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Dimensions of Digital Inequality Based on Pisa 2015 Data for Hungary

A Study

ABSTRACT

In the past ten years, use of ICT tools has become an integral part of everyday life among young people. Using these tools is second nature to these digital natives. It represents an organic part of their socialization. They make use of the Internet in countless areas and enjoy its benefits, just as they suffer the consequences of an online presence. ICT use among young people and its attendant effects on them can be studied in a number of areas. This study investigates features of dimensions of digital inequality developed by DiMaggio and Hargittai in the Hungarian subsample of the PISA 2015 international student assessment, which includes students' ICT use. The paper thus focuses on available ICT equipment, which is a particular aspect of autonomous use, knowledge of ICT use, social support for ICT use and patterns of purpose of use among 15-year-old students. The study first reviews the literature and research on modes of ICT use and digital inequality. It then outlines the data and methodology used in an analysis and provides a detailed report on the distribution of variables which can be interpreted as dimensions of digital inequality in the PISA survey.

KEYWORDS

Digital inequality, PISA, dimensions of ICT use

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Introduction

The study of the effects of ICT use on society has become increasingly urgent within sociology with the emergence of ICT tools and the growth of the ICT sector. To be able to approach certain social links to ICT use, it is necessary to know the patterns based on which further studies can be conducted. This study thus aims to identify dimensions of digital inequality and investigate the distribution of those dimensions among 15-year-old students in detail.

1. Concepts of the digital divide and the digital inequality

At the time when info-communication technologies began to spread two approaches emerged regarding its effects on social inequalities. According to the normalization hypothesis the use of ICT will contribute to the shrinking of social inequalities by offering equal chance to access information, knowledge and possibilities. Contrary to this the stratification model points out that the access to ICT won't diminish inequalities but will even strengthen and deepen them, which leads to a new form of social inequality: the digital divide or digital gap. (Pintér 2007, DiMaggio 2001). Although both hypotheses rely on theoretical concepts, empirical data support the stratification model as researchers face that ICT is unequally distributed in society and generates new forms of inequalities.

This new form of inequality can be studied at different levels. On the one hand it can be explored globally, between societies and on the other hand within a society between the different social groups (Bognár–Galácz 2004).

The focus of the researches on the social contributions of ICT applied different focuses depending on the extent of penetration. In the beginning, when penetration was low, studies concerning the social implications of ICT pointed their attention to the digital gap. This approach makes a dichotomous distinction between those who have access to ICT and those who don't and those who use these devices and who don't. Norris (2001) made an extensive analysis on the digital gap, the factors contributing to it within the American society. The study revealed that this type of inequality is mainly influenced by the traditional social inequality dimensions as income level, occupation, educational attainment, age, ethnicity and residence (Norris 2001).

However when the penetration level of ICT began to rise and ICT became accessible for the most part of society, the focus of research needed to be shifted from the dichotomous distinction between users and non-users to the differences among ICT users. This approach concentrates on the so called digital inequality or second-level digital divide (DiMaggio–Hargittai 2001, Hargittai 2012). The digital inequality can be explored through five dimensions. The first one refers to the technical equipment. The type of device, the hardware and software used as well as the type of internet connection have a strong effect on the quality of internet use. The technical equipment can enhance or limit some kinds of use. The second dimension of digital inequality deals with the autonomy of use. This dimension comprises on the one hand the place of use: is it a public or non-public place, how far is it, how much time does it take to get there, and on the other hand the limitations and control of use – which is related to the place of use. In the third dimension we find the skills that strongly influence the quality of internet use. When exploring digital inequality the social support of the user needs also to be taken into account. Is the close social environment supportive regarding ICT use? Can the user rely on a family member to ask

for informal help when facing problems while using the internet? These factors also influence the modes of ICT use. Finally maybe the most important dimension concerns the purpose of use. The activities on the internet are very diverse, some contribute to enhancing social, economic or cultural capital, others don't. Therefore the purpose of use indicates huge differences among users regarding their social status. (DiMaggio–Hargittai 2001).

2. Data and methods

The analysis of this paper is based on the Hungarian subsample from 2015 of the huge, extensive international survey of the OECD on student assessment (PISA) organised every three years. Students in the survey are tested mainly in three fields: mathematics, reading and science. Respondents are also asked to fill out complementary questionnaires as for example the ICT questionnaire which intends to measure different dimensions of ICT use and ICT competencies of the students. Our broader research aims to reveal the relationships between ICT use and school performance[1], in this paper though – as a starting point – we present descriptive results about the different dimensions of digital inequality among Hungarian 15-year old students.[2] The dimensions of digital inequalities are based on the model of Dimaggio and Hargittai explained in the previous section. The five dimensions have been explored by the questions and variables of the PISA database demonstrated in the table *(Table 1)*.

Dimension	Variables in the PISA 2015 database	
1. Technical apparatus	Are any of these devices available for you to use at home? *Desktop computer, Portable laptop or notebook, tablet computer, Internet connection, mobile phone with Internet access*	
2. Autonomy of use	During a typical weekday/ weekend day, for how long do you use the Internet outside of school?	
3. Knowledge and skills	Comfortable Internet use	Autonomous Internet use
	I feel comfortable when using my digital devices at home. *When I come across problems with digital devices, I think I can solve them.* *I feel comfortable using digital devices I am less familiar with.* *If my friends and relatives have a problem with digital devices, I can help them.* *If my friends and relatives want to buy new digital devices or applications, I can give advice.*	*If I need new software, I install it by myself* *I read information about digital devices to be independent* *I use digital devices as I want to use them.* *If I have a problem with digital devices I start to solve it on my own.* *If I need a new application, I choose it by myself.*

Table 1 *Dimensions of digital inequality based on PISA 2015 database* (Source: PISA 2015, own construction)

[1] Vincze 2018a, b, 2016.

[2] The effects of these dimensions on school performance are going to be presented in a further paper.

Dimension	Variables in the PISA 2015 database	
4. Social support	*To learn something new about digital devices, I like to talk about them with my friends.* *I like to share information about digital devices with my friends.*	
5. Purpose of use	Use for general activities	Use for school related activities and learning
	Playing one-player games. *Playing collaborative online games.* *Using email. <Chatting online> (e.g. <MSN®>).* *Participating in social networks (e.g. <Facebook>, <MySpace>).* *Playing online games via social networks (e.g. <Farmville®>, <The Sims Social>).* *Browsing the Internet for fun (such as watching videos, e.g. <YouTube™>).* *Reading news on the Internet (e.g. current affairs).* *Obtaining practical information from the Internet (e.g. locations, dates of events).* *Downloading music, films, games or software from the internet.* *Uploading your own created contents for sharing (e.g. music, poetry, videos, computer programs).* *Downloading new apps on a mobile device.*	*Browsing the Internet for schoolwork (e.g. for preparing an essay or presentation).* *Browsing the Internet to follow up lessons, e.g. for finding explanations.* *Using email for communication with other students about schoolwork.* *Using email for communication with teachers and submission of homework or other schoolwork.* *Using social networks for communication with other students about schoolwork (e.g. <Facebook>, <MySpace>).* *Using social networks for communication with teachers (e.g. <Facebook>, <MySpace>).* *Downloading, uploading or browsing material from my school's website (e.g. timetable or course materials).* *Checking the school's website for announcements, e.g. absence of teachers.* *Doing homework on a computer* *Doing homework on a mobile device.* *Downloading learning apps on a mobile device.* *Downloading science learning apps on a mobile device.*

Table 1 continued

The dimension of available ICT equipment was examined through the presence and use of ICT tools at home. Use was investigated through autonomy of use and duration of Internet use. Indeed, the amount of time a student spends online outside of school reflects the degree to which they enjoy free and unrestricted access to the Internet. Students' ICT knowledge was surveyed based on the extent to which respondents said they are able to use digital devices independently and to solve problems that may have arisen during use. Social support for ICT use was examined on the basis of the degree to which respondents discuss ICT with their friends and share related information with one another. Finally, purposes and modes of Internet use were surveyed among 15-year-old students. Home Internet activity was analysed in general as well as modes of use, which aid in studying, doing homework and progressing with their studies.

3. Findings

3.1. Technical apparatus: Available ICT equipment at home

The 2015 PISA survey asked about home access to and use of the following ICT tools: desktops, laptops/notebooks, tablets and smartphones. It especially examined the presence of Internet access and use at home. A total of 96% of the Hungarian respondents enjo home Internet access, which they also use (independently of which device they use to access the Internet). There is a similarly high percentage (89%) of 15-year-old Hungarian students who have the kind of mobile phone that enables them to access the web (a smartphone). At 73%, the proportion of those who have a desktop at home and use it was lower. The percentage of students who have a desktop at home but do not use it was relatively high (16%). However, 11% of the respondents have no desktop at home. A little more than three-quarters (78%) of the 15-year-old Hungarian students surveyed have a laptop or notebook, but around two-thirds of them use it as well. The tablet is the least widespread of the ICT tools, although two-thirds of the students surveyed have one in their home. However, fewer than half of the respondents (48%) use their tablet at home. This device shows the highest proportion of respondents who have one at home but do not use it (18%).

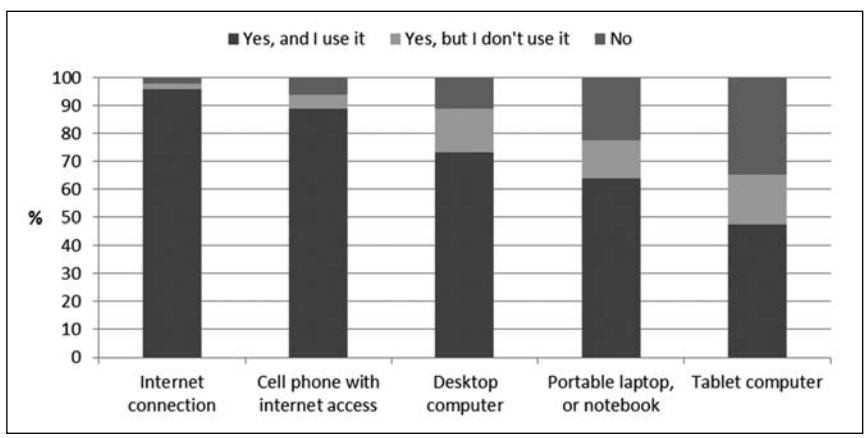

Figure 1 *Available for you to us at home: ...?* (Source: PISA 2015, own calculation)

3.2. Autonomy of ICT use: Time spent on the Internet outside of school on an average weekday and weekend day

Internet use differs somewhat during the week or weekend. A very small portion of respondents, 2% in all, spend no time on the Internet on weekdays or weekends, nor is it common for them to spend only a short period of time, an hour or less, on the Internet, either during the week or at the weekend. A total of 5% spend no more than half an hour on the web on an average weekday, while 8% are on it then for 31–60 minutes. Over the weekend, even fewer of them, 4% of respondents,

go online for less than half an hour, while 6% do so for between 30 minutes and one hour. During the week, more of them – a bit over one-fifth (22%) – are on the Internet for one to two hours than there are over the weekend (14%). Dedicating relatively long periods of time on the web is most characteristic of the weekend, with 21% of students spending four to six hours on it then and 29% doing so for over six hours. Using the Internet between two and four hours is popular in about the same proportion on weekdays (27%) and the weekend (24%).

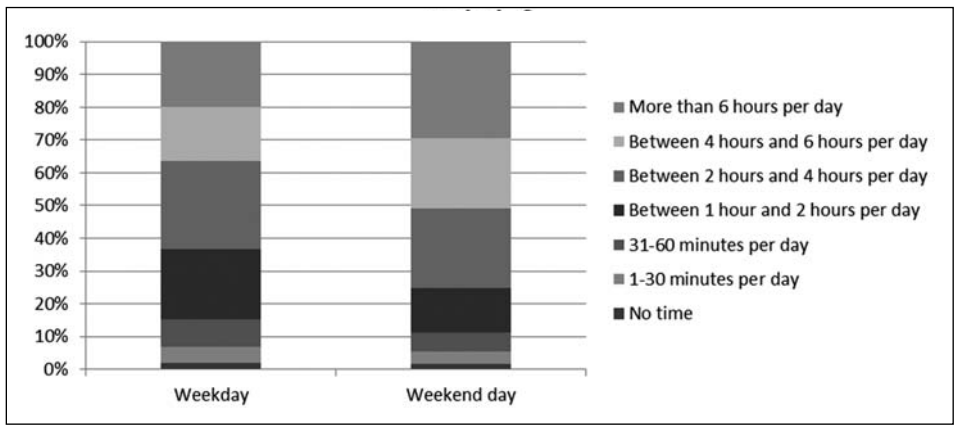

FIGURE 2 *For how long do you use the Internet outside of school on a typical...?* (Source: PISA 2015, own calculation)

The link between time spent on the Internet during the week and over the weekend is very strong, with a Pearson correlation value of 0.722.

The students typically use the Internet as much at the weekend as during the week or fall into the next category of Internet use. The exception is young people who do not go online outside of school weekdays. The largest proportion of them, 37 per cent, are not on the web at the weekend either. However, 40% in all spend some time there over the weekend – between half an hour and two hours. A comparison of Internet use on weekdays vs the weekend leads us to conclude that the time the students spend online is somewhat restricted. This control may be external, e.g. parents' regulating their children's use, which is more permissive at the weekend than during the week – but even then not without boundaries. Students' timetables, extra lessons during the week and weekend events, which determine the amount of free time they have for the Internet, may represent another external restriction. However, in the light of the correlations found, this assumption suggests that the majority of students' time is used similarly during the week and at the weekend, since most spend the same amount of time at the weekend or one to two hours more online than they do during the week. Another external restriction may be the device they use, as a device fixed to a particular place (e.g. a desktop) offers different options in terms of time than a portable device (e.g. a smartphone). This is because it is presumably easier to access the web occasionally with a portable device than with one that is tied to a given location.

Contrary to expectations, however, there seems to be little difference in time spent on the Internet between users of particular devices.[3] Desktop users spend their time on the Internet similarly to those who use portable devices. Even smartphone users are not typically online longer than those who use other devices.

Autonomous use of the Internet in terms of time does not therefore appear to be influenced by the device the students use to go online.

Among the controlling factors for time spent on the Internet, neither free time nor device used provides a satisfactory explanation, according to my study. Parental control may presumably be decisive in the population under examination; however, the database available provides no option to study this factor. In addition to external factors, however, a kind of internal control and motivation can be assumed, which influences time spent on the Internet. Indeed, if we consider time spent on the Internet during the week as being largely the result of some external (parental) control, then there would be a larger proportion of those who spend far more time on the Internet than the results show. Presumably, intrinsic motivation (the purpose of Internet use and attitudes toward the Internet) also significantly influences the amount of time someone may/can/would like to spend on the web.

3.3. Knowledge of ICT use and digital competence

The next dimension of digital inequality involves knowledge and skills tied to ICT and Internet use. The more at home one is on the web and knows what to do, the more content one can access and the greater the experience using the Internet is. ICT competence was measured with nine items on the PISA survey. Of those items, some refer to a moderate level of understanding, while others measure a deeper interest and knowledge.

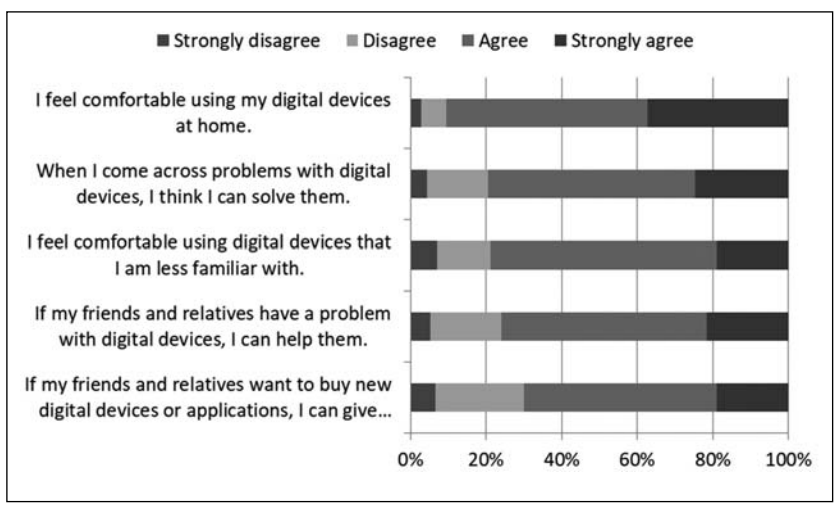

Figure 3 *Skills and knowledge for a comfortable Internet usage* (Source: PISA 2015, own calculation)

[3] This correlation obtains for time spent on the Internet both during the week and at the weekend.

Over 90% of the respondents feel comfortable using ICT at home. A total of 80% of the 15-year-olds believe that they can remedy problems that may arise in using ICT. Almost the same percentage reported that it is no problem for them to use an ICT tool which they do not know well. About three-quarters of the sample can provide assistance to their friends and relatives in resolving problems that may arise in ICT use. Compared to the rest of the data, the smallest proportion, 70% of the respondents, feel competent offering advice to friends or relatives with regard to shopping for a digital device or app. The largest proportion of 15-year-olds (70–90%), therefore, are comfortable and experienced with regard to their ICT knowledge and skills.

Another few items on ICT knowledge and skills in the PISA study measured the extent to which respondents are capable of autonomous use without any assistance. The majority of the young people, a bit more than 80 per cent, are able to choose apps they find necessary and are beginning to resolve problems that arise in using ICT. A total of 77% of the respondents are able to use ICT tools as they like and keep their use in check. Two items significantly reduce the proportion of competent users. Only about 60% of the sample know how to install the necessary software on their device, and only around half of the respondents demonstrate a deeper interest in ICT tools. They do additional reading to learn about their ICT tools to be able to use them as autonomously as possible.

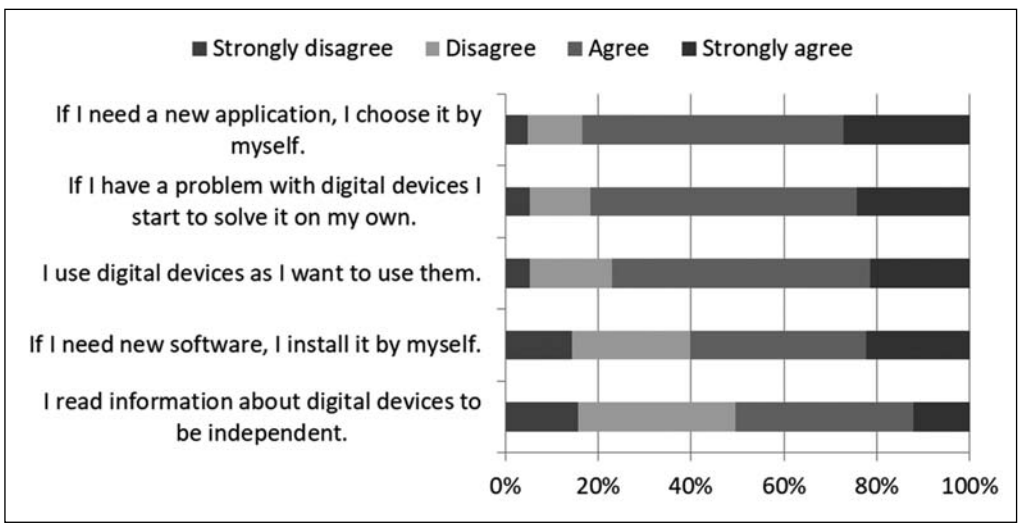

Figure 4 *Skills and knowledge for an autonomosuly Internet usage* (Source: PISA 2015, own calculation)

As regards skills and knowledge, it is clear that the majority of the Hungarian 15-year-old students are digital natives who use ICT tools autonomously, comfortably and knowledgeably.

3.4. Social support for ICT use

Social support is distinct as an influencing factor among the dimensions of digital inequality developed by DiMaggio and Hargittai. This dimension refers to the fact that the extent and quality of individual use are influenced by the degree to which the social environment is supportive of the individual as regards ICT use and whether the individual knows how to ask for informal help if necessary. In this study, this dimension manifests itself in the extent to which the respondent likes to talk to their classmates and friends about digital devices and to exchange information about them. Presumably, those for whom ICT use is more embedded in their relationships with their friends enjoy a greater quality of use and can thus perform better in school.

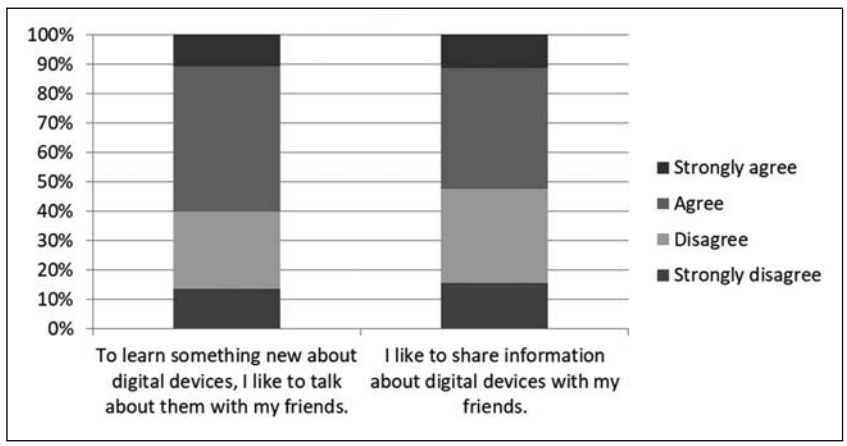

Figure 5 *Social support for ICT use* (Source: PISA 2015, own calculation)

A total of 60% of the respondents like to talk to their friends about digital devices to gather new information about their own. A bit more than half of the sample (52%) like to share information with their friends about ICT tools. This is how the ICT use of the majority seems to be embedded in their social environment.

3.5. The purpose of ICT use

The purpose of ICT use forms the most decisive dimension in the model of digital inequality developed by DiMaggio and Hargittai. They believe that the quality of use and its effect on social status is influenced by what the user does when they are on the Internet. Are they using their ICT tools for recreation or to increase their resources? The purpose of home ICT use was also examined in two areas in the PISA 2015 wave: general Internet use and use with the express purpose of studying and completing school assignments. The analysis in this study examines general Internet use and study modes.

3.5.1. General modes of Internet use

Placing individual activities in descending order according to everyday use, the study found that 15-year-old students most commonly use social media platforms. A total of 61% of the respondents use Facebook or other social media daily, while around 20% use them almost every day. The second most frequent activity among young people is searching for and watching entertaining videos on video-sharing platforms (e.g. YouTube), with 52% of them doing so daily and 27% of them doing so almost every day. Of all the activities listed, those who never do this represent the smallest percentage. Watching entertaining videos seems therefore to be one of the most widespread activities among young people. Among everyday Internet activities, chatting occupies third place. A total of 47.5% of the respondents use some chat app every day. However, compared to the previous data, those who never chat daily represent a relatively small proportion, 14% of the sample. Downloading music, films and games from the Internet is more widespread. Although only 32% of the respondents do this every day, a total of 94% download some kind of content from the Internet with some frequency. The frequency of the following two activities is distributed very similarly: reading the news and gleaning practical information from the Internet. The distribution of the respondents is relatively even within individual categories. Young people engage in these two Internet activities in the greatest proportion once or twice a week, with 30% of the sample obtaining practical information and 25% reading the news. Playing games is the least popular Internet activity among young people, whether it is done with others online or alone. A total of 61% of the sample never play online games on social media (e.g. Farmville), 42% never play multi-player online games, and 33% play no role-playing games. Similarly, it is infrequent for them to upload or share content that they have created, with 39% never having done so. Those who usually upload

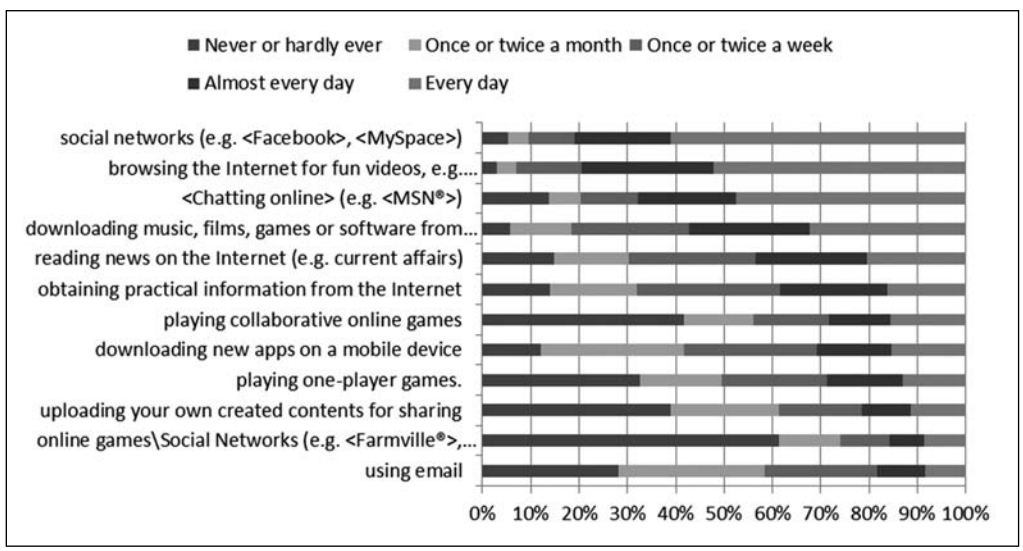

Figure 6 *General modes of Internet use outside of school* (Source: PISA 2015, own calculation)

or share content typically do so once or twice a month or week. One activity that is typically done once or twice a month or week is downloading new apps to a mobile device, with 57% of respondents doing so with this frequency. Young people also seldom use their email accounts, with 30% of them doing so once or twice a month and 23% using them once or twice a week.

The most frequent Internet activities among 15-year-old Hungarian students, therefore, are using social media, searching for entertaining videos and chatting. The least common online activities include playing games, mainly online games available on social media and multi-player online games, as well as sharing self-made content.

Based on how often someone engages in the activities listed, the study has attempted to separate the profiles to which the principal component method was applied. It was possible to distinguish between three types of use in forming the principal components with regard to general use: (1) use for communication and entertainment; (2) use for play; and (3) use for gathering information.[4]

A total of three-quarters of the information from the original variables are included in the three principal components. The cumulative explained variance is 75 per cent.

While the first and second principal components rather reflect Internet use for entertainment, relaxation and recreation, the third one points to use for resource growth.

	Communication and entertainment	**Use for play**	**Use for gathering information**
social networks (e.g. <Facebook>, <MySpace>)	0,852		
Chatting online (e.g. <MSN®>)	0,766		
browsing the Internet for fun videos, e.g. <YouTube>)	0,725		
playing collaborative online games		0,902	
playing one-player games		0,894	
reading news on the Internet (e.g. current affairs)			0,885
obtaining practical information from the Internet			0,876

Table 2 *General modes of Internet use – Rotated component matrix* (Source: PISA 2015, own calculation)

[4] As the principal components were being formed, certain items which had low communality or which were tied to more than one principal component were removed with an eye to the highest explained variance and ease of interpretability.

3.5.2. Internet use for learning

In the 2015 PISA survey, researchers included a question about the frequency with which students engage in Internet activity tied to study and school assignments outside of school. Of the choices offered, students most frequently communicate with each other about school assignments on social media, with 29% doing so every day and another 26% doing so almost every day. There were relatively few (8.9%) who never talk to their classmates about school assignments on social media. In contrast, it is less common for students to discuss school assignments with each other by email, with nearly 40% never doing so. A total of 43% email classmates about school assignments once a month or once a week. A total of 17% of the sample exchange emails every day or nearly every day.

Social media represent the main channel of communication between students about school assignments. They use social media platforms to maintain contact with teachers less often, with one-fifth of the students using them to communicate with their teachers every day or nearly every day. However, 34.9% of the respondents never use them to keep in touch with their teachers. However, email, another way to communicate with teachers online, is even less popular, with only 13.9% of respondents using it every day or almost every day. Six per cent more students never email their teachers (41%) than those who never contact them by social media. Students typically engage in some communication with their teachers online once or twice a month, with 30% doing so by email and 22.3% using social media for this purpose.

A total of 34.4% typically surf the Internet to complete school assignments, for example, essays and presentations, once or twice a week, with 29.3% doing so once or twice a month. Similarly, 63% of the sample use the Internet to look up information that they hear in lessons on a weekly or monthly basis, while 58% of them do their homework on the computer. Less frequently, they will use some mobile device to do homework, with 44.5% of the students reporting that they have never done school assignments that way. A total of 21% of the sample use a mobile device to do their homework once or twice a month, while 18.3% will do so once or twice a week. The proportion of those who use their mobile device to do homework every day or nearly every day amounts to 16.2 per cent.

A total of 21.9% of the students use the school website nearly every day for downloads, uploads and surfing. The same percentage do so weekly (21.7%), and a slightly higher portion do so monthly (27.2%). Nearly 30% of the respondents, however, never use the school website for downloads or uploads. Even fewer use the school website for information on news and bulletins pertinent to the school, teachers or students. A total of 37% of the respondents never use the school website for information. Around one-fifth of the students access the school webpage once a month, and the same proportion do so once a week. The percentage of those who check the latest information on the school website every day or nearly every day is a bit more than 20% altogether.

The least common kind of Internet activity of all those related to study and school assignments is that of downloading study aid apps to a mobile device. A total of 52.7% of the sample never download study aid apps for science, and 48.6% never download any other kind of study aid app. In both cases, 20% of them download these apps to their mobile devices monthly, 14–15% do so weekly, and 14% do so every day or nearly every day.

In sum, among the Internet activities tied to study and school assignments, the most frequent activity, i.e. done every day, is communication between students on social media. With a frequency of once a month or week, students typically surf the Internet to complete their school assignments, look up information that they have heard in lessons there and do their homework on the computer. Among the least common activities, i.e. indicated by respondents as something they never or almost never do, is downloading learning-related apps onto their mobile device and doing homework on their mobile device.

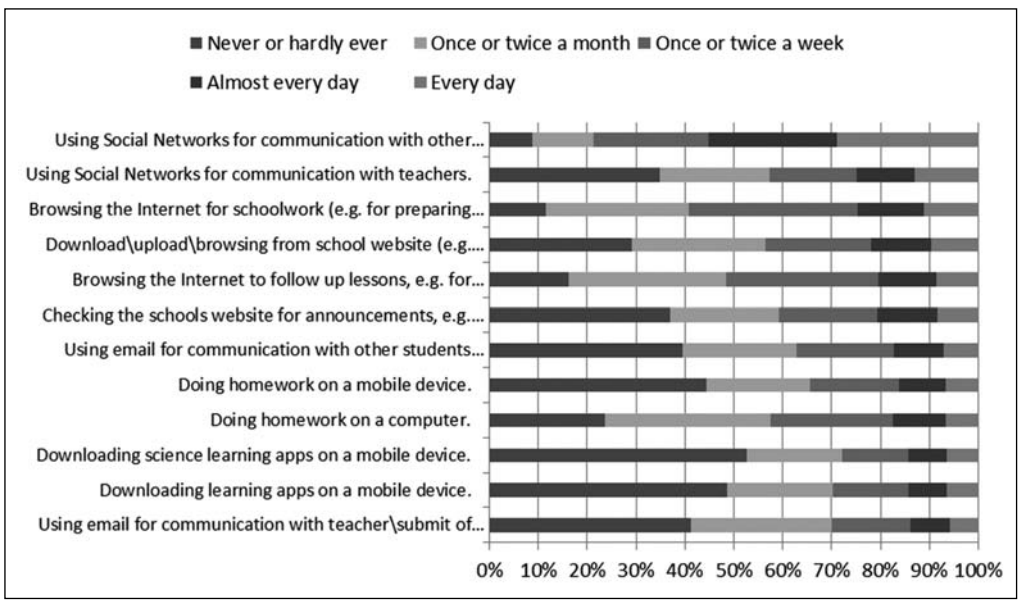

Figure 7 *Internet use for learning and school related activities* (Source: PISA 2015, own calculation)

A principal component analysis was similarly conducted of modes of Internet use tied to study and homework to ascertain patterns of use in this area. Based on this analysis, two principal components can be distinguished within the set of variables. One principal component involves activities that more specifically involve use of ICT tools for studying or learning, such as collecting information on the Internet to complete school assignments or to understand learning material as well as communicating with classmates about school assignments on social media platforms. The other principal component involves all the other activities from this set of variables, including downloading apps that aid learning, using ICT to do homework and keeping up-to-date on the school website. These modes of ICT use were summarized as activities that are facilitative of one's studies, but not strictly tied to doing schoolwork.

	ICT use for studies	ICT use for learning
Downloading science learning apps on a mobile device.	0,883	
Downloading learning apps on a mobile device.	0,882	
Doing homework on a mobile device.	0,815	
Using email for communication with teacher\submit of homework or other schoolwork.	0,739	
Doing homework on a computer.	0,724	
Checking the schools website for announcements, e.g. absence of teachers.	0,674	
Using email for communication with other students about schoolwork.	0,658	
Download\upload\browsing from school website (e.g. time table or course materials.	0,654	
Using Social Networks for communication with teachers.	0,531	
Using Social Networks for communication with other students about schoolwork.		0,81
Browsing the Internet for schoolwork (e.g. for preparing an essay or presentation.		0,758
Browsing the Internet to follow up lessons, e.g. for finding explanations.		0,695

Table 3 *Internet use for learning and school related activities – Rotated component matrix* (Source: PISA 2015, own calculation)

Conclusion

The study focused on the five dimensions of digital inequality developed by DiMaggio and Hargittai and examined the Hungarian subsample based on the PISA 2015 data. As regards available equipment, the research found that penetration and use of ICT tools at home is considerably high. Almost every student has Internet access at home, and nine out of ten have a smartphone with Internet access. Autonomy of use was examined through time spent on the Internet. About two-thirds of the students spend over two hours on the web during the week, and about three-quarters of them spend that much time online at the weekend. It was concluded from a deeper analysis of time spent on the Internet that this factor is influenced by intrinsic motivation rather than by external circumstances, e.g. the portability of the device. Presumably, parental control also plays an important role in limiting time spent on the Internet; however, the PISA data offer no option to analyse this factor. The 15-year-old Hungarian students mostly evaluated their ICT knowledge and competences as good, thus clearly suggesting that they are digital natives. In the dimension of social support, this kind of embeddedness of ICT use in social support was found among a bit over half of the respondents. Finally, the pattern of modes of Internet use was examined. As regards general Internet use,

three user modes became clear: one involves using the Internet primarily for communication and entertainment; another concentrates on playing games; and a third is aimed mainly at gathering information. Based on the responses, as regards Internet use tied to studying and completing school assignments, there is a distinct mode of use aimed primarily at doing schoolwork and one that is rather facilitative of one's studies.

Exploring and better understanding the dimensions of digital inequality among 15-year-old Hungarian students may represent a starting point for further studies, which may direct us to differentiating factors in the dimensions, e.g. the role of gender and socio-economic background, and which may examine the links of these dimensions to other areas, e.g. the relation to learning and school performance.

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