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LONG PAPER

Remark on digital accessibility: educational disparities define digital inclusion from adolescence onwards

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Abstract
Along with the digitalisation of societies and services, the accessibility of digital content has become the focus of attention. However, emphasis has been on technical accessibility, ignoring the large number of people suffering from cognitive challenges that are expected to increase as the population ages. The purpose of this study is to demonstrate that the problem affects not only the elderly but also the young. Utilising multivariate methods and a data set of 14,892 young Finns, the study examines the impact of educational disparities on young people's digital usage and skills. It is observed that the level of education, the form of education and the regularity of the education path are related to differences in digital abilities of young people. Based on the results, the risks of being excluded from digital inclusion accumulate among adolescents for the youngest, but especially for those with a wide range of language, learning or motivational difficulties that manifest as delays in education path. As is known from previous research, such differences are expected to be reinforced in later life, threatening to become rather determinative.

Keywords Digital accessibility · Digital inclusion · Education · Language and learning difficulties · Young people

1 Introduction

In the early days of the information society, with the spread of internet technology, it was widely assumed that digital technology would enhance democracy and inclusion in societies. The internet was seen as an interactive medium that would end the one-sided communication of mass media and facilitate transformation of its audience from passive viewers to active participants. Emerging new media technology was expected to promote equal opportunities, acceptance, and collective content creation among citizens. [1] However, as is known today, the situation turned out to be much more complicated. While technology has undoubtedly provided new opportunities for participation, it has been accompanied by more or less unexpected barriers to equal social inclusion [2].

Strong expectations regarding the democratisation capacity of technology were and continue to be related to the desire to eliminate social exclusion with the evolving information society. Social exclusion is described as a process involving a lack of resources, rights, and services, but especially referring to the individual's inability to participate in an everyday relationship or activity that is available to most members of society [3, 4]. In the context of the information society, terms such as digital exclusion, digital divide or digital inequality have been used to describe exclusion from technology, e-services and digital arenas, which allow for a wide range of participation and benefits in the lives of individuals [5–8]. In the information society, information poverty has been said to become a significant indicator of deprivation as it describes exclusion not only from information but also from arenas through which information and social networks can be accessed [9]. This threatens to divide individuals of modern societies into the gainers and losers of digitalisation.

Helsper and Reisdorf [10] examined the emergence of digital underclass in two European countries, Sweden and the UK, between 2000 and 2013, and found that digital exclusion is particularly associated with high age, low education, disabilities, social isolation and unemployment. The

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intertwining of digital inequality with traditional forms of inequality has also been strengthening over time, as it was found to be more closely linked to traditional disadvantage at the end of the period considered than in its early years. This was largely explained by strong negative attitudes towards technology, poor availability of devices and low skills in relation to online services.

Helsper and Reisdorf [10] argue that while the traditional causes of digital inequality (lack of access and skills) remain relevant, the importance of intangible factors in particular (motivation and attitudes) seems to have increased during their research period as a root cause behind the exclusion from exploiting the tools and services offered by digitalisation. They also noticed that the importance of education increased its significance, especially in Sweden; at the end of the period considered, those with only primary education were more than ten times more likely to opt out of digitalisation than those with higher education. It is important to notice the argument of Heslper and Reisdorf [10] that digital inequality will not disappear with the younger generations. In fact, they predict that in future generations, Sweden will face a small but seriously digitally excluded group that threatens to fall short of digital services.

Overall, previous research indicates persistent inequalities in digital inclusion, not only between, but within life stages as digital inequality manifests itself at different stages in life [11]. The digital ability of children and young people is strongly determined by differences in access, skills and usage habits [11, 12] as well as by differences in home cultural capital and technological attitudes [13]. Technological attitudes and skills adopted by youngsters strongly direct, not only the usage of technology and the further accumulation of digital skills, but also young people's educational choices, leading to, for example, gender differences in digital education [14]. Digital inequality takes new forms at the stage of young adulthood when individuals enter working life as the so-called white-collar world offers increasingly digitalised jobs favouring more technology-savvy workers [15]. Similarly, in middle age and retirement, the ability to take advantage of and benefit from digitalisation is strongly attached to the level of education [11].

Due to the concerns expressed by Helsper and Reisdorf [10] about the digital exclusion of future generations, this study focuses in particular on young people. Targeting research on young people is essential because the vast majority of research related to digital inclusion and accessibility of services focuses on the adult and elderly population [15–19]. In addition, the present research focuses specifically on education, as education in particular has been identified in previous studies [10, 11] as one of the main explanatory factors for digital marginalisation. For these reasons, this study focuses in particular on the effects of educational disparities on young people's digital usage and digital skills. The empirical part of the study is located in Europe's most digitally advanced country [20], Finland, based on high levels of connectivity and human capital, abundant use of internet services, advanced integration of digital technology as well as established digital public services.

2 Perspectives on the accessibility of digital services

The ambition of inclusion in Europe is to promote socio-economic inclusion of people with disabilities and encourage equal access to services, education, and healthcare [20]. The ideal of digital inclusion covers access, affordability, usage, skills, and relevance of digital technologies for citizens [21]. Digital inclusion as a concept focuses on the policies implemented to reduce digital inequality [22]. In previous studies, low digital inclusion has been experienced by people with socio-economic disadvantage, i.e. those with low incomes, low education and less employment, disabilities, as well as those with lower general and digital literacy [23, 24]. Overall, studies highlight a strong link between social and digital exclusion [6, 17, 19, 25].

A key challenge for public services is that, as the need for public services in disabled and otherwise vulnerable groups continues to be wide, digitalisation makes it difficult to reach these people and hinders their access to the services they need. Schou and Pors [26] state that the digitalisation of public services is built on the ideal of active and self-directed citizens favouring individuals with valid digital competences. As a result, access to welfare services is increasingly dependent on the ability of individuals to take advantage of both digital systems and digital information. In fact, it has been observed [27] that policies to promote the digitalisation of public services make frontline workers responsible for creating self-serving digital citizens. Differences within the population in the ability to take advantage of digital technology become problematic when the provision of well-being is based on the use of digital technology, especially in the form of self-service solutions. Thus, digital welfare services simultaneously both maintain and strengthen the existing modes of social stratification by creating new forms of digital exclusion [26].

The usage of digital technology and digital services is influenced by personal, social and positional variables (e.g. age, education, professional status), attitudinal variables (e.g. computer anxiety), and cognitive abilities (e.g. linguistic and comprehension skills) [5, 10, 18, 24]. Those with higher education and a better social status in general have better access to the resources available and are thus more likely to be able to use digital technology (for example, as part of their work-related duties, day-to-day services, study, leisure, or personal well-being) and to accumulate both their

digital skills and the diverse benefits made possible by digitalisation in their daily lives [28]. In addition to personal, social and positional factors, previous research indicates that attitudinal and cognitive abilities are important for digital usage [10, 18]. In particular, the cognitive challenges are related to linguistic and comprehension disabilities [24]. In terms of attitudinal factors, lack of motivation, but also specific computer anxiety and even so-called technophobia has been identified as significant barriers to the use of computers and the internet in many countries, especially by seniors, the low-educated and part of the female population [5, 10].

Unequal access to digital technologies also depends on the characteristics of the technology [5]. An approach familiar from technology research, the technology acceptance model, identifies two key factors in users' intentions to use technologies that are perceived usefulness and perceived ease of use. Perceived usefulness refers to the extent to which a person believes technology improves their performance, and perceived-ease-of-use refers to the extent to which a person believes that using technology is effortless. [29] However, the theory focuses on the willingness and the intention to use technology and basically offers a perspective related to the commercialisation potential of certain technology.

The above concepts are quite close to the concept of usability [30], which in turn is familiar from user interface design and the development of digital services. Usability of digital services refers specifically to the usability of software with dimensions like efficiency, engagement, error tolerance and being easy to learn [31]. The concept describes in particular how the implemented service and its user interface are being assessed in terms of its usability. The concept of user experience, familiar from human–computer interaction research, in turn, refers to the experience the service or interface provides to its user. It is not just about being useful or usable, but also about making the experience interesting and even fashionable [32].

While the usefulness, ease of use, attractiveness and other characteristics of the technology itself undoubtedly affect the adoption and experience of the technology, these concepts do not describe inequalities or barriers in the usage. In contrast, the term accessibility expressly addresses the discriminatory aspects of the user experience, in relation to objectives in which people can participate equally with websites and digital services [33]. Accessibility is defined in the European Disability Strategy [34] as ensuring people with disabilities equal access to the physical environment, transport, information and communication technologies and systems, and other facilities and services. Accessibility is seen as a precondition for participation in society and in the economy. Legislative instruments and standardisation have been promoted throughout the European Union to optimise accessibility. Since 2016, the Web Accessibility Directive [Directive (EU) 2016/2102] has provided disabled people with better access to public service websites and mobile applications.

Web Content Accessibility Guidelines are standards aimed at ensuring the equal access and use of online services and content [35]. The guidelines cover key areas of technical accessibility, but have long been recognised as providing an insufficient basis for requirements to ensure both cognitive accessibility for people with intellectual disabilities [36–39]. Despite this, the issue of cognitive accessibility of digital services has been found to be even more significant than physical accessibility. Johansson et al. [24] studied the perceived difficulties in internet use among Swedish population with disabilities and found out that they have less access to devices, use the internet less in their daily transactions (i.e. online banking or banking ID identification) and overall feel less included in the digital society than the Swedish population in general. The study highlights that people with disabilities related to language and understanding reported more difficulties than other disability groups. In fact, participants who had studied at special schools for students with intellectual disabilities had the lowest access to digital devices, felt least included in the digital society and found the internet the most difficult to use. Instead, sensory disabilities were not associated with similar experiences of being excluded from the digital society. [24]

Users who suffer from cognitive and learning disabilities have difficulties, not only understanding the linguistic elements and concepts of the content, but especially filling out forms, or entering data into online services in general. Tackling these comprehension difficulties in web design requires understanding the diversity of cognitive deficits. For example, focus on linguistic difficulties may tempt a shift from text-centric to visual guidance, but at the same time, users with memory difficulties face major problems in learning new symbols used in modern web interfaces. The scale of the problem is significant as the number of users with cognitive and learning difficulties is growing globally. This increases the need for assistance and stresses the role of caretakers or relatives and thus narrows the opportunities for people themselves to take care of their own affairs. [40]

Lazar [41] notes that the problem lies in law and design practice, as while tools for the development of accessible services and content have long existed, the web appears to be evolving less accessible over time. The vagueness of cognitive challenges prevents the promotion of wide accessibility in design, complemented by the fact that people with cognitive or learning disabilities are reluctant to report their problems for fear of discrimination or are simply unaware of their own disability [40]. Deficiencies related to cognitive capabilities and knowledge are crucial when facing the modern network environments consisting of intelligent, persuasive choice architectures designed primarily to maintain

user attention, monetise user data and maximise the economic return on platforms by predicting and influencing users' future behaviour [42]. These environments challenge independent decision-making, security and the ability to take care of one's own affairs in online environments, particularly threatening people with cognitive and learning disabilities or lower levels of knowledge as a result of low education.

3 Focusing on educational disparities in the Finnish context

In Finland, digitalisation is a key goal of public administration. The aim is to provide public services digitally accessible to individuals and businesses by opening up public information resources, supporting new solutions for identifying and managing digital identities, as well as developing cybersecurity capabilities [43]. The priority of digital services is a key development principle. The Act on the Provision of Digital Services (306/2019) [44] implements the Web Accessibility Directive nationally in Finland. The purpose of the law is to promote the availability, quality, information security and accessibility of digital services as well as to improve equal access to digital services. In addition to accessibility, the law obliges all public authorities in Finland to provide citizens with the ability to deliver electronic messages and documents related to their day-to-day matters through digital services. In fact, in Finland, the priority of digital services is emphasised in the goals of public administration service development [43]. There is also a clear demand for digital services in Finland. For example, in 2020, 85% of citizens in Finland sought information about public authorities from the internet [45].

The five most popular ways to use the internet among the Finnish population are online banking, sending and receiving emails, searching for information about goods and services, reading online magazines or news pages and using instant messaging services on a smartphone. In the youngest statistical group (16–24 years old), about 90% use all of these regularly, among adults (25–64 years old) the usage rate of these is between 90 and 100% (only instant messaging occupancy remains at 70% among those approaching retirement age), also among the retired (65–74 years old) the use of these five uses is regular as the prevalence is about 80%, although only just over half of this age group make use of instant messaging. The utilisation rate is clearly lower in the oldest age group, i.e. among 75–89-year-olds, where online banking is used by less than half, others by just over a third and instant messaging by a fifth of the age group. [46]

As for education in Finland, the education path starts with pre-primary education for children of the age of six. After one year of pre-primary education, provided in kindergarten or school, children start basic education at comprehensive schools the year when they turn seven. Basic education lasts nine years. After completing basic education, students enter general or vocational upper secondary education. Students in a general upper secondary school can choose advanced studies, for example, in languages, mathematics or social studies, but they are still aiming for an equal matriculation examination. Instead, vocational high school students study in separate degree programmes for a particular profession. Both options of secondary education are designed to last three years but may be completed in two to four years and both also produce eligibility for tertiary studies. [47] More than 90% of Finnish youngsters start upper secondary studies immediately after basic education. According to Statistics Finland's education statistics, more than half of young Finns (54%) continued in general upper secondary education, 40% in vocational education, one per cent in additional education and two per cent in preparatory education. Only 2.4% of those under 18 years who had completed basic education did not continue their education at all in the reference year 2019. [48]

Preparatory education for vocational training is primarily intended for young people who have completed basic education, but are still without a place in secondary education, as well as for young adults with an immigrant background. The training is aimed to find the right study field for the participants and to prepare them with the necessary skills to start their studies in vocational education. Training helps students to improve their language skills and other abilities needed for studying according to individual study plans. Preparatory education lasts between 6 and 12 months. In Finland, separate preparatory training is also provided for immigrants aiming to enter general upper secondary schools. [49] Starting the year 2022, with the new Act on Compulsory Education (1214/2020) [50], a new kind of preparatory education will be organised, from which students can continue to either vocational or general upper secondary education.

Although the regular education path in Finland begins in pre-school in the year the child reaches the age of six, continuing to basic education the following year and from there to the secondary education in the year the youngster reaches the age of 16, various flexible solutions related to the individual needs and life situations are part of the Finnish education system. For example, the beginning of the educational path can be delayed if the child's school readiness is insufficient, classes can be repeated if the learning objectives are not achieved, preparatory education is available after basic education and the started studies in some field of secondary education can be flexibly changed to another. For these different reasons, each grade, especially at the secondary education level, is attended by students who are older than the expected age of participation compared to the regular progression of the education path.

Based on previous Finnish research [12], it is known that gendered educational choices, inherent to the Finnish education system, produce differences among young Finns as the digital skills and digital engagement of students in male-dominated fields were found to be better than those in female-dominated fields. Based on this prior knowledge, the aim of this study is to focus more specifically on the educational factors that affect young people's digital inclusion abilities. The research questions, targeting Finnish young people aged 15–19, are as follows:

RQ1 How does the level of education affect the young people's digital usage and digital skills?
RQ2 How do the forms of education affect the young people's digital usage and digital skills?
RQ3 How does the regularity of the education path affect the young people's digital usage and digital skills?
RQ4 What is the role of educational differences in explaining digital inequalities in relation to personal characteristics (age and gender)?

4 Methods

4.1 Data and variables

This study utilises three data sets collected in previous research projects (in years 2014–2019) of the Research Unit for the Sociology of Education of the University of Turku.

1) Data set 1 includes 2486 respondents, aged 15–19, from both the basic and secondary education (both general and vocational upper secondary school students) and students from the preparatory training groups. The data were collected in 2014–2016. The sample mainly covers south-western Finland and is based on convenience sampling.
2) Data set 2 includes 9316 basic education-level students from grade 9, ages 15–17, and was collected in 2017–2019. The sample formed by the Finnish Education Evaluation Center covers the whole of Finland and is representative of different types of municipalities and regional administrative areas. Sampling has been done at the municipal level, with the participation of schools and individuals being voluntary.
3) Data set 3 consists of 3090 secondary education students (both general and vocational upper secondary school students), ages 15–19, and was collected in 2017. The sample represents the whole of Finland and is based on the same sample of municipalities as in data set 2. Sampling has been done at the municipal level, with the participation of educational institutions and individuals being voluntary.

All data sets included a comparable usage habits survey (for more information, see [12]), from which usage habits corresponding to the top 5 uses of Statistics Finland [46] were selected for this study, as well as use of social platforms and gaming, which are common uses of technology among young people [12]. In contrast to Statistics Finland's classification, emailing and instant messaging have been combined into a single communication variable. Thus, the uses considered in this study (i.e. variables of digital usage) are the use of the internet for (a) maintaining social relationships, (b) using digital services, (c) following current affairs, (d) communicating, (e) gaming and (f) searching for information. These were asked from participants in the following question format: "I use the internet for the following purposes on a scale of 0 = never, 1 = occasionally, 2 = weekly, 3 = daily, 4 = several hours daily".

In data sets 2 and 3, the uses were asked as the above categories. Instead, in data set 1 (i.e. the earlier version of the survey), the categories of maintaining social relationships, using digital services, gaming, digital communication, and internet searching were combined from separate variables. The category of maintaining social relationships was combined from variables about use of social platforms for networking, online photograph and video sharing services, blogs, and forums. The category of digital services was combined from variables about the use of online banking, public e-services and webstores. The category of current affairs was combined from variables related to following up of web magazines, news channels and weather services. The category of gaming included multi- and single-player video games and other digital games. The category of digital communication included emailing and instant messaging, and the category of internet searching was combined from variables about the search for both information and services on the internet. In the new version of the survey, these same sub-items were provided as explanations for the uses asked at the category level. All aggregations were based on the maximum value of the respondent sub-items because respondents may not be equally active in every sub-item of the particular usage category, but when asked at the category level, they would have answered specifically on the basis of their most active use.

The skills test of the Research Unit for the Sociology of Education used in original data collections was renewed after data set 1 (for detailed information about the tests and related item analysis see [12]. For this reason, only total test scores are used as an indicator of digital skills. The data set scores were standardised before the data sets were combined to achieve comparability over data sets utilising standard score, i.e. z-score method described as $\mathbf{Z} = (x - \mu)/\sigma$. The combination produced a data set (opened in the Zenodo data archive, see [51]) of 14,892 young Finns. The combined data set contains information on 15–19-year-olds' activity in the

above-mentioned six usage categories, an indicator of their digital skills and information about participant's gender, current participation in education and the regularity of the education path. Overall, 46.7% of the participants in the data are female and 53% male, in addition to which 0.3% did not want to report their gender.

For educational variables, the data include information about the participants' level of education (basic or secondary education), form of education (comprehensive school at the basic education level, general and vocational upper secondary school at the secondary education level and preparatory training group), as well as regularity of her/his education path (i.e. regular or delayed transition). Participants from basic education are identified as being over-represented in the data, with two-thirds of participants (9906) representing basic education-level students and about one-third (4918) secondary education-level students. Two-thirds (9906) of the participants are comprehensive school students, about one-fifth (3222) from general upper secondary schools, about 11% (1696) from vocational upper secondary schools and less than 1% (68) from preparatory education groups. The education path is considered as delayed if the age of student exceeds (by one or two years) the age of students with regular transition at the corresponding grade level. If the student's age corresponds to the normal age at his/her grade or the student's identification to the delayed group cannot be ascertained, he/she was considered to belong to the regular transition group. Altogether 133 students from basic education level and 111 from secondary education level were identified as belonging to the group of delayed transitions, in addition to which all students participating in preparatory training (68) are considered to belong to the group of delayed transitions. Thus, a total of 312 delayed education paths were identified, corresponding to about two per cent of all participants.

4.2 Analysis

In order to answer the RQ1 on the impact of the level of education on young people's digital usage and digital skills, the analysis was targeted at differences between basic and secondary education students. Participants in the preparatory training group were excluded from this analysis. When answering the RQ2 on the impact of the forms of education, the analysis focused on comparing the differences between different forms of education. To answer the RQ3, in turn, the focus is on the impact of the regularity of the educational path and the comparison is targeted between the regular and delayed transitions on the education path. All group-wise comparisons were made using analysis of variance (ANOVA). For pairwise comparisons in the analysis between forms of education containing more than two groups, Tukey's method was utilised.

After between group comparisons, a multiple linear regression analysis was performed to predict the digital skills (dependent variable) of 15–19-year-old Finns with independent variables classified into two models. The regression analysis not only answered the skills part of the RQ1, RQ2 and RQ3, but also allowed the effects of the variables to be controlled and thus helped to shed light on the relationship between personal characteristics and educational variables as explanators of young peoples' digital inequalities, thus answering the RQ4. Model 1 included socio-demographic factors (gender and age), to which Model 2 added educational factors (level of education, form of education and regularity of the education path). The regression model was built with a block-wise approach. *R* squared scores and residual standard error were applied to compare the explanatory power and the goodness-of-fit of the models.

5 Results

The use of digital devices is common among Finnish young people, especially in their leisure time, but also as part of their studies. Therefore, it was not surprising that there were no participants in the data who had not used any of the six usage categories under examination at least occasionally. Figure 1 shows the usage of digital technology by age. Among 15-year-olds, usage focuses on maintaining social relationships on social platforms (for an average of several hours a day) and digital communication (for an average daily basis). In addition, 15-year-old Finns regularly (on a weekly basis) use information technology to search for information, to follow current affairs, such as news and weather services, and to play video games. Instead, the usage of digital services among 15-year-olds remains only occasional. By the age of 19, maintaining social relationships and digital gaming decrease slightly, while other types of uses become more common with increasing age. In particular, the use of digital services is increasing among young people on the eve of adulthood. With regard to digital skills, the standardised total scores increase from an average of − 0.37 at the age of 15 to an average of 0.80 at the age of 19, being the highest among 18-year-olds (with average of 0.88), indicating a clear improvement in skills with age.

The first comparison was related to the impact of the level of education on young people's digital usage and digital skills (RQ1). Therefore, Table 1 visualises the differences in digital technology usage and digital skills between the levels of education (i.e. basic and secondary education). Secondary education students use social platforms and digital gaming less than basic education students, whereas other types of uses were more commonly used among secondary education students. The digital skills of secondary education students were significantly better than those of basic

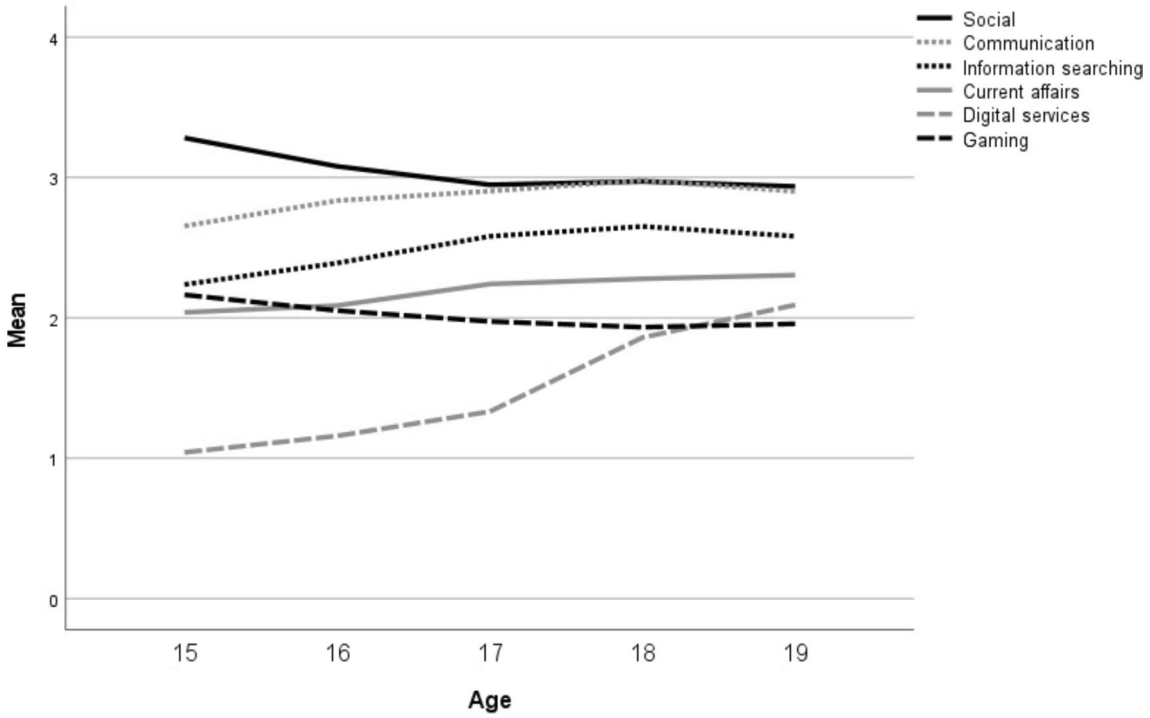

Fig. 1 Usage activity in digital technology usage categories by age (0 = never, 1 = sometimes, 2 = weekly, 3 = daily, 4 = several hours per day)

Table 1 The one-way ANOVA table for differences in digital usage and digital skills among 15–19-year-olds between the levels of education

Item of measurement	Basic education *M* (SD) (*N* = 9906)	Secondary education *M* (SD) (*N* = 4918)	*F*	d*f*	*p*
Maintaining social relationships in social platforms	.12 (.938)	− .23 (1.065)	427,002	1	< .001
Use of digital services	− .13 (.976)	.25 (.989)	502,539	1	< .001
Following current affairs online	− .06 (1.006)	.13 (.972)	121,141	1	< .001
Online communication	− .10 (1.029)	.19 (908)	274,295	1	< .001
Video and digital gaming	.06 (1.003)	− .11 (.987)	89,518	1	< .001
Searching for information on the internet	− .15 (1.015)	.30 (.896)	701,358	1	< .001
Digital skills	− .47 (.491)	.90 (1.096)	10,651,565	1	< .001

education students. Based on the analysis of variance, all differences between the levels of education were significant at the 0.001 level.

The next comparison related to the differences in digital use and digital skills of young people based on the forms of education (RQ2). Table 2 shows the differences in digital technology usage and digital skills between the forms of education (i.e. comprehensive school, general upper secondary school, vocational upper secondary school, and preparatory training for vocational education). All comparisons proved to be significant at the 0.001 level. Pairwise comparisons showed that the use of social platforms is most common among comprehensive school students (i.e. at basic education level) and remarkably low among students in preparatory training for vocational education. The use of digital services is most common among secondary education students, both vocational and general upper secondary school students. Instead, the youngest, i.e. comprehensive school students, used the digital services the least. The students in preparatory training were found to follow current affairs online most passively, whereas general upper secondary school students were most active users of news sites, weather services and other forms of current affairs.

In online communication comprehension school students found out to be the most passive. Surprisingly, students in the preparatory training for vocational education were most active in online communication. Video and digital gaming is most common among comprehensive school and vocational

Table 2 The one-way ANOVA table for differences in digital usage and digital skills among 15–19-year-olds between the forms of education

Item of measurement	CS *M* (SD) (*N* = 9906)	PTVE *M* (SD) (*N* = 68)	VUSS *M* (SD) (*N* = 1696)	GUSS *M* (SD) (*N* = 3222)	*F*	d*f*	*p*
Maintaining social relationships in social platforms	.12 (.938)	− 1.08 (1.279)	− .36 (1.117)	− .16 (.975)	185,229	1	< .001
Use of digital services	− .13 (.975)	− .03 (1.004)	.34 (1.071)	.22 (.944)	173,657	1	< .001
Following current affairs online	− .06 (1.006)	− .30 (1.054)	.01 (1.034)	.20 (.929)	56,567	1	< .001
Online communication	− .10 (1.029)	.37 (.983)	.15 (.979)	.21 (.866)	96,285	1	< .001
Video and digital gaming	.06 (1.002)	.04 (1.036)	.12 (.981)	− .24 (.966)	78,769	1	< .001
Searching for information on the internet	− .15 (1.015)	.23 (1.012)	.19 (1.001)	.36 (.827)	247,250	1	< .001
Digital skills	− .47 (.491)	− .69 (.461)	.62 (1.126)	1.06 (1.056)	3808,923	1	< .001

CS comprehensive school, *PTVE* preparatory training for vocational education, *VUSS* vocational upper secondary school, *GUSS* general upper secondary school

upper secondary school students, whereas general upper secondary school students play digital games the least. General upper secondary school students search for information on the internet most actively, while the low levels of information searching among the comprehensive school students significantly differentiate them from students in all other forms of education. In terms of digital skills, the preparatory training students lag behind the comprehensive school students, both of which differ greatly from students in secondary education level. Overall, general upper secondary school students have the strongest digital skills.

The last comparison of differences in digital usage and digital skills among young people was related to the regularity of the education path (RQ3) shown in Table 3. Maintaining social relationships on social platforms is significantly lower for those young people whose education path has been delayed for one reason or another. Video gaming and information searching from the internet were found to be significantly more common among delayed transitions than in the regular transitions group. On the other hand, no significant differences in activity were found in relation to usage of digital services, following current affairs or digital communication on the basis of regularity of education path. In digital skills, the difference was again found to be highly significant, in favour of those with regular transition on their education path.

After between groups comparisons, the multiple linear regression analysis was conducted (see, Table 4). It specifically sought to answer the RQ4 about what role do young personal characteristics play in explaining digital inequality in relation to the educational variables focused in the three previous comparisons. Both tested models proved to be significant (Model 1 [$\mathbf{F}(2, 14{,}342) = 1804{,}541$, $p < 0.001$], Model 2 [$\mathbf{F}(5, 14{,}339) = 2334{,}899$, $p < 0.001$)]. When comparing the explanatory power of the models (Model 1: adjusted R^2 0.20; Model 2: adjusted R^2 0.45), the explanatory power of model 2 was found to be stronger. In fact, adding education variables to the regression model increased the explanation rate from 20 to 45%. The standard error of the estimate decreased between Model 1 and Model 2 from 0.894 to 0.744, indicating that the latter model had also better fit to the data. The R^2 change of these two models also turns out to be statistically significant ($p < .001$) confirming the choice of model 2 as the final model.

Model 1 shows that the digital skills of young Finns are significantly explained by age (skills improve with age) and gender (the skills of boys and young men are somewhat better than those of girls and young women). The final model

Table 3 The one-way ANOVA table for differences in digital usage and digital skills among 15–19-year-olds based on the regularity of the education path

Item of measurement	Delayed transition M (SD) (*N* = 312)	Regular transition M (SD) (*N* = 14,581)	*F*	d*f*	*p*
Maintaining social relationships in social platforms	− .61 (1.291)	.01 (.987)	121,152	1	< .001
Use of digital services	.07 (1.110)	− .01 (.997)	1776	1	.183
Following current affairs online	− .09 (1.114)	.01 (.997)	2769	1	.096
Online communication	.07 (1.178)	− .01 (.996)	1633	1	.201
Video and digital gaming	.14 (1.079)	− .01 (.998)	6561	1	.010
Searching for information on the internet	.15 (1.149)	− .01 (.996)	7307	1	.007
Digital skills	− .57 (.497)	.01 (1.001)	96,651	1	< .001

Table 4 The multiple linear regression analysis of the predictors of young peoples' digital skills

	Model 1					Model 2				
Independent variables	*B*	SE	*β*	*t*	*p*	*B*	SE	*β*	*t*	*p*
(Constant)	−7.617	.128		−59,405	<.001	−2.804	.142		−14,087	<.001
Age	.481	.008	.448	60,018	.000	.025	.010	.023	2545	.011
Gender (0 = female)	.060	.015	.030	4044	<.001	.001	.012	.001	,130	.897
Level of education*						1901	.035	.902	54,812	<.001
Form of education**						.410	.023	.285	17,967	<.001
Regularity of education path***						−.645	.051	−.089	−12,535	<.001

*0 = basic education, 1 = secondary education

**0 = comprehensive school, 1 = preparatory training for vocational education, 2 = vocational upper secondary school, 3 = general upper secondary school

***0 = regular transition, 1 = delayed transition

(Model 2) shows that when educational variables are added to regression analysis, the significant effect of gender is eliminated indicating that gender is secondary to educational choices. The level of education emerges as important for the skills of young people, as the skills of those studying at secondary education level are significantly higher than those of basic education level. The form of education has a significant impact on young people's digital skills, as the ANOVA has already shown. In addition, the regression analysis confirms the observation already made that delays in the education path have a significant negative effect on young people's digital skills. Nevertheless, the importance of age to the explanatory variable remains significant in model 2, but to some extent lost its explanatory power when compared to model 1.

Figure 2 illustrates the findings of regression analysis related to the importance of educational variables for young people's digital skills. The figure makes it clear that low digital skills are characteristic of basic education students, but especially of students in preparatory training and those with delayed transition on their education path. In addition, the figure shows that although digital skills generally increase with age, this increase in skills does not occur among preparatory education or those whose education path has been delayed. Instead, their skills remain at most at the level of basic education students regardless of age.

6 Discussion

The results of this study show that the level of education has a significant impact on both students' digital usage and digital skills, as digital usage is more diverse and digital skills are stronger among secondary education students than among basic education students. It can be assumed that this happens as a result of increasing age, i.e. turning on to adulthood as well as a result of the requirements of upper secondary education, as the use of digital learning materials is common in Finnish educational institutions. Further in regression analysis, the level of education also proved to have an independent explanatory power on young people's digital skills regardless of age. Therefore, it is not just a question of the effects of increasing age, but it can be assumed that the requirements of secondary education and the increasing use of digital environments and content in studies affect students' skills in secondary education level.

The form of education was also found to have an impact on both digital usage and digital skills. It is noteworthy here that those who take part in preparatory training in particular stand out in terms of their usage habits especially if compared to young people in their own age group who are already studying in secondary education. In the case of preparatory training students, the meagre use of social platforms, but in contrast, abundant online communication, as well as the low level of digital skills, is highlighted. It should be noted that about one-third of the tested preparatory training students had an immigrant background, about one-third had special educational backgrounds or otherwise lacked study skills, and the last third had earlier failed attempts to participate in secondary education which had ended up dropping-out due to either lack of motivation or required learning ability, or a difficult life situation. These young people therefore had mainly either language or learning difficulties and/or motivational reasons why they had applied for or become guided in preparatory training.

The regularity of the education path was also found to be relevant to digital inclusion abilities. Particularly, the delayed transition on the education path was found to have a negative effect on young people's digital skills, and to be associated with differences in digital usage compared to those whose transitions in the education path have been regular. Specially, the delay was observed being related to the low use of digital devices to maintain social relationships on social platforms, which allow for multi-person

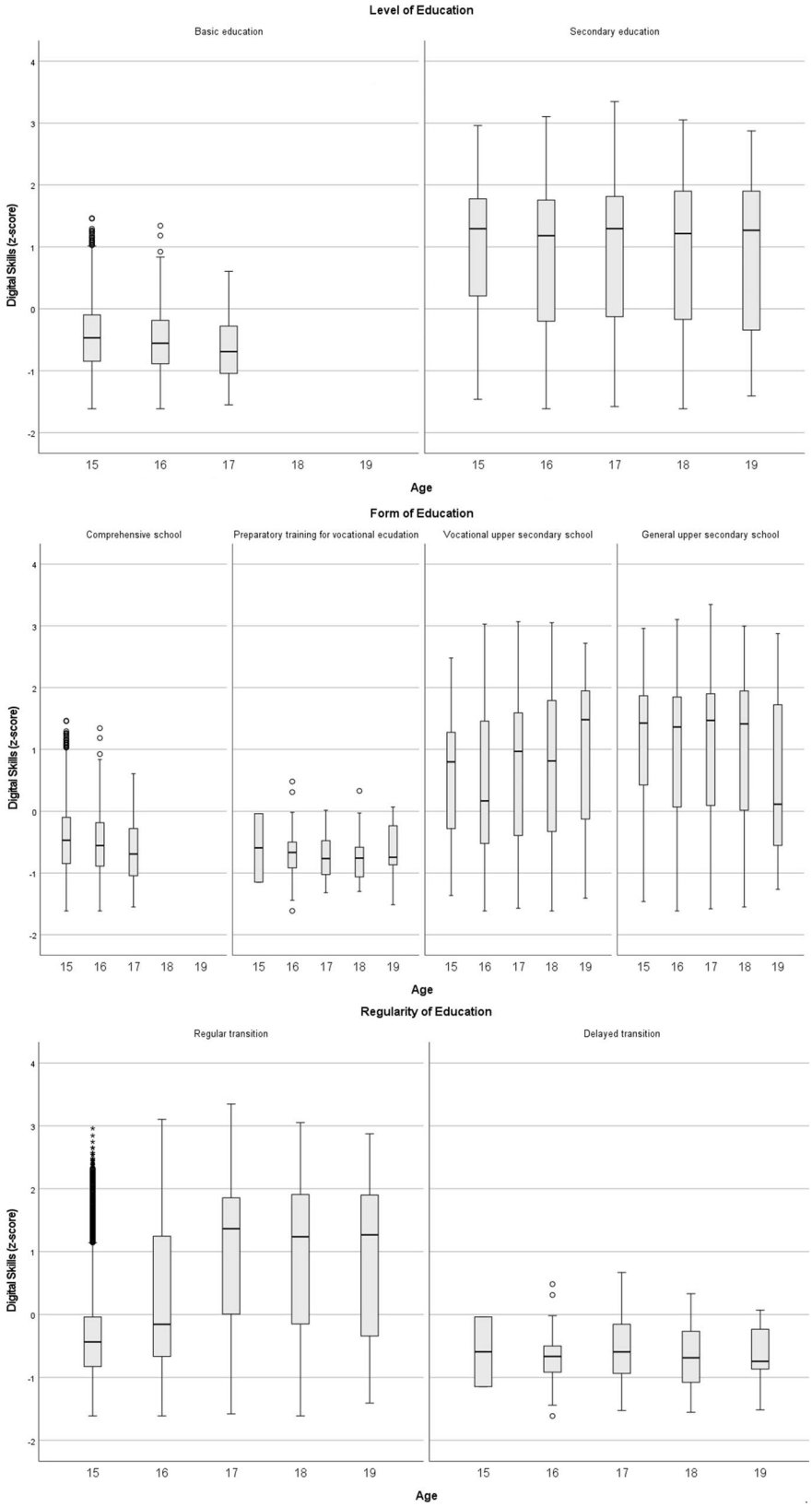

Fig. 2 Visualisation of the effect of educational variables on the digital skills of young Finns

communication. In turn, digital communication in media based on two-person communication was found to be more common among delayed transition group than among regular transition group. In addition, students with delayed transition were found to lack digital skills compared to other young people. Similar findings were also made among preparatory training students, as noted above. Previous research [52] suggests that social media can help to overcome language barriers and strengthen a sense of support among young people with an immigrant background. However, the results of the current study raise the question of the extent to which open, multi-person social platforms themselves constitute barriers to the social participation of young people with language or learning difficulties. This concern arises precisely from the fact that lower abilities for digital inclusion are linked to young people whose educational paths are delayed, likely to reflect wider learning and language difficulties. However, these underlying causes cannot be adequately elucidated with the data used in this study.

The overall empirical results of the study stress the importance of educational disparities for young people's digital inclusion. Educational factors proved to be more important as explanators of digital skills among young people than personal factors (age and gender). At the same time, the results indicate that the risks of being left out of digital inclusion accumulate among young people for the youngest, but especially for those with various unspecified language or learning difficulties and delays on their education path. The findings demonstrate not only a skills gap between youngsters with delays or difficulties and other young people in the same age group, but also imply the social exclusion from social platforms of young people facing challenges on their education path. The study provides support for previous findings [6, 11, 17, 25] in which shortcomings in education and wider social deprivation have been identified as risk factors for digital marginalisation. It is noteworthy that the well-known link between professional status and processes that strengthen participation in the information society [16, 53] materialises the effects of educational disparities on digital inequality as young people grow up and enter working life.

Current evidence, combined with a previous research finding [24] that individuals with language and learning difficulties feel most excluded from digital inclusion, emphasise the importance of cognitive and social accessibility in the development of digital services. Therefore, consideration must be given when developing and providing digital solutions to support young people with backgrounds in learning difficulties, previous interruptions or other challenges on their education path, as these are adolescents who are less able to make use of digital services or search for information on the internet compared to other young people in the same age group. Here, technical accessibility alone is not enough, as has been stated in the previous research [36–39]. As a result of the current situation, which largely ignores cognitive and social accessibility, the majority of online content and digital services are still not or are only partially accessible [54]. Particular attention should be paid to the fact that young people with low digital capabilities due to cognitive and social disabilities, have a greater need for support services and independent acquisition of information than their age group in general.

Among young people, grappling with their educational path, who have a great need for (digital) public services, but the ability to use them varies widely, problems arise not only from accessibility of services. Also the intrusion of false and misleading information into online content as well as huge amounts of information [55] that, in Simon's (1971) words, "creates a poverty of attention", makes it difficult for these young people to access services and reliable information. Information overload and scarcity of attention have become even more apparent with the rapid spread of modern media technology, and there are significant, largely unfamiliar risks associated with the speed of change. According to Kozyreva et al. [55], the most worrying thing is that digital transformation is largely taking place in a regulatory vacuum; nothing prevents platforms from radically changing their interfaces overnight, making it significantly challenging for people to survive in online environments, with unknown consequences for society and democracy.

The new Act on Compulsory Education (1214/2020) guarantees every young Finn a place in secondary education, preparatory education for those who need it, and enhanced guidance and support for those who find it difficult to find or get involved in studies. The ideal of the reform is not just to promote the needs of society, but rather a more individualised policy that emphasises the importance of increasing opportunities for individuals and is underpinned by the goal of effective transition of individuals to education and the labour market [56]. However, compulsory education ends when individuals reach the age of 18. Inevitably, there will continue to be some number of young people who will not be able or willing to complete their secondary education. Given the clear role of education in the digital inclusion of young people, emphasised in this study, there is a risk that in the future these individuals will form the core of a severely digitally marginalised population like the one Helsper and Reisdorf [10] warn about in their study of Finland's neighbouring country, Sweden.

As a main limitation of the current study, it should be noted that the research data are based on previously collected data sets, the sample of which is not representative in relation to the various educational options in Finland. In addition, young people who are completely out of education are missing from the sample. These are a hard-to-reach subgroup of young population whose digital usage and skills

should be explored in order to reach understanding of the issue, develop the necessary interventions and build up the services that are suited and accessible for them. There is also no comprehensive background information available on young people represented in the current data, such as the social status of their families or their previous school success. The main problem is that the available Finnish register data, which are comprehensively collected from various authority sources, and which would in itself solve the above-mentioned sampling problems, do not, at least not comprehensively, include indicators related to an individual's digital competence or use of digital services. Therefore, addressing and controlling such issues in survey-based data collections would be important in future studies on the subject.

7 Conclusion

The results obtained highlight the importance of educational disparities for the abilities of digital inclusion among young people. The differences do not necessarily have to arise as a result of a severe disability; rather, much minor deviations in education path are related to disadvantageous effects on digital usage and digital skills. However, further research is needed to address, for example, the above-mentioned shortcomings in the representativeness of data and the coverage of background variables. The current study is also limited to the individual's own life situation; research into the effects of intergenerational disadvantagement, known from research on educational inheritance [57], on digital inequality is yet to begin. In the case of Finland, it is also important to monitor the consequences of the new compulsory education act on young people's digital inequality as it must be assumed that failure to complete secondary education will become an increasingly exclusionary life event for individuals in the future.

The results of the study highlighted a somewhat unexpected finding that young people facing challenges on their educational path favour media suitable for two-person communication rather than social platforms that allow for multilateral interaction. It would be important to examine this difference in usage habits in the future, i.e. to find out the extent to which this is a matter of user preference and the extent to which it is due to a lack of digital communication skills related to specific language and learning disabilities. Such a difference in usage patterns has a significant impact on the social participation of young people, which is why it is also a matter of social accessibility and therefore should be taken into account in the design of digital services and their communication features and interfaces.

More generally, the results of this study stress the previous notions [36, 39, 40] that efforts on accessibility for online content and services should focus more on cognitive and social accessibility rather than mere technical accessibility and the implementation of assistive functions for users with sensory or physical disabilities. The cognitive challenges of users are in a sense a hidden problem that, however, affects a significant number of users of all ages today and will continue to do so in the future. Young generations born and raised in the midst of digitalisation do not solve this problem. This is due to the situation highlighted in this study, i.e. there are differences between young people in their abilities of digital inclusion, especially due to differences in education. These differences are to be reinforced in later life stages [11], which is why educational disparities are expected to determine the position of individuals in relation to an ever-digitalising society.

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