hull's broadband speeds were on average lower due to a longstanding monopoly provider situation). For our German group interview sample, we chose school locations in three cities in Lower Bavaria, which represent the structure of the district (the university city of Passau, Deggendorf at the edge of the Bavarian Woods and Landau in the catchment area of the BMW location Dingolfing). Typically, the schools in rural Bavaria are located in middle cities with catchment areas from the cities themselves as well as the surrounding villages. The area of the Bavarian Woods belongs to the most deprived regions in the region, with the social deprivation index measures of certain villages being a lot lower than the measures of cities such as Passau or Deggendorf.

Instruments

We collected both qualitative and quantitative data. We did this through using two tools: a survey and group interviews. The survey was hosted on a digital platform and comprised a mix of closed and open questions which allowed us to collect factual data (demographic information and Internet usage characteristics) as well as attitudinal data. In the next phase of the research we used a semi-structured interview model, based on the survey but using a greater number of open questions, as a participatory design that allowed scope for a greater number of divergent responses (see Carey and Smith, 1994, p. 124). During the group interviews we mainly investigated peer behaviour, attitudes, and beliefs (Nyumba *et al*., 2018). Selecting these two complementary instruments allowed the research to have the degree of ecological validity we needed to ensure a reliable set of findings.

The interview protocol was identical in both countries and the interviews were carried out by native researchers. They were digitally recorded and then professionally transcribed by a commercial company. Translation was carried out by the authors, who are all bilingual. We used a well-structured guideline consisting of three main topics: (1) experiences of local digital technological infrastructure, (2) experiences of personalised algorithms, and (3) use of the internet and digital devices, plus participants' perceptions of the role of schools in supporting information and digital literacy development.

Geographical Data

To ensure a systematic comparison, we drew on parallel Government information sources in both countries. We used publicly available data from the UK's Office of

Communications (OFCOM), the UK's Office for National Statistics (ONS), the EU's Eurostat, and Germany's Bundesnetzagentur, regarding broadband infrastructure. In terms of mapping deprivation we used the Bavarian Index of Multiple Deprivation, which is a subset of the German Index of Multiple Deprivation (GIMD), and for the UK sample we used the English Indices of Deprivation 2015 (the UK sample being located solely in England). In all cases we used the most recent official datasets available at the time of the study and carried out a 'best fit' mapping of postcodes by plotting the location of the postcode's central address into the areas of the super-low output layer grouping, or equivalent.

Ethics

Ethical approval for an anonymised qualitative study of human subjects by group interviews was given by the relevant institutions, as well as to take fully anonymised screenshots of young people's mobile phone screens for later analysis. Parental permission was obtained for under-16s. Data were stored securely and the principles of the GDPR (2018) were applied, including individual consent, anonymisation and right to erasure. We did not have permission to access students' school or college records for further data, for example home address or Free School Meal status.

Initial Data Analysis

Data analysis followed the step-by-step-model suggested by Mayring (2000) for qualitative content analysis consisting first of a summary analysis of manifest content (themes and main ideas) and secondly the interpretational explication carving out latent meaning (context information). A system of categories was inductively developed, following the three main topics as addressed in the guideline, and then populating them with the sub-themes the respondents mentioned as important to them. The coding unit was the 'aspect' or 'single idea' the group discussed; this could include only one single answer of one participant or a couple of answers of several group members depending on the moment, when anew 'aspect' occurs. To check the inter-coder-reliability we used Cohen's Kappa, for which $\kappa > .70$ would be accepted as sufficient with highly inferential reasoning. To ensure reliability a codebook was developed which explained the coding rules with examples from the text. 5% of the text material was coded by a thoroughly trained second coder with $\kappa = .83$. The analysis itself was computer-assisted with the program MAXQDA Analytics Pro 2018 (MAXQDA by VERBI Software).

SOME KEY FEATURES OF SOCIO-TECHNICAL NETWORKS IN THE MY LIFE ONLINE STUDY

Technology and Social Location

To attend school or college means to become part of a subtly shifting network of multiple social and technological engagements, that both represent and influence young people's online identities at the same time. Within this, differential opportunities are afforded individuals depending on other social circumstances. In our study, for example, it soon became clear that poor Internet access at school/college provided a new form of inequality whilst also exacerbating social differences in learning amongst students. Particularly in England, students were frequently encouraged to take advantage of the affordances of interactive educational platforms and/or mobile technologies during the school or college day, suggesting a participatory model of networking. However a combination of factors meant that their efforts were frequently frustrated. Either the hardware available to them was out of date, buildings were designed in ways that inhibited rather than facilitated WIFI access, or the very learning platforms they were supposed to be using proved to be unstable or unreliable. In many deprived areas, it would be fair to say that the technology we saw in use was frequently enfeebled and unfit for purpose, struggling to cope with the weight placed upon it. In the words of our research participants:

> Outside the building it's an alright signal. You get quite a decent signal when you're outside. When you're inside, you get barely any, like one bar. (England – G2)
>
> I have to reconnect three times a day.
>
> (England – G1)
>
> Q. What sort of resources do you use for revising?
>
> A. Mostly the college's Moodle, [4] which is always down.
>
> (England – G4)

Broadband in school was seen by some students as inferior to what was available at home, which resulted in a reluctance to use it, indicating sites of resistance as networks formed and re-formed around technical functionality. We saw evidence that more affluent students seem to have had compensatory financial and social mechanisms available to them which are not present in the case of deprived students, whose only substantive access to the Internet might be on site during the school day. An example of this is the use of superior data packages on mobile phones, of which some students were able to take advantage. During the Covid-19 pandemic, this would mean that deprived students were going to be immediately disadvantaged by not even having the most basic access to what was usually available in school, however imperfect. During what were unprecedented school and college closure periods, mirrored by the closure of local libraries, this represented a new form of discrimination within education that compounded earlier ones, with deprived students more

frequently locked out of the educational resources they needed compared to students from more affluent backgrounds.

There were other consequences to this as well. We found that students with poor access to the Internet also reported being shown a greater number of advertisements for consumer goods when they did manage to get online, but being shown fewer educational advertisements, also potentially crystallising disadvantage. One young German woman, who spoke in the group interview about being able to use her mobile phone frequently for homework, was the only participant that day who was able to show an example of an educational advertisement, in this case to a college open day. In England we encountered several examples of educational advertising, for learning materials, university and college open days, and so on.

These also tended to be seen by students who reported using their mobile phone more readily for educational purposes. We attributed to this to the likelihood that they had inadvertently trained their own digital algorithms to show them educationally beneficial materials, as a consequence of commercial tracking mechanisms such as cookies, search histories, social profiling by various platforms, and so on. This represents an example of a socio-technical network in action, and is likely to have amplified an already pro-education mindset, as discussed earlier in this article in relation to persuasive technologies. The skill of training an algorithm would not have been taught explicitly to them, but it arguably it should have been, as specific skills improvement along these lines has the potential for significant societal benefits (Davies and Eynon, 2018; National Literacy Trust, 2018). In the absence of this kind of instruction, by the time the Covid-19 pandemic arrived, the educational scales would already have been weighted towards those students with access to reliable Internet access, generous mobile phone provision, and personalised algorithms pointing them in helpful directions. As a result of these inequalities, and the way they are compounded, we see deprived social groups taking positions at the margins of the socio-technical network under consideration, rather than always engaging centrally. Their reaction to it in our study represents a narrative of marginalisation.

Network Formation and the Attention Economy

As might be expected given what has been written about the demands of the 'attention economy' in relation to education (most specifically for the purposes of this article authors such as Bakhtiar, 2020; Chen and Yan, 2016; Lanham, 2006; Mokhtari *et al*., 2015), the young people in our study generally spent a great deal of their lives multi-tasking. This meant simultaneously communicating with their friends, reading articles on news websites, listening to music, playing collaborative games, and posting on various forums during this time, whilst also attempting to complete homework. One way of considering this is to

see their networked activities as continually being in a state of flux. Their collective interest at any time determines areas of consensus as to the boundaries of any network.

Looking beyond the data collection period towards the pandemic, we expect these ongoing online interactions to have further intensified, with attendant risks to learning. As we know from laboratory tests, this type of multi-tasking is generally found to inhibit executive function (Baumgartner *et al*., 2014; Lee *et al*., 2012) and it is therefore generally discouraged in education settings. In our study, the students already appeared to view multi-tasking in a similar way, cultivating individual strategies to avoid being distracted by their mobile phones, several of them reported putting it away while doing homework. Ingenious other strategies were 'switching it to flight mode' or 'hiding it away in the bathroom'.

> I'm the kind of person who always listens to music or watch videos while I am learning. Sometimes that works quite well, but sometimes it goes wrong, so that things that appear in my work are irrelevant. You constantly chop and change between different things. The problem is, I am not sure whether or not I understand things. In some subjects this can be a major downfall, especially if you have to learn things by heart. In such cases learning while watching videos just doesn't work.
>
> (Germany – G3)
>
> A typical way of getting distracted was while using the mobile devices for learning:
>
> You google something for maths or physics (. . .) and all at once I find myself on Instagram scrolling through some videos, which are not really interesting, but better than doing maths. Yes, my time management skills are terrible, and that's supported by technology.
>
> (Germany – G3)
>
> You always discover new things on there, therefore it's very difficult to put the mobile phone aside.
>
> (Germany – G2)
>
> So, like, when you watch one video, your next one comes similar to that. Then you watch that one, and the one after that is a bit like that, so you watch it again . . . On YouTube it tends to only pop up with things you're interested in.
>
> Maybe not all the time, but usually it does. It makes you click on it. (England – G3)
>
> I would do more work if I didn't have a phone.
>
> (England – G5)

In terms of the socio-technical consequences of engagement, we see sites of consensus (acceptance of the fact that routine engagement with social media forms part of a networked life) and resistance (periodic rejection of social media on intrusion grounds) as the network continually adjusts and re-adjusts in response to different stimuli. However this frequent navigation between consensus and resistance is difficult for students, as persuasive technologies disrupt the adjustment process via appropriating students' attention:

S1: Advertisements cause me to stay for extremely long periods of time on specific sites. My mobile phone notices the sites I visit quite often and displays advertisements on my social media sites.
S2: On YouTube it often shows videos I like. I click on them next and then I'm going to spend a lot of time on YouTube.
(Germany – G2)
S1: When I think about how much time I spend on Instagram, that's partly not so good.
S2: Problem is, you don't notice how time speeds up.
S3: You scroll through sites all the time and it's difficult to assess, how much time you are really spending.
(Germany – G3)

I would probably be doing other things, but I guess I sort of focus more on music and then the more I focus, the quicker the time goes.
(England – G1)

The fact that students were aware of the manipulation of their attention did not seem to help the navigation process:

S1: I think, that often the time is no longer displayed at the top of the site. I feel it's disturbing, if you don't see what time it is. I think, they do this deliberately, so that you don't notice how much time passes (…)
S2: On Instagram I notice, that you can scroll though it quite quickly and like the pictures, and then you lose any sense of time, because everything speeds up
S3: And with Instagram it has no end if you scroll through it
S4: Yes, this endless scrolling!
S3: You don't come to an end, but it goes on and on
(Germany – G3)

From this it seems that specific power relations underpin the overall structure of this kind of performative network. Students are users/consumers of material, and when they start to engage with it, they render themselves governable, and subject to the policies of content providers, with limited ability to inform and control any impact.

Success in harnessing young people's attention means that organisations are increasingly able to control the range and scope of any particular network, achieving a position of dominance. This gives us an example of power relations as process (Latour, 1991), restricting access to what Bourdieu would term 'cultural capital' (1986), here meaning the ability to control personal privacy and information flows to ensure optimal digital interaction. In our study, the students least equipped with this form of cultural capital experienced the most digital distraction, increasing any associated disadvantage.

Networks and Digital Pedagogies

Embedding IT lessons within the school curriculum over the last 25 years has justified extensive capital investment in hardware, as well as large-scale programmes of skill dissemination. It would therefore be reasonable to expect digital pedagogy to play a prominent part in any 21st century socio-technical network.

However the responses of research participants seem to indicate this is not necessarily the case. One reason for this is that the pedagogical approach towards IT has been framed relatively instrumentally, orientated around what Bourdieu might classify within 'cultural capital' as 'technical capital'. This allows for technical skill accumulation orientated around the idea of future occupational advantage. It lies in contrast with the more complex aspects of the network, in which actors in the form of infrastructure, hardware, software and so on influence engagement in different ways at different times and for a variety of purposes, many of which are not educationally related. As Halford and Savage explain, technical capital has become so widespread that it no longer makes sense to see this as a form of social closure, and that we should pay attention to its context instead (Halford and Savage, 2010).

Our research participants reported that schools/colleges varied widely in their ability to use digital pedagogies effectively, and that this inconsistency impacted on their education. We found in both countries that schools/colleges were not perceived by young people as important agents in terms of developing digital literacy, and as such, were largely peripheral to their digital identities. In two of the German Gymnasium[5] groups, for example, digital competencies addressed in ICT classes were described as irrelevant and not usefully part of the wider socio-technical network:

S1: I think, the most crucial thing would be to talk with children about that [their experiences whilst online]. To tell them that there is stuff you should not see, and to give them the opportunity to have those experiences, but also give them the opportunity to talk about what they saw und how to avoid those things. (. . .) The IT lessons at school are simply a joke. You do not really learn what you need to know. For example, to use PowerPoint or Paint. Children can use these packages long before they even go to school. When I look at my little sister, she already knows that, she doesn't need any lessons to learn that.
S2: But that is the only thing that is taught in IT lessons.
S3: Right, and then that's exactly what is missing: how you learn how to deal with it.
(Germany – G3)

Despite their best intentions, schools and colleges can exacerbate the problem of knowledge creation within socio-technical networks. For example, in the German region of Bavaria, students' use of mobile phones is strictly forbidden during school hours unless the teacher explicitly assigns the students to an online search.

Participants complained not only about poor technological infrastructure in some of the schools, but also about not having access to wireless networks at all because it is not publicly accessible for students. One group even called their school 'hostile towards digitalisation' (Germany – G4) in terms of freely accessible WIFI or BYOD (Bring Your Own Device) concepts. In England, sometimes the situation was different. Some teachers had capitalised on the tendency to use social media for homework, for example by providing revision quizzes on Instagram and Snapchat:

> My science teacher did equations and stuff, and whoever completed the sheet on her Instagram got a chocolate bar if they won it.
>
> (England – G3)
>
> It's like the people in your class, you choose a topic, like say we typed it in, 'science', and then it comes up, it's like a quiz, and everyone on their phone connects to it, and you have to … It'll come up with a question with four possible answers, multiple choice, and then you just go from there … It's like competing, but learning at the same time.
>
> (England – G3)

Here we see teachers attempting to align their professional practice in a way that demonstrates awareness of the broader socio-technical network. However this is a relatively superficial approach pedagogically speaking, in the sense that it achieves little that a paper copy of a quiz could not. It also runs the risk of excluding those who already experience disadvantage as a result of a lack of technical assets, reinforcing inequality once again.

Discussion

In our analysis we have identified three primary areas of interest in in seeking to understand the performative socio-technical networks surrounding our young learners. These are the relationship between access to technology and social location, the impact of the attention economy on network formation, and the relationship of digital pedagogies to the overall network. All demonstrate the effect of new inequalities compounding older ones. There is widespread knowledge of these impacts and inequalities, and we have seen how individuals make efforts to resist their worst effects. However until very recently, there appears to have been little collective will by governments or technology platforms to take real steps to ameliorate any disadvantage. We expect this to have contributed to extensive problems with educational differentiation and fragmentation as a result of the Covid- 19 pandemic.

We know that the health and life expectancies of local citizens in deprived areas are measurably inferior to those in more affluent areas, as seen in the various official indices of deprivation, and latterly the mortality statistics surrounding the pandemic. The performative socio-technical networks identified within our study mirror this inferiority in digital form, highlighting a chronic lack of access to various forms of capital as well as the associated personal difficulties that arise as a consequence.

Hence both technology and citizens are marginalised, something that is played out internationally. We saw this pattern in our data from Northern Bavaria, around the former Communist border area in Germany, and repeated in Kingston-upon-Hull, an area subject to industrial decline in England. To live in these areas is to be what Bernstein (2000, p. 74) would call a 'retrospective citizen', behind time and out of step. As Konrad Adenauer, the first Chancellor of the Federal Republic of Germany, memorably said, "Wir leben alle unter dem gleichen Himmel, aber wir haben nicht alle den gleichen Horizont" (We all live under the same sky, but we don't all have the same horizon).

Such lack of opportunity arguably represents more than a purely coincidental digital divide, and points instead towards past policies of proactive decline, as though technology and social progress are limited resources that must be husbanded carefully and primarily retained in affluent areas for the greater good. In this way, it seems as though technical capital is being hoarded by particular social groups. This means the socio-technical network surrounding these students is being starved of the ability to function to full effect. School closures during the Covid-19 pandemic would have exaggerated such a weakness.

Obviously in the case of these students, nobody has deliberately elected to deprive them of the tools they need in order to learn to best effect in the 21st century, or indeed during periods of school closure. However, certain geo-political legacies (in this case Communism in Germany and industrial decline in England) have meant that they are vulnerable to various forces that contrive to make life difficult and more complicated when they try to get an education. These difficulties potentially combine to form a new type of bias against particular groups of the population, starting with the young. This problem was to be amply demonstrated by widely-reported difficulties accessing online education during Spring 2020 when schools were forced to go online. If not addressed, they could represent an ever-increasing threat to social inclusion.

One possible way forward (in addition to better and more systematically-planned infrastructure investment) may be to educate children in online skills and the influence algorithms may have on everyday life. Examples of this form of education can already be seen in countries such as Finland in relation to transversal (cross- curricular) competences (Lähdemäki, 2018) and in the work of organisations such as the UK's Commission on Fake News and the Teaching of Critical Literacy Skills (National Literacy Trust, 2018). Similarly, in Bavaria,

in 2019, each school was required to submit a media literacy curriculum to the school authorities, aligning this regionally, and these curricula have been supported through the provision of continuing professional development programmes for teachers, as to date the subject area has not been covered during Initial Teacher Training. Nevertheless, it is a difficult task to get right. Even amongst scholars there is no agreement on a full definition of media literacy (or competency depending on the respective author), and whether it should include related pedagogical competencies, media didactics, technological knowledge and so on (Tiede *et al*., 2015). Undoubtedly, any gap appearing in the context of school provision is likely to be mirrored out of school as well (Niesyto, 2009), so schools and colleges have an increasingly important task here in the future.

Another key aspect of future provision needs to be better recognition of the impact the 'attention economy' on young people's learning, as discussed earlier in the article. In our study, one of the greatest obstacles in organising one's time seemed to be social media use with all its concomitant distractions. Dornbach argues that it is underprivileged adolescents without parental and social support who particularly rely on external structures to deal with problems of this type (2018, p. 70), and it is here where schools and colleges can offer direction and leadership. If they don't, young people's learning is likely to be more and more at risk as education moves increasingly online. For example, dysfunctional time management is thought to be one of the main reasons for withdrawal in Massive Open Online Courses (Nawrot and Doucet, 2014, p. 1079), and there is also evidence that poor self-regulation leads to an increased risk of dropping out of university (Van der Meer *et al*., 2010). Mastering time, however apparently unfavourable the external environment, is always going to be useful to young people, and never more so than when schools are closed during a pandemic.

Although our fieldwork took place before the Covid-19 pandemic, recent literature shows that the situation echoes that of Malaysia during the Covid-19 crisis (Gong, 2020), as well as Africa (Mahaye, 2020) and China (Zhang, 2020) during the same period. Learners have had their physical access to schooling removed altogether for a period of time, leaving them to navigate technological options with little guarantee digital tools might be available or useful. This is frequently described in the emerging literature as a threat to education, manifesting what Mahaye has termed 'monopolies of knowledge' (Mahaye, 2020). Therefore we see inequalities exaggerated by an apparent hoarding of technical capital, and amplified by the closure of schools, which then can't fully function online. This represents a discriminatory double bind similar to that described by Grant and Eynon (2017).

This article began by seeking to identify and explore some key issues relating to technological equality and social access for young people. It is clear that the problems they encounter are likely to be systemic as much as

individually generated, and we note that in relation to perceptions of digital harm and persuasive technologies, our findings appear to align closely with those of similar youth studies, such as McCoy (2016) and Vallejos *et al*. (2021). Hopefully, the highly publicised fragmentation of learning cohorts in both digital time and space during the Covid-19 pandemic will bring a new urgency to the need for change and investment. How this plays out in the online lives of deprived young people will be an important area of focus for future research.

Acknowledgements

We would like to thank Richard Morfitt from the Hull Data Observatory, Diana Johnson MP, David Scott, Stephen Cox, Andrew Brown, Ansgar Koene, Michael Reiss, Eleanore Hargreaves and Meg Williams, and the young people who spoke to us, as well as two anonymous reviewers who provided significant insights and suggestions that improved the article immeasurably. This research was internally funded by the UCL Institute of Education and the University of Passau, receiving no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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NOTES

1. These technologies have been available for a considerable period of time and the associated published patents sometimes pre-date widespread use of social media, for example the analysis of IP addresses, the analysis of broadband speeds, classification of fixed/copper/fibre Internet access, and analysis of mobile phone signal strength (see Shkedi, 2007; Eldering *et al*., 2000).

2. The categories of deprivation used in the UK index are weighted as follows: Income Deprivation (22.5%), Employment Deprivation (22.5%), Education, Skills and Training Deprivation (13.5%), Health Deprivation and Disability (13.5%), Crime (9.3%), Barriers to Housing and Services (9.3%), Living Environment Deprivation (9.3%) (UK Department for Communities and Local Government, 2016). The Bavarian categories are similar.

3. Lower-layer super output areas are a geographical hierarchy designed by the UK Government to improve reporting on small area local statistics. They allow for consistency in population size whilst also defending the privacy rights of those living in less populous areas.

4. Internet-based learning platform.

5. Equivalent to the England's grammar schools in terms of typical intake.

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