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It's still a thing: digital inequalities and their evolution in the information society

Es gibt sie noch: Digitale Ungleichheiten und ihre Entwicklung in der Informationsgesellschaft

Noemi Festic, Moritz Büchi & Michael Latzer

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Abstract: Internet diffusion has prompted research into differences in internet access, use and consequences. Exploiting the full potential of the ongoing digital transformation in all spheres of life—a proclaimed goal of governments and international organizations—requires ensuring equal opportunities and supporting disadvantaged individuals in their internet use. Using representative, population-level survey data from Switzerland spanning nearly a decade (2011–2019; N_{total} = 5,581), multiple multivariate regression analyses tested the effects of demographic and internet-use related variables on access (general and mobile), on internet skills and on different types of use (information, entertainment, commercial transactions and communication). Results indicated that despite high access rates (92% in 2019), considerable usage inequalities persist in the Swiss information society: in particular, we found an increasing marginalization of older individuals regarding the adoption of the internet and revealed the importance of internet skills, experience and mobile internet use for adopting differentiated types of use. The extreme differences between the highly connected majority and an increasingly marginalized minority raise concerns about the latter group's opportunities for personal, social and economic benefits in an information society. This study provides unique results on current digital inequalities and their evolution which are crucial for assessing the success, suitability and legitimacy of digitization policies.

Keywords: Digital inequality, digital divide, information society, internet use, digital skills, social inequality, survey.

Zusammenfassung: Die Verbreitung des Internets hat Forschung zu Unterschieden im Internetzugang, in der Internetnutzung und in Folgen davon angeregt. Die Ausschöpfung des vollen Potenzials der fortschreitenden digitalen Transformation in allen Lebensbereichen—ein erklärtes Ziel von Regierungen und internationalen Organisationen—erfordert die Gewährleistung von Chancengleichheit und die Unterstützung benachteiligter Personen bei ihrer Internetnutzung. Anhand repräsentativer, bevölkerungsweiter Befragungsdaten aus der Schweiz, die beinahe ein Jahrzehnt umspannen (2011–2019; N_{total} = 5'581), werden in mehreren multivariaten Regressionsanalysen die Effekte von demografischen und Internetnutzungs-Variablen auf den Internetzugang (allgemein und mobil), auf Internetfähigkeiten und auf verschiedene Nutzungsarten (Information, Unterhaltung, kommerzielle Transaktionen und Kommunikation) getestet. Die Ergebnisse deuten darauf hin, dass trotz hoher Zugangsraten (2019: 92%) erhebliche Nutzungsungleichheiten in der Schweizer Informa-

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tionsgesellschaft fortbestehen: insbesondere zeigt sich eine zunehmende Marginalisierung älterer Personen bei der Internetnutzung und die grosse Bedeutung von Internetfähigkeiten, Erfahrung mit dem Internet und mobiler Nutzung für die Internetnutzung zu verschiedenen Zwecken. Die extremen Unterschiede zwischen der hochvernetzten Mehrheit und einer zunehmend marginalisierten Minderheit geben Anlass zur Sorge über deren Chancen auf persönlichen, sozialen und wirtschaftlichen Nutzen in einer Informationsgesellschaft. Die vorliegende Studie liefert bislang fehlende Ergebnisse zu aktuellen digitalen Ungleichheiten und deren Entwicklung, die für die Beurteilung des Erfolgs, der Eignung und der Legitimität von Policy-Massnahmen im Bereich der Digitalisierung entscheidend sind.

Schlagwörter: Digitale Ungleichheiten, Digital Divide, Informationsgesellschaft, Internetnutzung, Soziale Ungleichheiten, Befragung.

1. Introduction

Digitization and its implications for everyday life have been a matter of lively public debate. During the past decade, the importance of digital information and communication technologies (ICTs) has been used as an indicator of a nation's development status across the globe. In this context, many countries are proclaimed as and aspire to be *information societies*, characterized by the ubiquity of the internet in everyday life, increasing use time (ITU, 2018, pp. 3–5) as well as anytime/anywhere access as a societal standard (Büchi et al., 2019, p. 2).

With the goal of exploiting the full potential of the digital transformation, the Swiss government stated that one of their main goals was for the population to profit from advancing digitization in all spheres of life (Bundesamt für Kommunikation, 2018). A prerequisite to achieve this is ensuring equal access and opportunities to ICTs and supporting potentially disadvantaged citizens in their ICT use. Research in the broader field of internet studies has addressed various negative effects of internet use on everyday life (e.g., privacy violations or displacement of offline social interaction, see Liu et al., 2019; Waldman, 2013). Still, the notion of an information society as a normative target, which is supported by the OECD for instance, is very much in line with the basic assumption of the digital divide framework: skilled internet use is understood to be advantageous in one way or another (DiMaggio et al., 2004, p. 355; Robinson et al., 2015, p. 570) and is believed to facilitate political opinion formation and informed participation in a democratic society (Bundesamt für Kommunikation, 2018).

In such information societies, near-universal access to ICTs is often regarded as a given. However, even very high internet diffusion does not automatically resolve digital inequalities. Rather, there may be a shift in inequalities from access to usage (Büchi et al., 2016, p. 2713), entailing questions of how differential internet use leads to inequalities and disadvantages in the information society (van Deursen & van Dijk, 2014, p. 508). Not having access to the internet or the capacity to use it is particularly detrimental for people who are already part of disadvantaged groups in information societies. For example, the Swiss railway operator offers discounted tickets for underutilized connections. These tickets are exclusively available through a smartphone app. The company justified this decision as follows: "The supply and prices for discounted tickets change constantly. Online is

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the easiest and quickest way to find the most suitable option for you" (SBB, 2020). This offer systematically excludes individuals who do not or cannot use the internet, in this case incurring a direct financial cost. This mundane example reflects a broader underlying mechanism in the mutual shaping of technological and societal developments (see Schroeder & Ling, 2014, p. 790; Witte & Mannon, 2010, p. 2): ICTs structured to provide benefits to already advantaged groups incentivize intense use and the requisite skills development for this population, leading to continuous technological restructuring to more fully cater to their preferences, thereby exacerbating the relative disadvantages of the excluded.

The goal of this study is to reveal persisting digital inequalities in a highly connected information society at various levels and investigate whether and how they have changed. The strong and widespread pursuit of prompting the formation of information societies by governmental and non-governmental organizations lies at the core of this approach: we are investigating digital inequalities *within* a social context in which there is a strong push for increasing and manifesting the importance of ICT use in all life domains, which brings about certain disadvantages for those who are not (as) highly connected. This article thus addresses the following research questions: *What are the usage patterns of the (mobile) internet and specific uses over time? Which digital inequalities regarding use and skills persist in an information society and how have they changed?*

In spite of the ongoing and broad public debate on issues related to the information society in many countries with high internet diffusion, clear empirical grounds for evidence-based policy-making are lacking, especially regarding representative and long-term data on internet use that go beyond purely access-related variables. This article answers the call for more representative and long-term data on digital inequalities (e.g., White & Selwyn, 2013, p. 4). Such data provides reliable results on current digital inequalities and insights into their evolution. A broad view on internet use and related perceptions is needed to complement existing, more specific analyses (e.g., use of voting applications or health information seeking) to locate digital inequalities in the information society. The case of Switzerland as a European country with very high internet penetration offers indications for other social democracies where the internet is essential in everyday life. This article's main contributions consist of a comprehensive review of the extant theoretical and empirical literature on the evolution of digital inequalities and representative empirical results to illustrate these mechanisms.

2. Theoretical perspectives

2.1 Information society and digital inequality

Before investigating how innovations diffuse in different social groups and what empirical results are available for the diffusion of the internet, we first establish a better understanding of the concept of an information society. Information societies are generally characterized by a key role of information in all aspects of society and the proliferation of ICTs (Feenberg, 2019, p. 240; Floridi, 2009, p. 153; Webster, 2014, p. 3). The International Telecommunication Union (ITU) measures

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its ICT Development Index (IDI) through three different types of indicators: ICT infrastructure and access, ICT usage, and ICT skills. The development towards an information society is assessed based on mean scores or population shares for each country (ITU, 2020b). While these indicators are tied to specific countries in this case, societal structures that transcend nation borders are another relevant layer. Overall, there is an emphasis in the literature on the importance of ICTs for the development of societies, for instance with Castells (2002, p. 12) arguing that the diffusion of ICTs in a society greatly affects its prosperity and growth.

In global comparison, internet adoption in Switzerland is very high: 92% of the population used the internet in 2019 (Latzer et al., 2020). In comparison, 54% of the world population were internet users according to the ITU's (2020a) most recent data. In its ongoing global assessment of information societies, the ITU (2017) classifies Switzerland as "one of the leading countries in ICT development" (p. 182) in an internationally comparative perspective. Reliable broadband internet access is considered a universal service in Switzerland and has to be granted to every citizen (ComCom, 2019). However, even in a country like Switzerland where internet use is so widespread, whether different dimensions of digital inequalities remain significant must be addressed empirically: functioning in an information society not only requires access to information but also the knowledge and skills to acquire, process and classify information. According to van Dijk and Hacker (2003, p. 324), information can also be understood as a positional good, since early access can lead to different kinds of advantages. Shedding light on those who potentially are left behind is vital, even in countries where population-wide averages paint a promising picture: especially when a nation fulfills the criteria of a highly connected information society, not being included in the use of new technologies becomes a more extreme personal disadvantage. As soon as internet use for different purposes is a societal standard, non-use becomes a clear disadvantage, reflecting the *relative* nature of digital inequalities. This problem has been amplified by constant availability and connectivity becoming societal norms (Büchi et al., 2019, p. 2; Ling, 2016, p. 130). It has recently also been shown that dealing with innovations like the Internet-of-Things requires a new set of skills, which are likely to be subject to digital inequalities and reinforce them (van Deursen & Mossberger, 2018, p. 130).

Before we continue to elaborate on the need for research on social differences within information societies, it is important to note that the concept of an information society as a normative goal for nation states has also received criticism from the outset (see e.g., Garnham, 2000; Mansell, 2010) and its suitability as an ideal has been questioned, especially against the backdrop of digital inequalities. Nevertheless, the characteristics that determine a nation's stage of development towards an information society are factors that not only nation states (e.g., see Bundesamt für Kommunikation, 2018 for Switzerland) but also international organizations measure and actively promote. So long as there is this push for countries to become information societies, we need to assess the evolution of internet use against this conceptual background.

Such national-level assessments do not sufficiently account for social differences within a population: The state of an entire nation with regard to the diffu-

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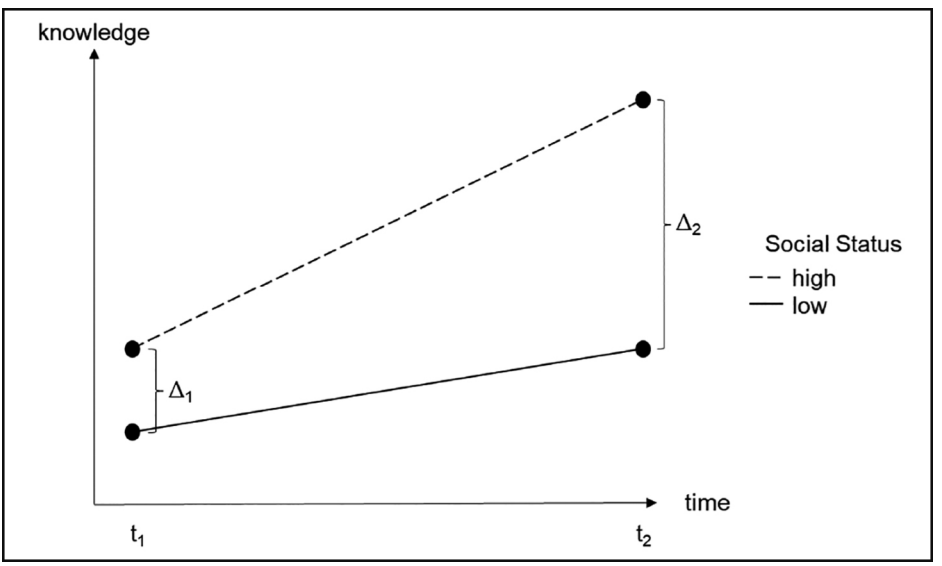
sion of ICTs says little about the adoption of innovations by specific societal groups. In addition to international comparisons and research on country-level predictors of digital inequalities, it is therefore highly relevant to also consider potentially prevalent divides *within* proclaimed information societies. Considerations on individual factors influencing internet usage variables have given rise to an extensive body of research on *digital divides* in the last two decades (Robinson et al., 2015, p. 570): Not long after significant shares of the population began using the internet, social science research recognized the connections between social and digital inequalities (see e.g., Bonfadelli, 2002; DiMaggio et al., 2001; Nie & Erbring, 2002; Norris, 2001; van Dijk, 2005; Warschauer, 2004; Witte & Mannon, 2010). The knowledge gap hypothesis (Tichenor et al., 1970, p. 160) is foundational for research on digital inequalities: when the flow of information into a social system increases, there are differences in acquiring new knowledge between individuals of different social status. Those population segments with higher social status acquire information faster, resulting in an increasing knowledge gap over time (see Figure 1).

Figure 1. Relative inequality: Evolution of knowledge differences over time



The digital divide research tradition has primarily been concerned with how demographic and socioeconomic factors like sex, age, educational attainment, employment and income relate to internet access (first-level digital divides), internet use (second-level digital divides) and outcomes (third-level digital divides) (see e.g., Büchi et al., 2016; DiMaggio et al., 2004; Hargittai, 2001; Reisdorf & Groselj, 2017; van Deursen & Helsper, 2015; Zillien & Hargittai, 2009). The basic assumption is that social inequalities cause differences in skills and usage, while using the internet prompts the acquisition of different primary goods that

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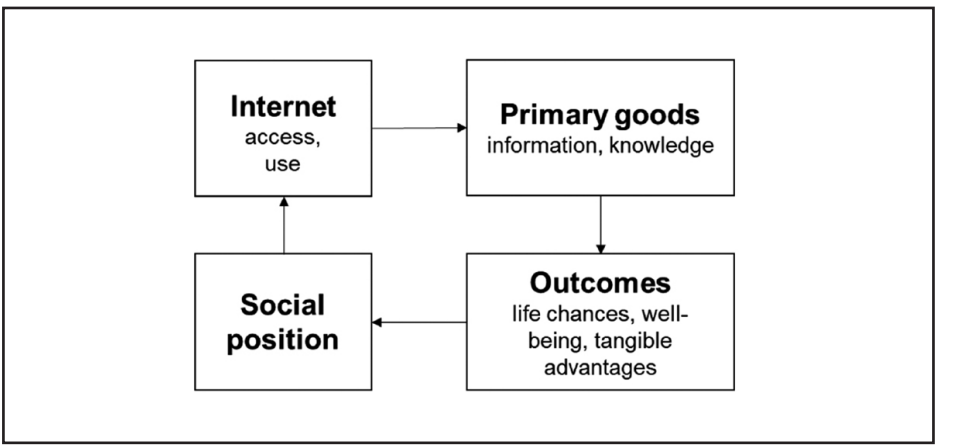
determine an individual's social position in a society (Duff, 2011; Ragnedda & Muschert, 2015; Stern, 2010) (see Figure 2).

While these various outcomes of internet use have been theoretically derived and empirically confirmed, a technology-deterministic view should be avoided. Rather, social and technological change are co-evolutionary processes that depend on and shape each other. This is partly reflected by the arrow depicting how an individual's social position feeds back into their internet access and use in Figure 2.

Figure 2. Basic digital inequality assumptions



This section has established why studying digital divides remains relevant even—or especially—in so-called information societies. In the next section, we continue by explaining why adding a longitudinal perspective to this general research goal is vital.

2.2 Diffusion of innovations over time

At its core, this study deals with the diffusion of an innovation (the internet) over time and in different societal groups. Following the tenets of Rogers' (1962, 2003) innovation diffusion theory, innovations tend to diffuse in a social system following an S-shaped curve. Figure 3 shows that the empirical diffusion of the internet closely matches the theoretical prediction, both for the world (high growth phase) and Switzerland (saturation phase).

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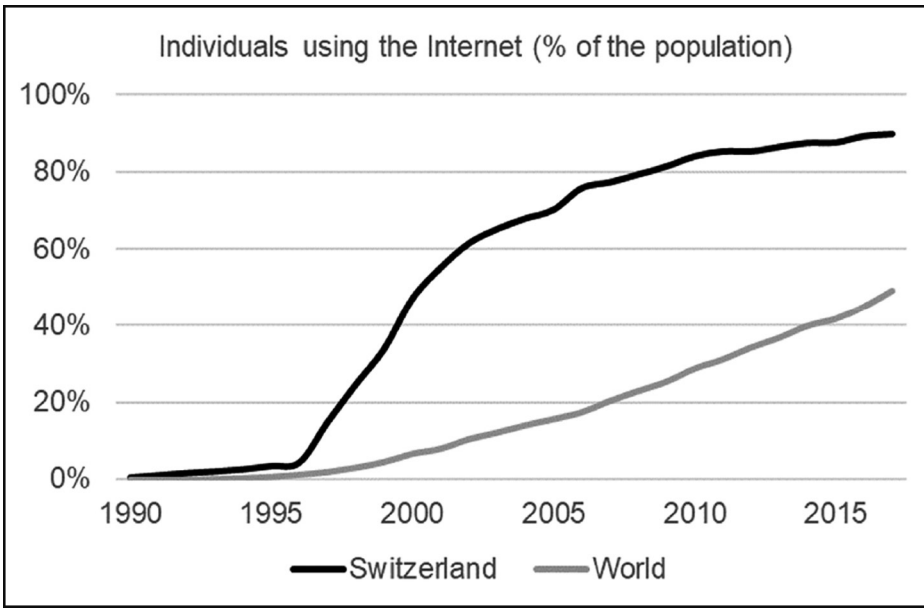
Figure 3. Individuals using the internet in Switzerland and the world



Data Source. World Bank (2018).

This adoption process differs between societal groups; people with higher social status generally adopt innovations earlier. The "innovativeness-needs paradox" (Rogers, 2003, p. 263) is relevant in this context: The members of a social system who could arguably benefit most from adopting an innovation tend to do so later than more advantaged groups. One reason for this gap is that new products are generally costly to adopt. Applied to internet adoption, for example, older people or socially marginalized groups could particularly benefit from online communication and commercial transactions given their potentially limited mobility and distance to social support systems (Hofer et al., 2019, p. 4427). In contrast, groups who traditionally adopt innovations earlier (male, young, educated members of a social system) are less dependent on the affordances of online engagement.

Existing literature on the adoption of innovations in various social groups over time permits two plausible predictions for the evolution of digital inequalities: they can either resolve themselves over time—this is generally captured by the term *normalization*—or they can persist or even increase, indicating a process of *stratification*. As a technology becomes more easily available, its diffusion is generally expected to reach a point of saturation and eventually reach all parts of society, with socioeconomic status no longer a predictor of adoption. Following this normalization argument, the digital divide can be understood as a digital delay, which will resolve itself over time (Nguyen, 2012, p. 252). In contrast, among the approaches that predict stratification, the question is where differences in internet use are rooted. Arguably, if it were simply the case that certain societal groups make an informed and autonomous choice to not use the internet, there

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would be no need for policy intervention. However, the current literature points more towards the notion that these digital inequalities reflect structural social inequalities rather than deliberate non-use (van Dijk, 2020).

According to Rogers (2003), the "paradoxical relationship between innovativeness and the need for benefits of an innovation tends to result in a wider socioeconomic gap between the higher and lower socioeconomic individuals in a social system" (pp. 263–264). These theoretical considerations suggest that the diffusion of the internet reinforces existing social inequalities instead of resolving them. Further, it is likely that the differences in internet usage and outcomes (van Deursen & Helsper, 2015) feed back into an individual's social status, further exacerbating existing social inequalities. This logic predicts stratification, i.e., the persistence or even an increase of existing digital inequalities over time. Accordingly, internet diffusion could only decrease social inequalities over time if socially disadvantaged members of a population used the internet more in beneficial ways than those with a higher socioeconomic status (Hargittai & Hsieh, 2013, p. 15), for which there are currently no indications in the literature.

Following the dynamics of online news adoption and use, Lister (2009, p. 231) and Nguyen (2012, p. 261) have also argued that—partly due to the internet's "logic of upgrade culture"—digital inequalities are here to stay: Since the internet constantly evolves and keeping up with this change demands ever-new skills and resources, there will always be societal groups who are far in advance compared to other groups regarding their internet usage. As the internet evolves, the affordances of new technologies change; and using them to their full potential and incorporating them into everyday life requires additional skills (Eynon et al., 2018, p. 318). Accordingly, it is likely that groups who have an advantage over others also reap more benefits from their skilled internet use, such as tangible outcomes or an increase in their overall well-being. This scenario predicts that digital inequalities remain prevalent, but constantly shift from basic ways of internet usage to more elaborate and up-to-date types of use (van Dijk, 2020).

The evolution of digital inequalities is both a theoretical and empirical question. The next section summarizes existing empirical findings on the evolution of these inequalities regarding internet access and use.

3. Existing empirical results on the evolution of digital inequalities

The main theoretical hypothesis of the digital divide research tradition—i.e., social and digital inequalities are related (see Figure 2)—is empirically well supported: a rich body of literature has repeatedly shown for different contexts that traditionally advantaged societal groups (especially male, younger, higher-educated, higher-income individuals) are more likely to have access to the internet, use it for different purposes and in a skillful way, and reap more benefits from their internet use (see e.g., Billon et al., 2020; Büchi et al., 2016; DiMaggio et al., 2004; Hargittai, 2001; Reisdorf & Groselj, 2017; Robinson et al., 2015; van Deursen & Helsper, 2015; Zillien & Hargittai, 2009).

While there are these extensive cross-sectional studies on digital inequalities for various countries and also a number of qualitative studies (e.g., Eynon & Ge-

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niets, 2012; Reisdorf et al., 2012) that mainly focus on internet nonusers, the long-term *evolution* of these inequalities remains empirically largely unobserved. Research on the evolution of digital inequalities was more prevalent in the early days of the development of the internet (e.g., Hoffman et al., 2000), but subsided later—presumably entailing the assumption that the internet had or would eventually ubiquitously spread.

Table 1 presents a systematic collection of existing studies that investigate the evolution of digital inequalities for individual (or a few) countries with longitudinal or multiple cross-sectional samples. It includes studies that investigate individual differences affecting internet use rather than macro or national-level effects, because this analysis focuses on individually varying factors that affect different variables related to internet use. However, it is important to keep in mind that internet adoption depends on an interplay between such individual factors like socioeconomic status and macro factors (e.g., infrastructure, urbanization) at different levels (nation, region, community, etc.) (e.g., Feng, 2015).

These existing empirical results do not offer a conclusive picture concerning the evolution of digital inequalities and do not permit an answer to the question of whether these gaps have been closing over time. However, most point in the direction that despite the progressing diffusion of the internet and various policy initiatives, digital divides remain prevalent since "it is impossible to close the digital divide without reducing other social inequalities" (van Dijk, 2020, p. 131).

This review of existing empirical research reveals several research gaps. Very few studies use recent empirical data for countries where having access to and using the internet for many different purposes is the norm and the non-users accordingly represent a small minority. Additionally, there has been a focus on developing countries in research on the evolution of digital divides (Bornman, 2016). While these are clearly valuable, empirical analyses in saturation-phase information societies additionally point to new disadvantages—which many countries currently in the growth phase will soon face as well—and subsequently devise governance options.

Regarding the operationalization of internet use, there is a focus on first-level digital divide indicators, while differentiated types of internet usage and skills are under-researched and newer types like social media use are even scarcer. As Table 1 reveals, digital divide research has also been characterized by a lack of consistent terminology. Reisdorf et al. (2017, p. 115) pointed at how results on internet diffusion in different temporal and geographical contexts are significantly affected by the operationalizations of digital divides. They consequently argue for the inclusion of broader definitions of internet use to study the evolution of inequalities. When it comes to the predictors of digital divides, most studies rely on socioeconomic background and do not take account of variables like internet skills or experience, which are especially relevant when investigating usage and outcome divides and account for the notion that differences in internet use can feed back into the social position of individuals in a society (see Figure 2).

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Table 1. Literature overview of empirical studies on the evolution of individual factors influencing internet use

Study	Data	Operationalization of Internet Use (Dependent Variables)	Inequality-Related Predictors of Internet Use (Independent Variables)	Method of Data Analysis	Main Results
White & Selwyn, 2013	Nationally representative, UK, repeated cross-sectional data with sample drawn each year, 2002–2010	Access to internet, use of internet for accessing government services, personal banking, purchasing goods and services, looking for jobs	Sex, age, ethnicity, occupational class, economic activity, age of leaving full-time education, presence of children in household, participation in current or recent learning	Set of logistic regression analyses for each dependent variable and survey period	Steady increase in internet access and use; divides based on social, occupational and educational backgrounds remain; age, education & occupational class strongly associated with internet access for whole period, economic activity only becomes relevant in later years; slightly different trends for each use variable; participants with higher social status use internet more for purchasing, banking or accessing government services; educational participation consistently associated with purchasing goods and accessing government services online; sex had no consistent relationship with any dependent variable
Van Deursen & van Dijk, 2014	Annual, representative online surveys in the Netherlands 2010–2013	Internet skills (operational, formal, information, strategic), internet use (frequency of performing a range of online activities)	Sex, age, education	Multiple linear regression analyses with interaction terms for examining changes over time	Overall increase in skill levels; being male, younger and more educated positively associated with skill levels; sex gap remains consistent; no clear results on the development of the age gap; increase in gap between higher and lower/middle educated
Bornman, 2016	Afrobarometer surveys 2008 and 2011, countrywide probability samples of South African population 18+, total of 2,400 respondents, personal interviews	Frequency of computer and internet usage, mobile phone use (to access the internet), use of internet to access news	Sex, population group, level of education	Descriptive comparisons of distribution figures	Increase in daily and non-computer users; similar but less profound tendency for internet usage; digital divides prevalent for computer and internet usage regarding sex, population group belongingness (race) and education; divides for mobile phones & their use for internet regarding population group and education (lower differences than for internet / computer usage); considerable sex gaps, noteworthy gaps regarding education, deep division between population groups

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Study	Data	Operationalization of Internet Use (Dependent Variables)	Inequality-Related Predictors of Internet Use (Independent Variables)	Method of Data Analysis	Main Results
Bergström, 2017	Longitudinal surveys, representative of Swedish population, 1998–2015, 3,000–17,000 people per year, for this analysis they used age group 60–85	Frequency of internet use (binary and for different purposes) in last year	Sociodemographic variables (sex, age), socioeconomic status (educational level), social capital (variables of household composition & frequency of socialising with friends)	Bivariate analyses, multivariate regressions	Uptake of internet slow among older part of population compared to population average, but large differences between different groups of elderly: uptake among people aged 80+ only recently started, effect of age remains similar, impact of sex decreased, older seniors persistently use different types of digital activities (email, news services, information search, online banking and social networking) less, also when controlled for other variables; digital gap due to age closing, but very slowly
Helsper & Reisdorf, 2017	GB: OxIS, nationally representative, 14+, face-to-face interviews SWE: WIP, representative sample 16+, panel data Bi-annual waves 2005–2013	Likelihood of being an internet non- or ex-user vs. being an internet user	Socioeconomic background, self-reported reasons	Logistic regressions	Belonging to a vulnerable group (older, less educated, more likely to be unemployed, disabled, socially isolated) became stronger predictor of being offline in Britain and Sweden; increases in lack of interest in internet as reason for non-use; results partly contradict other research indicating replacement of primary digital divides (cost and access) by second-level digital divides (interest and skills) access and costs become less important over time as reasons for non-use in comparison with lack of skills

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Study	Data	Operationalization of Internet Use (Dependent Variables)	Inequality-Related Predictors of Internet Use (Independent Variables)	Method of Data Analysis	Main Results
Nishijima et al., 2017	Representative data of Brazilian population, 2005, 2008, 2011 and 2013	Access to internet in last 3 months and mobile phone ownership for individual use	Individual characteristics and external factors related to ICT access: socioeconomic, demographic & geographical variables	Concentration index, logistic regressions	Younger, white, educated individuals with higher income more likely to have internet access; (negative) effect of being elderly on internet access was reduced due to improvements in educational attainment levels; while impact of external barriers to ICT access declined, education remains main barrier for personal capacity of ICT goods utilization over time (connected to digital illiteracy) Being male, white, employed, student, higher income and higher education positively influence probability of mobile phone ownership; inequalities in mobile phone ownership decrease greatly over time compared to inequalities in internet access; decrease in negative effect of being elderly & increase in positive effect of education indicates that mobile utilization may involve higher complexity in comparison to internet access
Eynon et al., 2018	British Household Panel survey (and successing survey), four waves 1997–2013, *N* = 2,155	Internet use (binary)	Social class (based on employment status and relationships with employers); controls: age, sex, health, education	Reciprocal effect model (estimation of autoregressive and cross-lagged paths)	Social class and internet use are positively associated; internet use predicted social class in the two latter panel waves (controlled for previous social class, age, sex, health, and education)
Koiranen et al., 2020	Representative biannual cross-sectional surveys of Finnish population 2008–2016, phone & web	Social media use (having a registered profile), purpose of social media use (e.g., social, work-related, political)	Sex, age, education, residential area	Proportion comparisons across different populations, tests of temporal variance with logit models	Increase in social media use in all population groups, increasing age gap, age had the strongest effect; effect of sex, education and region remain stable over time; divides between population groups remain present; diversification of use purposes and persisting sociodemographic differences; partial shift in digital divides from mere use to use purposes

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This article seeks to contribute to filling these research gaps with representative, long-term, population-level data from a highly connected information society where internet use is socially expected. Analyses rely on a broader and more up-to-date operationalization of internet use, predicted by demographic and socioeconomic variables as well as by internet skills, experience and mobile internet use for differentiated uses.

4. Method

4.1 Data collection and participants

This study uses nationally representative, repeated cross-sectional survey data (N_{total} = 5,581) collected in Switzerland in 2011, 2013, 2015, 2017 and 2019 (see Table 2 for a detailed overview of the sample). Computer-assisted telephone interviews were conducted in order to reach a representative sample that included both internet users and non-users. The interviews were conducted exclusively by landline in 2011 and 2013. Thereafter, a fifth to a quarter of the participants were reached by mobile phone (2015: 21%, 2017: 21%, 2019: 25%).

Table 2. Repeated cross-sectional survey overview

Year	*N* total	Max. margin of error	Internet users	Mobile internet users
2011	1,104	±2.95%	77%	20%
2013	1,114	±2.94%	85%	39%
2015	1,121	±2.93%	88%	63%
2017	1,120	±2.93%	90%	72%
2019	1,122	±2.93%	92%	80%

The bi-annually conducted survey includes varying questions on attitudes towards the internet, online privacy, and digital well-being. One important asset of this data set is that the core variables of the questions on internet use, skills and personal background including their exact wordings have remained the same over the entire period of investigation. Asking the same, detailed questions on various aspects of life in an information society allows us to trace its evolution. In repeated, cross-sectional surveys, this is often not the case (see Table 1), which is a source of bias and can lead to error-prone interpretations due to the uncertainty about whether effects can be attributed to actual change or reflect methodological modifications.

4.2 Data analysis

In addition to descriptive comparisons over time, a series of multivariate regression analyses were conducted in order to test the association of demographic and socioeconomic variables, internet skills and experience and mobile internet use with different use variables (see Table 3 for the detailed analytical strategy). We estimated models with the *glm* function in R (Rdocumentation.org, 2020) using

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binomial logit regressions for binary dependent variables (internet use, mobile internet use, internet skills) and gaussian identity regressions for the ordinal dependent variables (internet skills mean score, internet use types). We performed multiple imputation of missing values using predictive mean matching with the *mice* package in R (all variables had less than 3.5% missing values at the start).[1]

Table 3. Analytical strategy for the multiple regression models

		Dependent variables			
		Internet use	Mobile internet use	Internet skills	Types of internet use
Independent variables	Demographic & social background	●	●	●	●
	Internet experience		●	●	●
	Mobile internet use			●	●
	Internet skills				●

4.3 Measures

Internet use. Internet use was a binary variable: respondents reported whether they were currently using the internet or had done so at least once in the last three months. The question specified that this did not mean internet use in the actual moment but referred to their life in general. Using the internet is a first, basic measure of participating in the information society. As such, it corresponds to van Dijk's (2017, p. 2) concept of access in the broader sense and acknowledges that digital divide research needs to take "the whole process of appropriation of a particular technology" into account. This is why we avoid mere "physical access" as a first variable here and measure internet use instead.

Mobile internet use. The internet users in the sample further reported whether they used the internet on the go via portable devices such as mobile phones. This was a binary variable.

Internet skills. The measurement of general internet skills relied on a single-item question. Respondents assessed their ability to use the internet on an ordinal scale with the following response options: 1 = *bad*, 2 = *sufficient*, 3 = *good*, 4 = *very good*, 5 = *excellent*. For the regression, we assigned all users who perceived their own skills as at least good value 1 and all others served as the reference group (0), relying on the idea that purposeful internet use in an information society requires being able to use online services well.

Since the measurement of internet skills through a one-item question relying on self-reports has potential biases, the measurement was extended to a validated survey instrument for general populations (van Deursen et al., 2016, p. 816) for the survey periods 2015, 2017 and 2019. Respondents rated their ability to perform internet-use-related tasks on a five-point Likert agreement scale. The five

1 All syntax files and results are available at: https://osf.io/pesuh/?view_only=144329ea72c5482ea03bcd24874ee967

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tasks in question were: opening downloaded files, finding suitable search terms, changing sharing settings, creating and uploading content, and installing mobile applications. For 2015, 2017 and 2019, where these measures were available, a mean score index was created for these five items. These results can be used to underline the plausibility of the results obtained with the one-item question available for the entire period of investigation.

Types of internet use. The survey included a broad number of online activities that comprehensively reflect individuals' day to day internet use in an information society (Latzer et al., 2020). We distinguish between four different *usage types*: information, entertainment, commercial transactions, and communication. In the context of studying the information society, internet activities that are most widespread and part of everyday life for the vast majority of the population represent meaningful usage types. For each of these four types of internet use, the four commonest activities among the Swiss population that were part of all survey periods were therefore selected. For each activity, the internet users in the sample reported their frequency of use on a six-point scale ranging from 1 = *never* to 6 = *multiple times a day*. Sum indices were calculated with these frequencies for each type of use. *Informational* use measured the use of search engines, searching for health information online, looking for news online, and checking the meaning of a word on the internet. For *entertainment* use, respondents answered how frequently they used the internet for listening to or downloading music, for watching or downloading videos, and for watching TV online live or time-delayed. Using the internet for *commercial transactions* was measured through the following activities: looking up product information online, purchasing goods on the internet, comparing prices of goods or services, and making travel bookings or reservations. Internet use for *communication* purposes entailed using email, online messaging, making phone calls over the internet, and the use of social networking sites.

Demographic and socioeconomic variables. The dichotomous variable female was assigned the value 1 for women and 0 for men. Respondents were asked to report their age, which was recoded into four groups. For measuring income, respondents stated their household income on a six-category scale. The lowest (below CHF 4,500) and highest (over CHF 9,000 for 2011 and 2013 and over CHF 10,000 for 2015–2019) income categories were included as dummies and people with an income in between served as the reference group. High education took the value 1 for individuals with tertiary qualifications (university degree or similar). Low education took the value 1 for respondents whose highest completed education level was primary school. Employment status was categorized as part-time or full-time, with unemployed respondents serving as the reference group.

Internet experience. Further, internet experience measured how many years respondents reported having used the internet.

5. Results

Results are presented separately for each dependent variable. The data fit the models well consistently: the variance inflation factor (VIF) was lower than 2.5

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for all independent variables in all models, indicating low levels of multicollinearity. For all binomial regressions, the Hosmer-Lemeshow test was not significant ($p < .05$), meaning that the expected and observed values for the dependent variables did not differ in subgroups, further indicating good model fit.[2]

5.1 Internet use

Internet diffusion in the Swiss population continuously increased between 2011 and 2019. While 77% of the Swiss reported using the internet in 2011, the number rose to 85% in 2013. The growth rate subsequently slowed with diffusion at 88% in 2015, 90% in 2017 and 92% in 2019.

The figures below show odds ratios with confidence intervals for all independent variables and each year. When the confidence interval of an odds ratio includes 1—i.e., the error bars intersect the dashed line at $OR = 1$—this corresponds to a non-significant effect.

Figure 4 reveals that education, age and income were strongly and persistently related to internet adoption across all years. Sex was unrelated to the adoption of the internet: the odds of being an internet user did not significantly differ between males and females between 2011 and 2019. Educational attainment remained a persistent predictor of internet use throughout the period of investigation: while individuals with low educational attainment were significantly less likely to be internet users, high educational attainment was significantly and positively associated with internet usage. In 2019, individuals with high educational attainment were four times more likely ($OR = 4.37$) to be internet users than those with medium educational attainment. At the same time, individuals with low educational attainment were more than twice as likely to *not* use the internet ($OR = 0.43$).

Age was the variable most strongly related to the likelihood of being an internet user. It is particularly apparent that while those aged between 30 and 49 no longer significantly differ from the reference group (individuals aged 14 to 29) in their internet adoption rates in 2019, it is especially older individuals who are increasingly less likely to be internet users. The negative effect of higher age on internet use generally increased over time, indicating its growing importance as a predictor. Swiss people aged 50–69 or 70+ were more than 20 times ($OR = 0.05$) and 125 times ($OR = 0.008$) less likely, respectively, to be online in 2019 than those aged between 14 and 29, revealing a persistent and increasing marginalization of older individuals when it comes to the adoption of the internet. While there were already differences in internet adoption between age groups in 2011, they were far less pronounced, with those aged 70+ being only ten times ($OR = 0.1$) less likely to be online compared to the youngest group (14–29). Another group that is becoming increasingly marginalized are those with low income: they were 2.4 ($OR = 0.41$) and 3.4 ($OR = 0.29$) times less likely to be online compared to the group with a medium level of income in 2011 and 2019, respectively. The significant advantage of individuals on higher incomes compared to those

2 The separate fit statistics for all models are available at: https://osf.io/pesuh/?view_only=144329ea72c5482ea03bcd24874ee967

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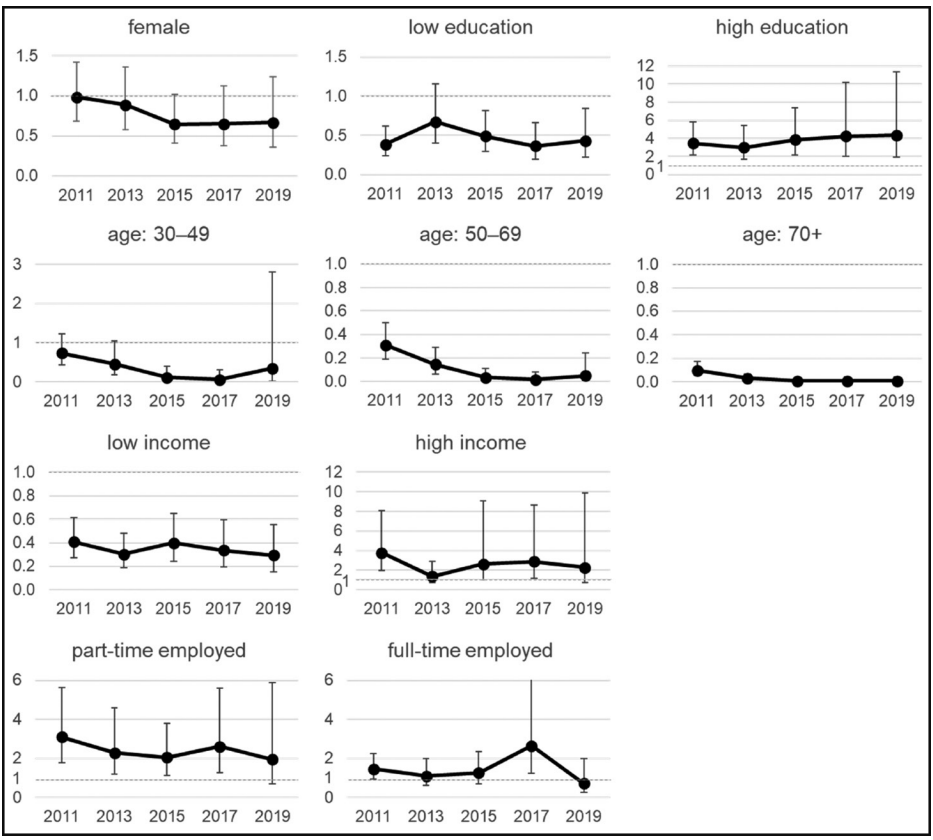
with a medium level of income diminished and disappeared over time. Similarly, the small but initially significant positive effect of being employed is no longer apparent.

Figure 4. Odds ratios with confidence intervals for predictors of being an internet user 2011–2019



Note. Omitted categories: male, medium education, age 14–29, medium income, unemployed. Significant (i.e., CI does not intersect dashed line at *OR* = 1) odds ratios above (below) 1 indicate a higher (lower) likelihood of using the internet compared to the omitted category.

In order to make more nuanced statements about the predictors of different types of internet usage, we continue by investigating differences in specific types of online engagement among Swiss internet users. The subset of those who did use the internet was therefore used for all subsequent analyses.

5.2 Mobile internet use

Analogous to the diffusion of the internet, the proportion of the Swiss population that report using mobile internet via portable devices has strongly increased be-

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tween 2011 and 2019. While the diffusion of the mobile internet doubled in the first two years of investigation (20% in 2011 and 39% in 2013), the diffusion rate of the mobile internet in the Swiss population subsequently decelerated. Mobile internet diffusion reached 63% in 2015, 72% in 2017 and 80% in 2019.

Sex was not significantly related to mobile internet use until 2019 when the odds of mobile internet use were 1.65 times higher among female internet users. While internet users with low and medium levels of educational attainment did not significantly differ in mobile internet use, with the exception of 2015, a tertiary qualification consistently increased the likelihood of accessing the internet via mobile devices. The effect appears to be increasing slightly, with highly-educated internet users being 2.4 times more likely to be mobile internet users compared to those with medium levels of educational attainment in 2019. Age had a strong and persistent negative effect on mobile internet use between 2011 and 2019 with no clear trend regarding effect size—older internet users are in general much less likely to use the internet on the go.

While internet users with low- and medium-income levels did not significantly differ with regard to mobile Internet use, high-income internet users had higher odds of using mobile internet throughout the period of investigation, and the effect is increasing.

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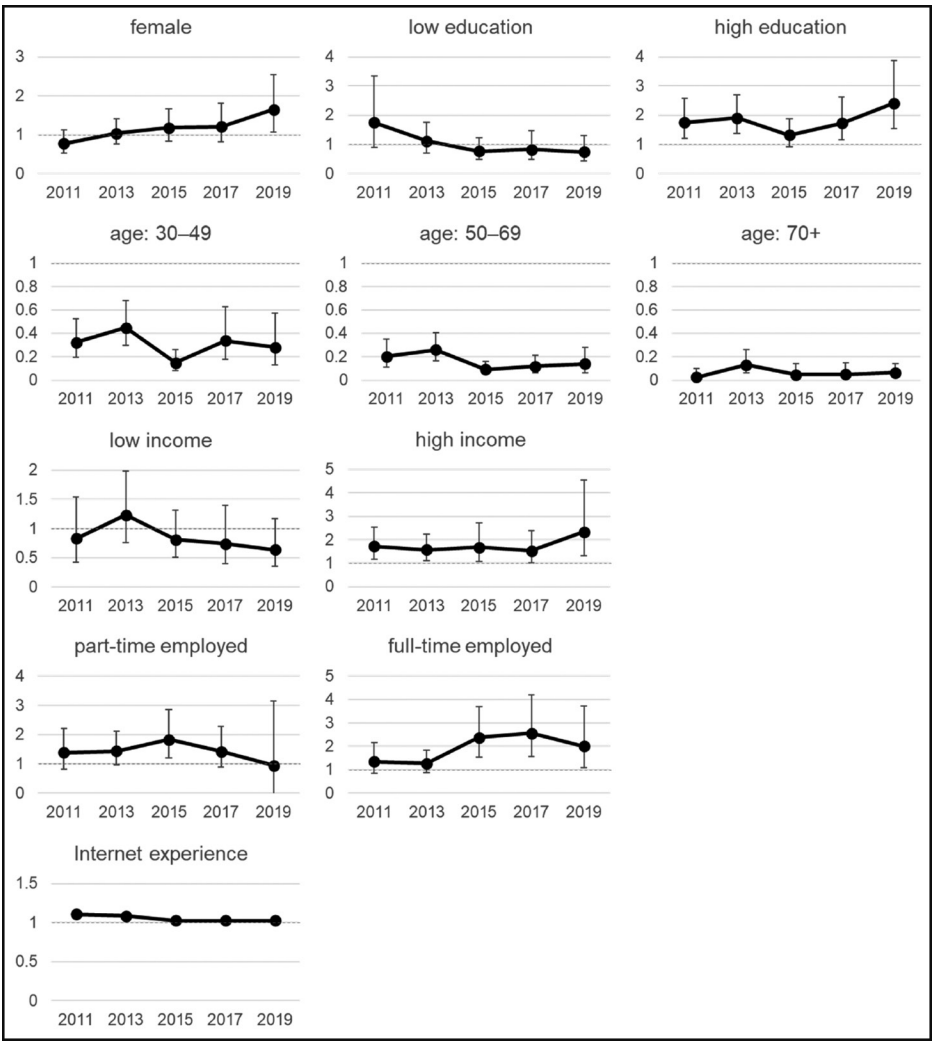
Figure 5. Odds ratios with confidence intervals for predictors of mobile internet use 2011–2019.



Note. Omitted categories: male, medium education, age 14–29, medium income, unemployed. Significant (i.e., CI does not intersect dashed line at *OR* = 1) odds ratios above (below) 1 indicate a higher (lower) likelihood of using mobile internet compared to the omitted category.

In 2019, higher income increased the likelihood of mobile internet use among Swiss internet users by 2.34 as compared to those with medium income levels. While employment status was not significantly associated with mobile internet use in 2011 and 2013, since 2015 full-time employees in particular have become significantly more likely to use mobile internet. Internet experience was a predictor of mobile internet use throughout all survey waves. A marginal increase in internet experience of one year increased the likelihood of mobile internet use by

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a factor of 1.03. To illustrate this effect: an individual with 10 years in internet experience is 1.34 times more likely to be a mobile user than someone with no internet experience (see Figure 5).

5.3 Internet skills

For the one-item skills measure, the results reveal a slightly increasing sex gap, with female respondents reporting lower perceived levels of internet skills. While internet users with higher educational attainment were more likely to have good internet skills in 2011 and 2013, there have since been no skills differences between educational groups. Age had an increasingly negative effect on the ability to deal with the internet well. A positive effect of internet experience and mobile internet use on internet skills prevailed in 2011–2019. Income and employment status were not related to the respondents' perceived level of internet skills (see Figure 6).

The five-item skill-question was only part of the survey in 2015, 2017 and 2019. The results confirm the conclusions from the one-item measure above. This more elaborate skills measure was also most heavily (and negatively) impacted by the internet users' age, indicating an even larger age gap than for the one-item question. Higher education and respondents' internet experience had the opposite effect, significantly increasing the perceived level of internet skills. The only noteworthy difference between the two skills measures was that there was no significant sex gap for the five-item measure.

5.4 Types of internet use

The mere use of the internet as opposed to non-use is not automatically advantageous for individuals. Rather, skillful and informed use of the internet for different purposes and in different life domains is likely more consequential. Digital inequalities with regard to specific types of internet use therefore matter (see Tables 4–7).

Over the period of investigation, a small but significant difference regarding sex emerged where females used the internet less for information purposes. Higher age has also become increasingly associated with less use of the internet for information purposes. Internet users with high educational qualifications tended to use the internet more for information purposes until 2013, but this difference between educational groups has since disappeared. At the same time, low-income individuals have been obtaining information online significantly less frequently since 2017, indicating a widening income gap regarding this type of internet use. Using mobile internet, good internet skills as well as more internet experience had the opposite effect and persistently contributed to the frequency of using the internet for information purposes.

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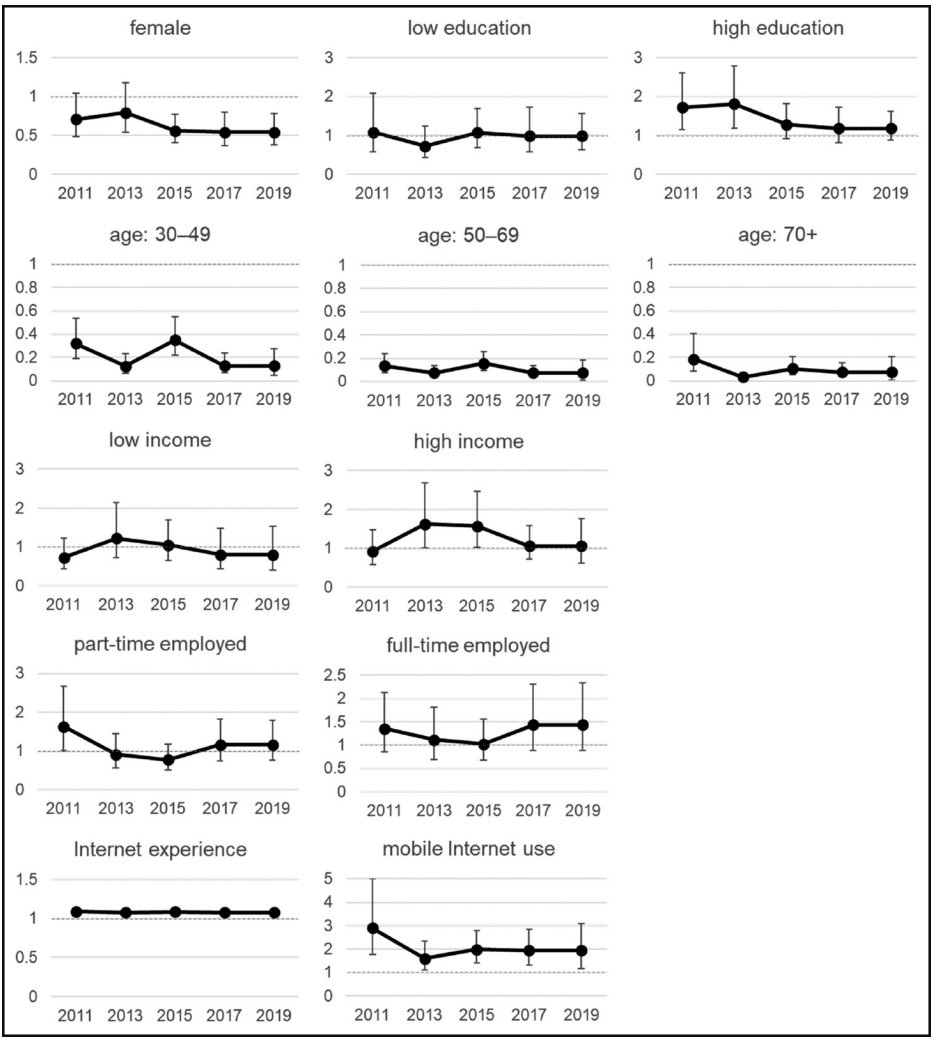
Figure 6. Odds ratios with confidence intervals for predictors of having good internet skills 2011–2019



Note. Omitted categories: male, medium education, age 14–29, medium income, unemployed, mobile internet non-use. Significant (i.e., CI does not intersect the dashed line at *OR* = 1) odds ratios above (below) 1 indicate a higher (lower) likelihood of having good internet skills compared to the omitted category.

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Table 4. Predictors of internet use for information 2011–2019

	2011			2013			2015			2017			2019		
	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*
Intercept	10.51	0.49	< .001	9.02	0.47	< .001	12.69	0.48	< .001	12.63	0.49	< .001	11.89	0.51	< .001
Female	-0.08	0.27	.765	-0.86	0.26	.001	-0.18	0.23	.425	-0.14	0.24	.551	-0.46	0.23	.045
Age 30–49	0.07	0.35	.834	0.97	0.35	.006	-1.04	0.30	.001	-1.58	0.32	< .001	-0.70	0.31	.024
Age 50–69	-0.47	0.39	.224	0.62	0.38	.099	-1.26	0.34	< .001	-1.81	0.33	< .001	-1.64	0.32	< .001
Age 70+	-0.20	0.58	.726	-0.96	0.54	.075	-1.26	0.51	.014	-2.99	0.46	< .001	-1.54	0.45	.001
Low education	0.05	0.45	.912	0.35	0.37	.342	-0.50	0.31	.114	-0.67	0.33	.042	0.58	0.33	.075
High education	1.35	0.27	< .001	1.18	0.28	< .001	0.12	0.24	.611	0.26	0.24	.286	0.29	0.23	.206
Low income	-0.31	0.39	.426	0.54	0.39	.169	-0.05	0.35	.895	-1.25	0.43	.003	-1.16	0.39	.003
High income	0.54	0.30	.074	1.23	0.30	< .001	0.14	0.28	.614	0.41	0.24	.083	0.23	0.24	.352
Part-time employed	0.47	0.35	.185	0.27	0.33	.418	0.49	0.31	.110	-0.02	0.29	.952	0.07	0.29	.801
Full-time employed	0.05	0.32	.866	-1.13	0.31	< .001	0.34	0.30	.257	0.02	0.29	.951	-0.06	0.30	.855
Internet experience	0.02	0.02	.296	0.07	0.02	< .001	0.05	0.02	.001	0.07	0.01	< .001	0.06	0.01	< .001
Mobile internet use	1.68	0.29	< .001	2.67	0.25	< .001	1.14	0.26	< .001	1.49	0.28	< .001	1.79	0.31	< .001
Good internet skills	1.59	0.29	< .001	0.51	0.30	.092	1.52	0.24	< .001	0.95	0.26	< .001	1.02	0.25	< .001

Note. N_{2011} = 1,104, N_{2013} = 1,114, N_{2015} = 1,121, N_{2017} = 1,120, N_{2019} = 1,122. Omitted categories: male, age 14–29, medium education, medium income, unemployed, mobile internet non-use, bad internet skills.

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Table 5. Predictors of internet use for entertainment 2011–2019

	2011			2013			2015			2017			2019		
	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*
Intercept	9.79	0.45	< .001	7.88	0.46	< .001	11.15	0.52	< .001	11.29	0.53	< .001	10.76	0.60	< .001
Female	-0.97	0.25	< .001	-0.82	0.25	.001	-1.16	0.25	< .001	-0.85	0.26	.001	-1.08	0.27	< .001
Age 30–49	-2.61	0.32	< .001	-1.40	0.34	< .001	-3.23	0.33	< .001	-4.12	0.34	< .001	-2.76	0.37	< .001
Age 50–69	-3.87	0.36	< .001	-2.25	0.36	< .001	-4.35	0.37	< .001	-4.98	0.36	< .001	-4.90	0.38	< .001
Age 70+	-4.29	0.54	< .001	-3.12	0.52	< .001	-5.38	0.56	< .001	-5.84	0.50	< .001	-5.62	0.53	< .001
Low education	1.70	0.42	< .001	0.43	0.36	.227	0.32	0.34	.351	0.95	0.36	.007	1.63	0.38	< .001
High education	0.48	0.25	.062	0.48	0.27	.083	0.43	0.26	.099	0.79	0.26	.002	0.45	0.27	.090
Low income	-0.68	0.36	.063	0.58	0.38	.128	-0.41	0.38	.282	-1.02	0.46	.027	-0.50	0.46	.274
High income	0.38	0.28	.180	0.35	0.29	.225	-0.05	0.30	.858	0.21	0.26	.411	0.93	0.29	.001
Part-time employed	0.40	0.33	.218	0.26	0.32	.413	-0.57	0.33	.085	0.32	0.31	.307	0.08	0.34	.810
Full-time employed	0.16	0.30	.600	-0.35	0.30	.239	-0.63	0.32	.051	0.73	0.32	.021	-0.55	0.36	.124
Internet experience	0.00	0.02	.975	0.03	0.02	.074	0.02	0.02	.298	0.02	0.02	.302	0.04	0.02	.021
Mobile internet use	1.61	0.27	< .001	2.44	0.24	< .001	1.47	0.28	< .001	1.31	0.31	< .001	1.57	0.36	< .001
Good internet skills	1.02	0.27	< .001	0.64	0.29	.028	1.63	0.27	< .001	0.92	0.29	.001	0.91	0.29	.002

Note. N_{2011} = 1,104, N_{2013} = 1,114, N_{2015} = 1,121, N_{2017} = 1,120, N_{2019} = 1,122. Omitted categories: male, age 14–29, medium education, medium income, unemployed, mobile internet non-use, bad internet skills.

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While older people have reported less internet use for entertainment purposes since the first survey period, the age gap has widened over the years. Further, we found a persistent sex gap, with female respondents reporting less use of online entertainment. Contrary to using it for information purposes, individuals with lower levels of educational attainment used the internet slightly more frequently for entertainment between 2011 and 2019. In 2019, high-income individuals used online entertainment services slightly more often. Mobile internet use and good internet skills were also positively related to using the internet for various entertainment activities. While more experience with the internet had the same association with internet use for entertainment, this effect was weak.

For using the internet for commercial transaction purposes, we found a significant and constantly widening sex gap: females have been using the internet for this purpose less frequently since 2011. Similar to the results for information and entertainment, higher age was strongly and negatively associated with using the internet for commercial purposes. However, the results reveal that the gap between the two youngest age groups has been closing, while individuals aged 50 and over remain significantly less frequent users of such services. Except for 2013, there was no association between educational attainment and internet use for commerce. On the contrary, the results revealed a widening income gap. Individuals with lower levels of income in particular have become increasingly less frequent users of online services for commercial transactions. Again, mobile internet use, good internet skills and more internet experience had a stable positive association with using commerce services.

While females used the internet significantly less often for communication in 2011, this association has changed direction: female internet users have used online communication services more frequently since 2017. Higher age was consistently and strongly associated with less internet use for communication. This negative effect increased over the period of investigation. Individuals with lower levels of educational attainment used the internet (increasingly) more frequently for communication. At the same time, there was a widening income gap, indicating that individuals with higher income used communication services more often in 2019. As for all other types of internet use, mobile internet use and good internet skills were persistently positively related to using the internet for communication.

Another way to assess the importance of various factors for the dependent variables is an investigation of the explained variance in the dependent variables (see Figure 7).

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Table 6. Predictors of internet use for commerce 2011–2019

	2011			2013			2015			2017			2019		
	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*
Intercept	7.63	0.43	< .001	6.29	0.38	< .001	7.52	0.42	< .001	7.96	0.42	< .001	8.27	0.47	< .001
Female	-0.69	0.23	.003	-0.71	0.21	0.001	-0.74	0.20	< .001	-0.85	0.20	< .001	-0.95	0.21	< .001
Age 30–49	0.03	0.30	.915	0.47	0.29	0.103	-0.21	0.26	.434	-0.80	0.27	.003	0.01	0.28	.968
Age 50–69	-1.06	0.34	.002	-0.24	0.30	0.438	-0.60	0.29	.040	-1.23	0.28	< .001	-0.94	0.29	.002
Age 70+	-1.56	0.51	.002	-1.09	0.44	0.013	-1.20	0.44	.007	-2.10	0.40	< .001	-1.38	0.41	.001
Low education	-0.61	0.40	.126	-0.56	0.30	0.065	-0.29	0.27	.290	-0.22	0.28	.440	0.20	0.30	.501
High education	0.36	0.24	.135	0.62	0.23	0.007	0.27	0.21	.202	0.01	0.21	.968	0.35	0.21	.094
Low income	-0.44	0.34	.204	0.17	0.32	0.584	-0.47	0.30	.118	-0.92	0.36	.012	-1.04	0.36	.004
High income	0.84	0.26	.001	1.30	0.24	0.000	0.60	0.24	.014	0.31	0.20	.129	0.53	0.22	.017
Part-time employed	0.78	0.31	.012	0.29	0.27	0.273	0.55	0.27	.038	0.40	0.25	.107	-0.01	0.27	.963
Full-time mployed	0.64	0.28	.022	-0.32	0.25	0.203	0.39	0.26	.133	0.69	0.25	.006	0.38	0.28	.169
Internet experience	0.05	0.02	.001	0.08	0.01	< .001	0.07	0.01	< .001	0.07	0.01	< .001	0.04	0.01	.001
Mobile internet use	0.85	0.25	.001	1.85	0.20	< .001	1.20	0.22	< .001	0.94	0.24	< .001	1.13	0.28	< .001
Good internet skills	1.06	0.25	< .001	0.67	0.25	0.006	1.19	0.21	< .001	1.05	0.23	< .001	1.19	0.23	< .001

Note. N_{2011} = 1,104, N_{2013} = 1,114, N_{2015} = 1,121, N_{2017} = 1,120, N_{2019} = 1,122. Omitted categories: male, age 14–29, medium education, medium income, unemployed, mobile internet non-use, bad internet skills.

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Table 7. Predictors of internet use for communication 2011–2019

	2011			2013			2015			2017			2019		
	Estimate	*SE*	p	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*	Estimate	*SE*	*p*
Intercept	12.89	0.50	< .001	12.37	0.43	< .001	12.79	0.55	< .001	12.39	0.53	< .001	13.86	0.57	< .001
Female	-0.61	0.27	.026	-0.36	0.24	.128	0.29	0.26	.254	0.92	0.26	< .001	0.66	0.26	.010
Age 30–49	-2.47	0.36	< .001	-2.22	0.32	< .001	-1.98	0.34	< .001	-2.60	0.34	< .001	-1.48	0.34	< .001
Age 50–69	-3.77	0.39	< .001	-3.67	0.34	< .001	-3.87	0.38	< .001	-3.14	0.35	< .001	-2.53	0.36	< .001
Age 70+	-3.87	0.59	< .001	-4.95	0.49	< .001	-4.67	0.58	< .001	-5.04	0.49	< .001	-5.04	0.50	< .001
Low education	-0.04	0.46	.930	0.18	0.34	.588	-0.09	0.36	.797	0.23	0.35	.515	0.94	0.36	.009
High education	0.03	0.28	.913	0.10	0.26	.711	0.10	0.27	.713	-0.04	0.26	.888	-0.17	0.25	.508
Low income	0.11	0.40	.784	-0.35	0.36	.332	-0.19	0.40	.630	-1.26	0.46	.006	-0.10	0.43	.810
High income	0.51	0.31	.096	0.26	0.27	.333	-0.19	0.31	.555	0.02	0.25	.924	0.97	0.27	< .001
Part-time employed	-0.08	0.36	.814	-0.95	0.30	.002	0.01	0.35	.968	0.07	0.31	.832	-0.24	0.32	.461
Full-time employed	0.23	0.33	.485	-0.24	0.28	.393	0.08	0.34	.808	0.36	0.31	.253	-0.35	0.34	.293
Internet experience	-0.02	0.02	.295	0.02	0.02	.256	0.01	0.02	.420	0.05	0.02	.001	0.03	0.01	.063
Mobile internet use	1.45	0.30	< .001	1.99	0.23	< .001	2.98	0.29	< .001	4.07	0.30	< .001	3.05	0.34	< .001
Good internet skills	1.53	0.29	< .001	1.23	0.28	< .001	1.53	0.28	< .001	0.83	0.28	.004	0.85	0.27	.002

Note. N_{2011} = 1,104, N_{2013} = 1,114, N_{2015} = 1,121, N_{2017} = 1,120, N_{2019} = 1,122. Omitted categories: male, age 14–29, medium education, medium income, unemployed, mobile internet non-use, bad internet skills.

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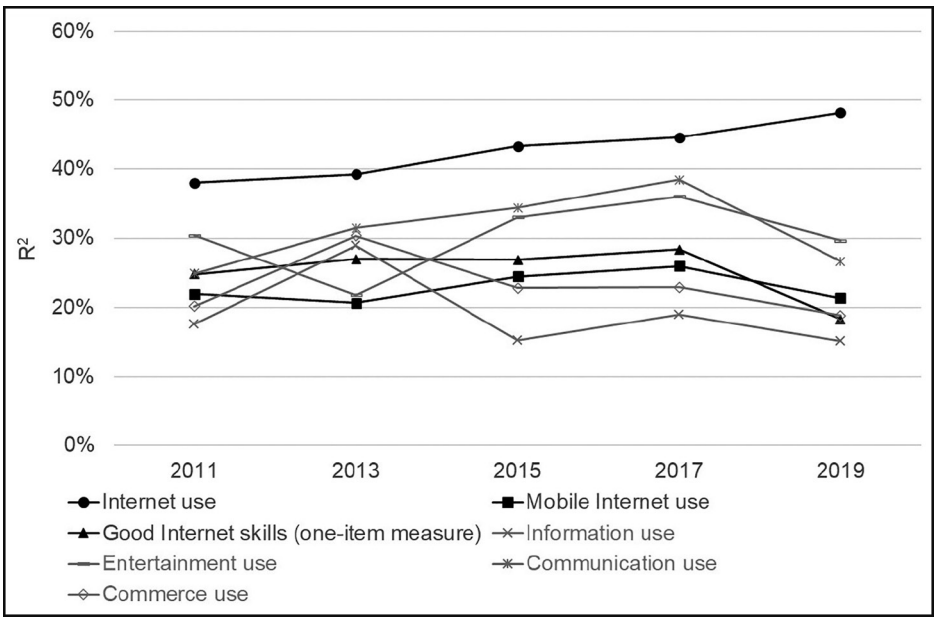
Figure 7. R^2 of dependent variables over time



Note. Nagelkerke's R^2 is reported for internet use, mobile internet use and good internet skills and adjusted R^2 for information, entertainment, commerce and communication internet use.

The results revealed that the proportion of variance explained by the set of socio-economic variables on internet use increased between 2011 and 2019, which means that the inequality-related predictors have become more important in explaining the likelihood of using the internet in Switzerland. Inequalities in mobile internet use and internet skills appear to have remained relatively stable. Using the internet for information or commerce was most unequally distributed among internet users in 2013. Inequalities for more leisurely types of internet use (communication, entertainment) peaked in 2017 and have declined since. The proportion of explained variance in the models is comparable to similar studies (e.g., Bergström, 2017), indicating that variance in internet-related variables is predicted by social exclusion-related variables at about a quarter to a third.

6. Discussion

With internet access and usage becoming a global imperative, investigating inequalities in the adoption of ICTs remains relevant. As initially addressed, at 92%, internet penetration in Switzerland is very high. Using the internet for various purposes has, therefore, become a societal standard. Assuming that internet use can be beneficial for individuals in their everyday lives, the diffusion of the internet is often understood as a socially desirable development. However, being part of a disadvantaged group is likely to have broader negative implications when this group is smaller and divides deepen.

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Internet diffusion, mobile internet usage, internet skills and different types of internet use steadily increased in Switzerland between 2011 and 2019. However, even for very basic internet access variables, digital inequalities persist along traditional societal fault lines (e.g., age, sex, education). These findings are in line with the basic hypothesis of the digital divide framework (see p. 13) and the same was, for instance, found for Britain and Sweden, where access divides remain relevant (Helsper & Reisdorf, 2017). This empirical finding partially contradicts or at least qualifies van Deursen and van Dijk's (2014, p. 521) prediction that access divides regarding sex and age will disappear as the internet spreads across societies and is more in line with their more recent results that highlight the importance of material access to the internet (van Deursen & van Dijk, 2019).

These inequalities also remain relevant for more differentiated types of internet usage. This finding is in line with the constant upgrade culture of the internet (Lister, 2009; Nguyen, 2012): Although traditionally disadvantaged societal groups are increasingly moving online, the advantaged majority of an information society is adopting more differentiated types of internet usage and rapidly developing their internet skills: a basic mechanism is that acquiring new knowledge is proportional to already acquired knowledge. Disadvantaged groups therefore keep falling behind and being asked to play catch-up. In the same vein, structural differences in internet skills are relevant because—as van Dijk (2017, p. 2) puts it—"obtaining physical access makes no sense when people are not able to use the technology".

As for predictions for the future evolution of digital inequalities in Switzerland, our results do not allow a definite answer. The fact that basic access divides are not shrinking, but rather widening, suggests that it is likely that these inequalities will not resolve themselves. As the technology evolves, not using it to its full potential involves many disadvantages for everyday life. Our results suggest that the internet and the expected scope of online engagement are evolving faster than inequalities are resolving themselves. One argument that allows more optimistic predictions for the future is that initial internet adoption is a much higher hurdle than experimenting with more complex types of use when one is already online.

There are limitations to acknowledge when considering the implications and results of this study. Long-term cross-sectional surveys, i.e., repeatedly drawing new representative samples from the Swiss population, is necessary to make statements about the evolution of digital inequalities. However, panel data might complement this analysis by allowing a more detailed understanding of individuals' decision processes when moving online. Since this article's aim was to trace the evolution of indicators of digital inequalities, it relied on a set of unmodified variables. While this was necessary to enable comparisons over time, it simultaneously meant that on-going research in the past decade, which has advanced our understanding of how to best measure certain concepts, could not be considered for the empirical part of this article. Future research should use these updated measurements and scales, while also including a broader set of sociodemographic predictor variables in order to account for emergent intersectional understandings of inequality. Further, the assumption that more internet use is generally preferable has been at the core of digital divide research. It remains plausible that using

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the internet for information seeking or commercial transactions is generally desirable from both an individual and a societal perspective. However, other dimensions of using the internet with potentially more negative outcomes have also been identified. As we have initially mentioned, there is a growing public and academic interest in internet overuse or even addiction, although the latter is highly contested. While conceptual and empirical studies on this phenomenon are emerging (see e.g., Aagaard, 2020; Büchi et al., 2019; Helsper & Smahel, 2020; Kardefelt-Winther, 2014; Sutton, 2020), an encompassing picture of how digital inequalities relate to overuse and its implications is hitherto lacking. However, recent results have shown that sections of the population deal with the abundance of ICTs in their everyday lives differently and experience digital overuse at different rates (Gui & Büchi, 2021). Considering digital overuse in the realm of digital inequality research could mean to understand it as a form of a digital divide outcome (see van Deursen & Helsper, 2015) and stresses the importance of including individual reflections of everyday internet use into these kinds of studies. Reconciling these emerging, potentially harmful forms of internet use with the general pursuit of information societies, which has hitherto mainly relied on the assumption that internet use is solely beneficial from both an individual and a societal perspective, remains a challenging task.

The results of our analyses have shown that Switzerland has a shrinking group of internet non-users, yet access is not universal. Attempts to bring these people online have to specifically focus on these excluded groups and their various reasons for not engaging online. The variance in circumstances, internet skills, online experience and reasons for non-use must be accounted for when developing tailored (policy) interventions that promote internet use. As White and Selwyn (2013) have noted, digital inequalities and online disengagement have to be understood as both technological and social issues.

Waiting for ageing to resolve inequalities is an unviable option for two reasons: first, since societies are ageing, existing digital inequalities are likely to remain a problem for longer and affect ever larger proportions of societies. Second, the results of this study show that inequalities are likely to remain, merely partially shifting to other forms of internet usage. Consequentially, it is necessary to take measures to uphold the quality of life and provide means for functioning in society, also for older societal groups (Bergström, 2017; Hofer et al., 2019). It is likely that a good solution would be to specifically target these disadvantaged groups (e.g., the elderly).

Future research should also include cross-country comparisons of inequality-related predictors of different types of internet usage that investigate the effects of political, economic, and cultural factors. It is likely that variables at the country level affect the evolution of digital inequalities (Helsper & Reisdorf, 2017). Research on the evolution of inequalities also lacks in-depth analyses of individual (sociodemographic) predictors of digital inequalities. For instance, Helsper (2010) calls for "an explicit comparison of sex differences within different generational, occupational, and other groups" (p. 353). Related to our understanding of (inequality-related) differences in internet usage as continua rather than binary distinctions, future research should also focus on more nuanced dependent variables

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that take into account the various possible modes of internet usage. Above all, it is important to stress that everyday internet use is a highly personal and context-dependent behavior, embedded into varying individual and societal contexts. Reasons for engaging in or refraining from certain activities are likely very diverse and more qualitative research is needed to understand these intricacies.

The results of this article emphasize that inferring the specific situations of various segments of society from the fact that a country as a whole, in this case Switzerland, is labeled an *information society* is problematic: the way some people actually live within an information society is likely to be very different from population averages. Even in highly connected information societies, great digital inequalities remain. Our results revealed that older individuals especially tend to be excluded from several facets of digitization. It has become especially apparent that those who do not engage in various types of internet use are at a higher risk of becoming part of a marginalized and shrinking group. It is vital to tackle this threat of digital exclusion and prevent specific parts of the population from suffering compound disadvantages in various spheres of life, especially considering the speed of digital transformation.

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