Article

new media & society
2018, Vol. 20(7) 2489–2508

DOI: 10.1177/1461444817725918
journals.sagepub.com/home/nms

The social inequalities of Internet access, its use, and the impact on children's academic performance: Evidence from a longitudinal study in Switzerland

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Abstract

This longitudinal study explores differences in Internet access and use among school-aged children in Italian-speaking Switzerland and whether and how these differences contribute to inequalities in academic performance. Applying multilevel structural equation modeling with two-wave original survey data from 843 students, their parents, as well as students' end-term school grades, we show that a family's socio-economic status indirectly affects children's school grades as lower parental income leads children to use the Internet more frequently for entertainment and online communication purposes. This form of Internet use also increases as children have more personal digital media devices. As children's increased use of the Internet for entertainment and online communication worsens their academic performance, our results suggest that social inequalities due to children's socio-economic status are reinforced by a second-order digital divide. We discuss potential reasons for our findings as well as their implications and recommendations for possible interventions.

Keywords

Academic performance, children, digital divide, Internet, Italian-speaking Switzerland, longitudinal study, socio-economic status

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Introduction

Coming of age during the digital revolution, children today are avid consumers of digital media. While more traditional forms of media such as television still remain popular, children are increasingly turning to new forms of media including the Internet (Rideout et al., 2010; Roberts and Foehr, 2008; Waller et al., 2016). The Internet can now be accessed from a suite of devices such as laptops, tablets, and smartphones, which are increasingly marketed to children as social necessities and fuel the privatization of their media exposure (Roberts, 2000). In wealthy countries, the Internet has become an almost inescapable part of the child development process. Children have greater autonomy over their Internet use and are subjected to its influence from an early age (Kirkorian et al., 2008).

Yet, screen media—including the Internet—are often blamed for children's poor academic achievement as its use is said to shorten attention spans (Carlson, 2005) and costs time that children could better spend studying or engaging in offline activities that support their cognitive development (Ennemoser and Schneider, 2007; Subrahmanyam et al., 2000). At the same time, research on the use of new media has revealed benefits for children's cognitive development (Attewell, 2001) as the Internet provides additional reading time (Jackson et al., 2006) and allows for multimedia (Zhang, 2005), interactive (Evans and Gibbons, 2007), and peer-based learning (Itō et al., 2009), which are known to enhance the motivation to learn and the memorization of information.

Given this conflicting evidence, the scholarly agenda is moving beyond the question of whether there is a general impact of the media on children (Gross et al., 2002) by looking at how situational conditions and personal characteristics of children may differentially affect media use and developmental outcomes. Recent evidence points to the need to distinguish between different types of media and different purposes of children's media use (Borzekowski and Robinson, 2005; Kirkorian and Anderson, 2010). Furthermore, it is claimed that certain characteristics in children can allow them to make beneficial use of screen media or can make them particularly vulnerable to its negative impact (Mößle et al., 2010; Notten and Nikken, 2016; Roe, 2000). A child's family situation has emerged as among the most potent factors, with children in disadvantaged families being at a higher risk of negative media impacts (Vigdor et al., 2014; Wallenius et al., 2007). The question remains why and how inequalities in socio-economic status contribute to the detrimental impact of digital media on children and on their cognitive development and academic performance in particular.

Digital divide and academic performance

The conventional understanding of social inequality sees a family's lower socio-economic status as potentially posing financial or knowledge barriers to accessing the Internet. More precisely, lower income and education families are considered to have limited resources and competences, which are needed to purchase media devices and supporting technology including broadband connection (Resta, 1992; Sutton, 1991). Not discounting the relevance of the *(first-order) digital divide* in accessing the Internet to social inequality in less developed countries (Castells, 2002; Norris, 2001; Warschauer,

2004; Wessels, 2010), this understanding is less applicable in today's affluent societies where the proliferation of mobile technology now gives relatively affordable access to the Internet (Lopez et al., 2013; Tondeur et al., 2010). Still, some financial costs may limit which media devices a family purchases. For instance, computers—more commonly linked with educational and work-related use and needs—are still relatively more expensive than other devices. This may explain why lower income families in European countries own fewer computers than their better-off counterparts (Braak and Kavadias, 2005; Facer and Furlong, 2001).

Nevertheless, inequalities may persist due to the emergence of a *second-order digital divide* (Attewell, 2001; Hargittai, 2002; Ragnedda and Muschert, 2013; Riggins and Dewan, 2005; Van Deursen and Van Dijk, 2014) where disparities occur in what children use the Internet for rather than obtain access to it, per se. Recent studies in Europe have found that coming from a lower socio-economic background does not mean that children lack access to devices and new media (Braak and Kavadias, 2005; Tondeur et al., 2010) but suggests that children of parents with higher educational attainment and higher occupational status are more likely to use the Internet for informational needs (Notten et al., 2009; Peter and Valkenburg, 2006). These behavioral differences potentially result in disparate outcomes, that is, children's academic performance. Yet scholars acknowledge, we still have much to learn about how media use at home shapes children's classroom outcomes (Eamon, 2004; Lauman, 2000). Prior empirical work shows that the manner in which children use home computers is critically important, highlighting a distinction between use for academic and non-academic purposes (Eamon, 2004) as consequential for children's academic performance (Casey et al., 2012; Wittwer and Senkbeil, 2008). Thus, in light of the emerging second-order digital divide, we seek to answer the following research question:

> *RQ.* Do differences in the access and use of digital media by children with different socio-economic backgrounds contribute to disparate academic performance, and if so how?

While we know that children from families with a lower socio-economic status tend to be worse off than their peers (Capron and Duyme, 1989; Lee and Burkam, 2002), the role that access to the Internet and its use have in exacerbating gaps in academic performance has yet to be fully understood. Research on the digital divide considers unequal family income and parental educational attainment as two central socio-economic family indicators that predict differences in Internet access and its use by children (Livingstone et al., 2005; Peter and Valkenburg, 2006). This understanding of causes and effects follows the framework by Bonfadelli (2002), who explains the evolvement of knowledge gaps in the era of the Internet as a consequence of socio-economic factors that lead to differential Internet access, skills, and use.

The study of knowledge gaps dates back to the 1970s and the rise of television as a mass medium. According to the knowledge gap hypothesis (Tichenor et al., 1970), people with higher formal education are more likely to turn to print media to obtain information and gain knowledge about public affairs. Furthermore, they have better reading and comprehension skills needed to learn about important news or science. With the

diffusion of the Internet in the 1990s, the basic assumptions of the knowledge gap hypothesis were adopted for the digital divide concept, according to which—as previously described—people with higher socio-economic background have greater access to the Internet than their worse-off counterparts (first-order digital divide). In addition, people with better education and more financial resources have the necessary skills and motivation to use the Internet for informational needs and this way make more beneficial use of online content (second-order digital divide). (Bonfadelli, 2002)

Grounded in these theoretical considerations and empirical findings on first- and second-order digital divide, we put forward the following hypotheses:

H1. Higher level of parental educational attainment at t_1 leads to more digital devices for children's personal Internet access at t_1 (first-order digital divide).

H2. Higher family income at t_1 leads to more digital devices for children's personal Internet access at t_1 (first-order digital divide).

H3. More digital devices for personal Internet access at t_1 increase children's Internet use for information and education at t_2 (second-order digital divide).

H4. More digital devices for personal Internet access at t_1 increase children's Internet use for communication and entertainment at t_2 (second-order digital divide).

Although studies have shown that the Internet can offer learning opportunities for children (e.g. Evans and Gibbons, 2007; Itō et al., 2009; Zhang, 2005), obtaining access to digital devices alone does not guarantee that children will be able to translate them into academic benefits. While research on newer mobile media devices is still in its infancy, studies on home computer use are better established. These demonstrate that access to a computer by itself does not foster studying (Fairlie and Robinson, 2013) and use can have a negative impact on educational performance (Malamud and Pop-Eleches, 2010; Vigdor et al., 2014; Woessmann and Fuchs, 2004). Instead, computer use can have a positive effect on school performance if it is used for educational purposes (Woessmann and Fuchs, 2004). It remains an open question whether or not mobile Internet devices such as smartphones or tablets follow similar patterns.

There is reason to expect that these devices distract from learning. For instance, in a cross-sectional study across seven European countries, Mascheroni and Ólafsson (2016) found that "smartphone use is associated with a consistent increase in social networking and entertainment activities but is not correlated with use of the Internet for schoolwork" (p. 1676). Furthermore, evidence shows that using social media reduces study time (Kirschner and Karpinski, 2010) and can interfere with sleep (for a review, see Cain and Gradisar, 2010). In addition, research on media multitasking while learning revealed negative short-term impacts on academic performance when (mobile) media are used for social networking and instant messaging during homework and in class (for a review, see Chen and Yan, 2016), mainly because it leads to attention problems and scattered learning habits, which eventually result in lower grades (Wei et al., 2012). For these reasons, we distinguish educational and informational use from entertainment and communication use and hypothesize that both types of Internet use have differential effects on children's academic performance:

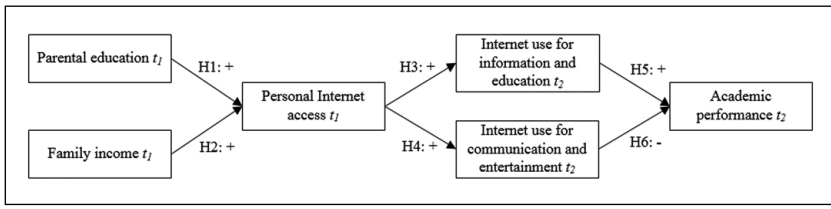

Figure 1. Mediation model with hypothesized relationships.

H5. Increased Internet use for information and education at t_2 are related to better academic performance at t_2.

H6. Increased Internet use for communication and entertainment at t_2 are related to worse academic performance at t_2.

All hypotheses are summarized and will be tested simultaneously in a mediation model shown in Figure 1.

If the model holds true, we know if, how, and why digital divides occur and what effect they have on academic performance. To build on existing research, we focus on the access to personal digital media (i.e. devices with Internet access in children's bedrooms and mobile media), as well as their use for information, education, communication, and entertainment.

The contribution of this article is to establish how access to digital media and its differential use contribute to and perpetuate socio-economic disparities in children's academic performance over time. First, we choose to study the usage gap among children rather than adults or adolescents, a field that has been less studied (see Livingstone and Helsper, 2007). Second, our study goes beyond existing empirical work which focuses only on a specific device (e.g. a home computer) and its effect on academic performance (Jackson et al., 2006; Paino and Renzulli, 2013; Vigdor et al., 2014) by considering the suite of digital devices that are available in today's technology landscape. Third, we have the methodological advantages of two-wave data that we analyze with a full-information approach where we apply structural equation modeling to test for the pathways (with access and differential use as mediators) from a family's socio-economic background to a specific child outcome. Therefore, we overcome one of the flaws of digital divide research mentioned by Van Dijk (2006) as our longitudinal design allows drawing conclusions on causal relationships and the impact of digital divides on children's academic performance.

Methods

Data collection

This study uses data from wave 1 and wave 2 from the larger longitudinal MEDIATICINO study, in which we follow students in their transition from childhood (approximately 10 years of age) to adolescence (approximately 15 years of age) by collecting data through an annual self-administered paper-and-pencil student

questionnaire, a biennial self-administered paper-and-pencil parent questionnaire, and annual end-term school grades between 2014 and 2019. Data collection is carried out in collaboration with the regional education administration of Italian-speaking Switzerland, which, in autumn 2013, invited all public elementary schools to participate in the study. Based on this opt-in technique, 39 out of 79 schools agreed to participate. Within these schools, a total of 60 grade 4 classes comprised of 1083 students were randomly selected: In small village and city schools, all grade 4 classes were selected, whereas in bigger agglomeration schools, up to three classes were included in the sample. Parents received a letter on the purpose and the nature of the study, assuring anonymity and confidentiality of all collected data including students' end-term school grades.

Data collection for wave 1 and wave 2 was carried out as follows: In January 2014, class instructors distributed the parent questionnaire among all students with the request to hand it over to their parents. A pre-stamped envelope was attached to each questionnaire allowing parents to send it directly back to the principal investigators. Of 1083 parent questionnaires that were sent out, 914 successfully completed questionnaires came back (84% response rate). In March 2014, class instructors administered the student questionnaire in the classroom with a response rate of 94% ($n = 1021$). After 1 year, the student questionnaire was administered a second time following the same procedure. This time, 1146 out of 1184 children[1] (97%) successfully completed the form. In June 2014 and 2015, the regional education administration provided the principal investigators with students' end-term school grades for eight major subjects. Annual end-term grades give a holistic measure of students' academic performance. As such, they determine the 1-year time lag between wave 1 and wave 2. An identifier was used to match data from the three different sources and two waves. Since the use of an identifier assured anonymity of all data and thereby sufficiently addressed ethical considerations regarding privacy, the regional education administration approved the study design.

Sample

At the end of wave 2, the data of 843 students and their parents were available from the three different data sources and two time points. Students were distributed across 35 classes across the same number of schools. Socio-demographics of the final sample are shown in Table 1.

Measures

Internet access at time 1. Children's access to digital media devices for personal Internet use was measured for media in the bedroom and mobile media. Children were asked to indicate which of the following types of devices they possess to go online: PC, laptop or tablet, and smartphone. A sum score was calculated for the number of personal media devices ranging from 0 to 3 (mean [M] = 0.73, standard deviation [SD] = 0.88).

Table 1. Sample characteristics.

	n	%
Child		
Male	413	49.0
Female	430	51.0
Age t_2	10.4 (*M*)	0.5 (*SD*)
Parents		
Highest educational attainment: at least one parent with …		
Lower secondary education	63	7.5
Post-secondary non-tertiary education	444	52.7
Tertiary applied university education	135	16.0
Tertiary university education	188	22.3
Not specified	13	1.5
Gross annual household income in Swiss Francs		
Less than 48,000	92	10.9
Between 48,000 and 72,000	205	24.3
Between 72,001 and 96,000	179	21.2
Between 96,001 and 120,000	141	16.7
More than 120,000	145	17.2
Not specified	81	9.6

M = mean; *SD* = standard deviation.

Internet use at time 2. On a scale from 0 (never) to 3 (always), children were asked how often they typically use the Internet for TV, music, email, social media, blogging, instant messaging, information, research for school, and games. Exploratory factor analysis was performed using maximum likelihood extraction and oblique rotation. Two latent factors with an eigenvalue greater 1 were extracted. Six Internet activities (TV, music, email, social media, instant messaging, and games) described the factor "Internet use for communication and entertainment purposes" ($M = 0.95$, $SD = 0.65$, $\alpha = .79$) and two activities (information and research for school) described the factor "Internet use for educational and informational purposes" ($M = 1.12$, $SD = 0.67$, $\alpha = .64$).

Academic performance at times 1 and 2. Children's academic performance was measured with a mean score calculation of end-term school grades obtained for eight subjects 3 months after the student surveys of wave 1 and wave 2 were conducted. Subjects included Italian, French, Math, Environmental Education, Physical Education, Painting, Creative Arts, and Music. School grades ranged from 1 (very poor) to 6 (very good) ($Mt_1 = 5.12$, $SDt_1 = 0.36$, $\alpha t_1 = .88$; $Mt_2 = 5.19$, $SDt_2 = 0.36$, $\alpha t_2 = .87$).[2] We included academic performance of both years in the analyses to account for autoregressive effects and allow for causal claims.

Socio-economic status at time 1. Data on the family's socio-economic status were obtained from the parent questionnaire, which included questions on the highest educational

Table 2. Univariate descriptive statistics for manifest indicators.

	No. of items	Range	No. of MV	*M*	*SD*	Skewness	Kurtosis	α
Parental education t_1	1	1–4	13	2.54	0.92	0.46	−0.93	–
Family income t_1	1	1–5	81	3.06	1.30	0.09	−1.14	–
Personal Internet access t_1	3	0–3	44	0.73	0.88	0.98	0.05	–
Internet use for information and education t_2	2	0–3	1	1.12	0.67	0.59	0.51	.64
Internet use for communication and entertainment t_2	6	0–3	0	0.95	0.65	0.80	0.38	.79
Academic performance t_1	8	1–6	11	5.12	0.36	−0.27	−0.39	.88
Academic performance t_2	8	1–6	2	5.19	0.36	−0.30	−0.43	.87
Social desirability t_2	13	0–13	0	5.28	3.43	0.35	−0.80	.82

MV = missing values.

attainment of the responding parent, his or her partner, and the annual gross household income. If parents differed in their educational attainment, the highest level was considered for both parents as a continuous measure ranging from 1 (lower secondary education) to 4 (tertiary university education) ($M=2.54$, $SD=0.92$). The annual gross household income was also considered as a continuous measure ranging from 1 (less than 48,000 Swiss Francs) to 5 (more than 120,000 Swiss Francs)[3] ($M=3.06$, $SD=1.30$).

Social desirability at time 2. Since Internet access and use were measured with self-report data, we accounted for a potential social desirability bias in our analyses using 13 items from the Italian version of the Children's Social Desirability Short (CSD-S) scale originally developed by Baxter et al. (2004). Items were formulated as questions (e.g. "Have you ever felt like saying unkind things to a person?") to which students could respond either "yes" (1) or "no" (0). Before conducting data analyses, items assessing socially undesirable behavior were re-coded so that a 1-coding indicated a socially desirable response across all items. The summated scale ranged from 0 to 13 ($M=5.28$, $SD=3.43$, $\alpha=.82$).

Results

We first checked whether data were normally distributed and whether observations were missing at random. Skewness and kurtosis for all manifest indicators included in the final model indicated normal distribution at the univariate level (Table 2).

The proportion of missing values was less than 10% for each indicator and values were missing at random. Thus, the statistical requirements for testing the mediation model were met. We then calculated bivariate correlations between all measures (Table 3).

Next, we evaluated our mediation model and its underlying hypotheses (Figure 1) using structural equation modeling as implemented in Stata© v.14. We controlled for social desirability bias in children's self-report by adding direct paths from social desirability to personal Internet access and to both indictors of Internet use. To allow us to draw causal conclusions, we introduced academic performance at t_1 as an exogenous variable

Table 3. Bivariate correlations among all concepts.

	2	3	4	5	6	7	8
1. Parental education t_1	.432**	−.126**	−.079*	−.139**	.276**	.248**	.020
2. Family income t_1	1	−.156**	−.035	−.177**	.287**	.259**	.050
3. Personal Internet access t_1		1	.071*	.330*	−.260**	−.231**	−.085*
4. Internet use for information and education t_2			1	.346**	−.018	−.019	.040
5. Internet use for communication and entertainment t_2				1	−.178**	−.203**	−.249**
6. Academic performance t_1					1	.929**	−.031
7. Academic performance t_2						1	−.022
8. Social desirability t_2							1

*$p < .05$; **$p < .01$.

related to a child's socio-economic background. Academic performance at t_1 was modeled as a direct predictor of academic performance at t_2 (autoregressive effect), as well as an indirect predictor through personal Internet access and differential Internet use. The model was run on a dataset with missing values using a maximum likelihood algorithm and estimating means and intercepts. The χ^2-goodness-of-fit index of the initial model indicated bad model fit ($\chi^2(8) = 17.442$, $p = .026$). Modification indices above 4 were evaluated, and the model adapted until a theoretically meaningful good fitting model was achieved. Modification indices suggested a direct path from family income at t_1 to children's Internet use for communication and entertainment at t_2. After including this path, the χ^2-goodness-of-fit index pointed toward good model fit ($\chi^2(7) = 9.299$, $p = .225$).

To account for the nested structure of the data (students within 35 classes, each class in one school), we reran the model using a generalized structural equation modeling framework where we introduced a second-level (class/school) latent variable which allows for random intercepts for all endogenous variables.[4] Figure 2 shows the final partial mediation model with all significant path coefficients highlighted in bold. Table 3 provides the unstandardized path coefficients, variances, and covariances between endogenous variables together with their significance level and confidence intervals.

Concerning our hypothesized first- and second-order digital divides, the results show that a family's socio-economic status did not predict personal Internet access, when applying a multilevel framework and controlling for children's academic performance at t_1 (*H1* and *H2* not confirmed). An increase in digital devices for personal use, in turn, led to a significant increase in Internet use for communication and entertainment (*H4* confirmed), while children's use of the Internet for information and education was not affected by personal Internet access (*H3* not confirmed). Furthermore, increased Internet use for communication and entertainment significantly lowered children's school grades (*H6* confirmed) while Internet use for information and education had no significant positive effect (*H5* not confirmed).

Academic performance at t_1 explained most of the variations in academic performance at t_2. On top of the direct autoregressive effect, children's end-term school grades at t_1 also significantly predicted those at t_2 mediated by children's personal Internet access and use

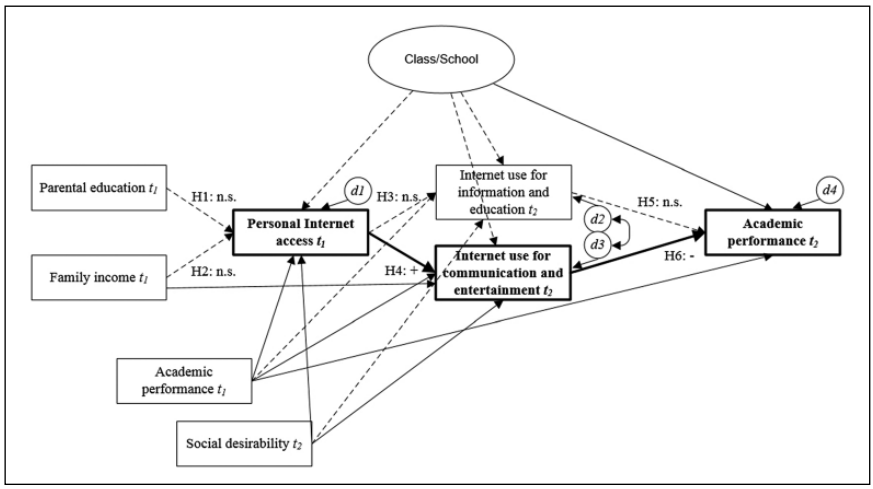

Figure 2. Final mediation model.
The final model includes academic performance at t_1 and social desirability at t_2 as control variables; latent variable "Class/School" denotes multilevel random intercepts for endogenous variables; exogenous variables are allowed to be correlated; $\chi^2(7) = 9.299$, $p = .225$.

for online communication and entertainment. To test for the significance of indirect effects, we performed a non-linear combination of estimators. The indirect effect of academic performance at t_1 on the one at t_2 was small but statistically significant ($B = .003$, standard error [SE] = .001, $p = .004$, lower limit of confidence interval [CLL] = .001, upper limit of confidence interval [CLU] = .006), so was the indirect effect of personal Internet access on academic performance at t_2, highlighted in bold in Figure 2 ($B = -.005$, $SE = .002$, $p = .001$, $CLL = -.009$, $CLU = -.002$).

In addition to the hypothesized paths, the final mediation model includes a significant direct negative impact of family income on children's use of the Internet for communication and entertainment. The additional path is based on modification indices that emerged from the full-information approach underlying our statistical analyses and, hence, require interpretation as follows in the discussion.

Before moving on to the discussion of our findings, we conclude the presentation of our results by summarizing the role of social desirability in the final model. As shown in Table 4, the tendency in children to provide socially desirable answers was significantly negatively related to self-report number of personal devices for accessing the Internet as well as Internet use for entertainment and communication. Social desirability was not significantly related to self-report Internet use for information and education purposes.

Discussion

Despite a public concern surrounding the impact of digital media on today's children, we do not find that the Internet is universally detrimental to children's academic performance. The results of this study help reconcile the seemingly mixed evidence from

Table 4. Results of the final mediation model.

	B (*SE*)	*p*	*CLL*	*CLU*
Personal Internet access t_1 ←				
Parental education t_1	−.024 (.039)	.534	−.101	.052
Family income t_1	−.041 (.028)	.135	−.096	.013
Academic performance t_1	−.609 (.094)	<.001	−.793	−.426
Social desirability t_2	−.022 (.009)	.017	−.040	−.004
Second-level class/school	1 (constrained)			
Internet use for information and education t_2 ←				
Personal Internet access t_1	.044 (.029)	.130	−.013	.102
Academic performance t_1	−.025 (.072)	.731	−.167	.117
Social desirability t_2	.012 (.007)	.107	−.003	.026
Second-level class/school	.965 (.614)	.116	−.238	2.169
Internet use for communication and entertainment t_2 ←				
Personal Internet access t_1	.192 (.026)	<.001	.140	.243
Family income t_1	−.052 (.017)	.002	−.084	−.019
Academic performance t_1	−.186 (.067)	.005	−.317	−.056
Social desirability t_2	−.041 (.007)	<.001	−.054	−.029
Second-level class/school	.309 (.419)	.460	−.511	1.130
Academic performance t_2←				
Internet use for information and education t_2	−.002 (.008)	.827	−.016	.013
Internet use for communication and entertainment t_2	−.029 (.008)	<.001	−.044	−.013
Academic performance t_1	.933 (.013)	<.001	.908	.960
Second-level class/school	.878 (.446)	.049	.004	1.753
Variance				
d1: Personal Internet access t_1	.721		.650	.800
d2: Internet use for information and education t_2	.444		.400	.492
d3: Internet use for communication and entertainment t_2	.356		.321	.395
d4: Academic performance t_2	.014		.013	.016
Covariance				
d2: Internet use for information and education t_2 d3: Internet use for communication and entertainment t_2	.154	<.001	.123	.186

previous empirical studies by refining our understanding of the hazards of children's Internet use. Importantly, we find that children's Internet use is not detrimental per se but rather problematic when personal digital media is frequently used for entertainment and communication purposes. Research on adult populations has shown that there are some clearly beneficial Internet activities including health information seeking, news consumption, or the exploration of career opportunities, while music, videos, games, or social communication are said to be purely consumeristic or entertaining (for a more detailed discussion, see Pearce and Rice, 2013). Yet, the children in our sample who rely more on the Internet for communication and entertainment systematically show lower

school grades. Thus, engaging in consumeristic and entertaining online activities does not only seem to impede learning benefits (expected non-significant effect) but also to decrease school grades as a form of learning outcomes (actual significant negative effect). A possible explanation may be that online activities such as listening to music, social media use, messaging, and gaming lead to attention deficits and keep away students from other activities that help obtain the knowledge and skills required in tests, which eventually influence their end-term grades (Carrier et al., 2015; Chen and Yan, 2016).

At the same time, children who use the Internet more for educational and information purposes do not necessarily have better academic achievements. One explanation might be that school tests and performance evaluations do not value new forms of learning as already argued by Livingstone (2003) in a reflection on early research on children's Internet use. Another explanation could be that, when reporting on "information" and "research for school," children count Internet activities that do not reflect activities with beneficial impact on their grades. This last finding is particularly interesting considering the financial and structural efforts in Italian-speaking Switzerland to introduce Internet access at schools and complement curricula with training in media and information literacy as transversal competencies across major subjects (Dipartimento dell'educazione, della cultura e dello sport [DECS], 2004). It should be noted, though, that these efforts concentrate on middle schools including children from 11 to 14 years of age. As the data for this study come from elementary school students, follow-up assessment of Internet use and academic performance eventually allows putting our results in the context of the regional school policy.

Children tend to use the Internet more often as a form of communication and entertainment when they have more digital devices at their individual disposal. It is not certain from our data if this reflects a supply-driven or demand-driven social phenomenon. In other words, it remains to be seen whether this pattern is due to a child's preferences for communication and entertainment over educational and informational contents or the fact that websites and services are targeted toward children in such a manner.

The availability of digital devices for personal use does not depend on the socio-economic status of a child's parents. Although media devices have become more technologically sophisticated, they have been commoditized in affluent societies (Tondeur et al., 2010) and, thus, have become relatively inexpensive. In other words, contrary to the first-order digital divide hypothesis, access to new media no longer appears to be a privilege reserved for families with higher incomes (Livingstone et al., 2015; Peter and Valkenburg, 2006). Our non-finding with regards to the first-order digital divide speaks to the broader debate about the complex relationship between material resources and behavioral differences and how they together contribute to inequalities in children's academic performance (Glendinning et al., 1995; Maggi et al., 2010). It may be that parents with a higher socio-economic status make a concerted effort to protect their children from the perceived negative effects of new media use by limiting the digital devices available to their children. This intended limitation of general access can be considered a form of restrictive mediation, which so far has meant restriction of amount of screen time or specific contents (Gentile et al., 2012). Furthermore, like other behaviors with health consequences (Reilly et al., 2014), media behaviors should be understood as the

result of a choice that is made under economic constraints. As Notten et al. (2009) point out, parents with a higher socio-economic status may have more income to allocate to fostering good media behaviors in their children. In contrast, parents in the present sample with a lower socio-economic status may tend to worry about social exclusion of their children and invest in digital devices for personal use. It remains unclear whether our findings are specific to the cultural context of Italian-speaking Switzerland where the study was conducted. Hence, replication studies in other affluent societies are needed to make robust conclusions on the seemingly obsolete first-order digital divide. Also, more nuanced forms of assessing Internet access such as broadband speed and mobile data plans may lead to different results.

The use of personal digital devices is characterized by children's preferences for communication and entertainment resulting in worse academic performance. This mediation speaks for the presence of a second-order digital divide (Van Deursen and Van Dijk, 2014), which attributes social inequalities to differences in Internet use rather than access to it.

Eventually, our final mediation model includes a negative direct effect of family income on the child's Internet use for communication and entertainment purposes which could mean that children from families with a lower socio-economic status increasingly use the Internet for communication and entertainment not only through their personal digital devices but also through devices they freely share with other family members or friends. Although it is reasonable to assume that in higher income households digital devices other than those in possession of the child are also available, parents may imply rules on when, how often, and for what reasons these devices can be accessed, leading to a decreased use of the Internet for communication and entertainment and, thus, stressing once again the potential role of restrictive mediation.

So, what do these results tell us in terms of policy and action? Concerns and efforts should move away from how to facilitate access to the Internet to children of lower education and income families toward how to raise awareness among this social stratum of the impact of increased Internet use for communication and entertainment. Recommendations and concrete interventions should be provided for how to communicate and teach a deliberate use of the Internet by children. Interventions should be family- and school-based, thus directed both to children and their parents as central socialization instances. They could be integrated in increasingly diffused media and digital literacy programs—as currently underway in middle schools in Italian-speaking Switzerland (DECS, 2004)—by helping students develop healthy study habits that deal specifically with the distraction of communication and entertainment on their digital devices and promote alternative activities. Although we were not able to untangle whether differential Internet use across socio-economic strata is due to different habits or a lack of skills on how to use the Internet for information and educational purposes, we suggest that a skills gap could and should be bridged by digital literacy programs too. The teaching of digital information literacy combined with an increased utilization of digital devices in classroom settings to promote a habitual use of the Internet for information and educational purposes (Prasse et al., 2016) may eventually result in better academic achievements. In Italian-speaking Switzerland, such programs should extend to elementary school children or even younger age groups (Holloway et al., 2013), since our study revealed that a second-order digital divide is evident at an early age.

Limitations

A major methodological advantage of our study is its longitudinal design applied to a large sample. Yet, as any study, this study is not free from limitations. First, while we were able to obtain children's end-term grades as an objective measure of their academic performance, strictly speaking, these grades are not comparable across our sample as grades are based on tests and evaluations that are based on guidelines and curricula from the regional education administration but that are subject to some variation from school to school. Unlike in other countries, standardized testing is not conducted at elementary school level in Switzerland. Second, we have to rely on self-report measures for Internet access, Internet use, and a family's socio-economic status. With regards to child-report data, we accounted for a potential social desirability bias by controlling for children's tendency to provide socially desired answers in our analyses. The significant negative relationships between social desirability and self-report Internet access and use for entertainment and communication confirmed that children tend to under-report "bad" behaviors (Ford and Rubin, 1970), being well aware of the negative connotations of social media and other communication and entertainment offers on the Internet. Our findings underline the need to account for social desirability bias in self-report studies on Internet use. Third, the broader scope of the MEDIATICINO study impeded a more refined assessment of Internet use. As Pearce and Rice (2013) have pointed out, some activities such as watching videos or television online can be either for information (e.g. news, documentaries, and tutorials) or entertainment (e.g. movies, reality shows, and music videos) purposes. In the present study—based on results from exploratory factor analysis—we have considered online television viewing as entertainment only. Exploratory factor analysis also suggested to us that we should combine Internet use for entertainment with online communication, that is, instant messaging, emailing, and social media use. Yet, children may engage in online communication for various purposes like reinforcement of existing offline relationships but also informational support (Subrahmanyam and Greenfield, 2008; Valkenburg and Peter, 2011). Furthermore, in our study, we were not able to disentangle children's skills from their habitual use of the Internet as both may not necessarily coincide with regards to, for example, Internet use for information and educational purposes. Thus, a more detailed assessment of Internet skills and use is needed to draw clear conclusions about beneficial versus detrimental online activities and the skills required to engage in these activities before deriving content-specific recommendations. Fourth, we acknowledge that we have not considered the potential moderating role of parental media monitoring, which, in broader terms, includes restrictive mediation, active mediation, and co-use (Gentile et al., 2012; Lee, 2013). The application of these practices by parents has shown to be associated with Internet use by their children (Gentile et al., 2014) and academic achievement in later life (Cingel and Hargittai, 2015). Finally, although our sample is demographically diverse across families of different education, income, and cultural backgrounds, we recognize that the findings may not be generalizable to all societies. In particular, they may not hold true in less affluent societies where access to the Internet may still depend on the family's financial resources. Even if low-income families in Italian-speaking Switzerland are better off in absolute terms than families with a lower socio-economic status in other societies, we

were interested in relative inequality and the impact of having less financial resources relative to other families in the same society.

Conclusion

This study on social inequalities of Internet access, its use and impact on children's academic performance underscores how new media behaviors can have important consequences for the cumulative disadvantage among children with a lower socio-economic status. Based on two-wave longitudinal data from an original survey of 843 children and their parents and children's end-term school grades, we showed that socio-economic status no longer determines children's possibilities to get personal access to the Internet (no first-order digital divide) in an affluent society such as Switzerland. Rather we show that, even at a young age, the more children are given personal digital media devices, the more they use these devices for entertainment and online communication (second-order digital divide), which, eventually, worsens their academic performance.

Despite some caveats, the outcome of our study has highlighted some fruitful opportunities for both practice and future research. To bridge the gap of differential use between children of different socio-economic backgrounds, we suggest that family- and school-based digital literacy programs are needed to raise awareness. Such programs should, on one hand, give students coping strategies for managing the distractions of communication and entertainment on the Internet so that it does not interfere with studying and homework and, on the other hand, teach the skills for and promote habitual Internet use for information and educational purposes.

With the emergence of even more technologically sophisticated mobile devices and always faster and more affordable broadband connection, future research should look into the particular role mobile media have and will have with regards to second-order digital divides and differences in children's academic performance. Although, first correlational evidence between mobile media, and, more specifically, smartphone ownership and children's preferred use for social media, communication, and entertainment exists, further studies implementing a longitudinal design are needed to conclude on the impact of differential use on academic outcomes. Furthermore, the role that parents play in guiding their children's Internet usage and its impact on their children's academic performance would give further insights in potential bolstering or mitigating factors that can be addressed with recommendations and family- and school-based interventions to eventually overcome social inequalities in children associated with the use of the Internet.

Acknowledgements

The authors thank the regional education administration of Italian-speaking Switzerland and the participating schools for their collaboration during data collection.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Notes

1. Since students were surveyed at class-level in 2015, 101 new students joined the sample as they entered already sampled classes or, in the case of one school, classes were reassembled following directions from the regional education administration.
2. Average grades are comparable to the Cantonal average for each reference population, that is, 2014, 5.09 among all fourth graders ($N=2915$), and 2015, 5.15 among all fifth graders ($N=2937$).
3. One Swiss Franc corresponds to US$1.04 (7 June 2017).
4. Before conducting multilevel structural equation modeling, we tested a null model with random intercept for each endogenous variable. The intra-class correlations (ICCs) were as follows: personal Internet access (ICC = 0.03), Internet use for information and education (ICC = 0.05), Internet use for communication and entertainment (ICC = 0.08), academic achievement at t_2 (ICC = 0.07).

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