Through a better understanding of 'undesirable futures' towards better digitalization

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Abstract

In this paper, we widen the scope of sociotechnical approach in respect of digitalization. Our claim is that the focus should be shifted from organizational consideration to the level of the whole society, or in some cases, to the humankind. The primary impetus to this shift can be found from the environmental threats. However, environmental issues are not the only reason. Individual concerns related to privacy and health, as well as digital divide as a social and societal problem are other examples, for which a broader approach is necessary. In our analysis, we borrow the concept of 'sociotechnical imaginary' which was introduced by Sheila Jasanoff and Sang-Hyun Kim, and further developed by Jasanoff. While Jasanoff emphasizes the "positive visions of future" over the negative ones, our analysis starts from "undesirable" or "resisted" futures and goes further towards "a better future". Our argument is that we should be much more proactive in developing digital systems that extensively change societies.

Keywords

Digital society, Digital system, Digitalization, Sociotechnical imaginaries, Undesirable future.

1. Introduction

Organizational information systems have been seen as an effective means to improve individual and organizational performance and productiveness. Adopting a sociotechnical approach makes information systems more acceptable to the end-users, which, in turn, help to achieve the organizational goals of these systems [1]. A better understanding of sociotechnical aspects has led to increased productivity of organizations also in terms of flexibility and learning [2].

It is acknowledged that sociotechnical systems should be considered from a new perspective which shifts the focus to sustainability [3]. Lange and Santarius [4] have considered conditions for sustainable digitalization. They argue that we must consciously and proactively shape the digital process, and the process must not be left by no means to chance. They call for three principles to be followed. According to the first principle, we should have digitalization as much as necessary and as little as possible. The second principle underlines that citizens own their own data. The third principle says that we must develop the Internet and its services as 'common goods'.

The mainstream research on information systems has promised a light future for digitalized societies. However, it is hard to find any *systematic analysis* of the threats of, and problems caused by, digitalization. However, digitalization has, indeed, several adverse effects that should be taken into account in developing digital systems, and in building digital societies. Warnings about potentially negative effects of digital systems, or of the ways in using them, can be found. For instance, a recent study that provides evidence of positive impact of digitalization on environment, concludes that "it is also important to identify the negative effects of digitalization to minimize that impact" [5]. A more recent study that recognizes the potential of health information technology worries about the digital divide related to using the technology [6]. Negative effects or questionable positive impacts of digitalization on environment are considered by Lange, Pohl and Santarius [7], for example.

The 9th International Conference on Socio-Technical Perspectives in IS (STPIS'23) 27.-28.10. Portsmouth, UK

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In this paper, we attempt to draw an overall picture of the societal and global threats that should be tackled when developing new digital systems. In our analysis, we make use of the concept of 'sociotechnical imaginary'. Sociotechnical imaginaries are defined by Jasanoff and Kim [8] as "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology" and later elaborated by Jasanoff [9] as "collectively held and performed visions of desirable futures (or of resistance against the undesirable)... animated by shared understandings of forms of social life and social order attainable through, and supportive of , advances in science and technology." As Jasanoff puts it, it is not only a question of desirable futures but also of avoiding the undesirable ones. In this paper, we aim to show through examples why resistance against the undesirable futures should be much more in focus when it comes to digitalization of societies.

This study is based on conceptual consideration with practical examples. The primary impetus for this study was our new university course on sustainable and responsible digitalization. When gathering material for the course, we found several eye-opening facts on the harmful effects of digitalization. These effects include (1) increasing energy consumption of, and other environmental threats caused by, digital systems, (2) privacy and information security concerns, (3) digital divide, (4) illegal or other undesirable digital behavior by individuals, and (5) health problems and deterioration of well-being. The list is not inclusive. For example, artificial intelligence is developing so rapidly that proactive research about the potentially negative impacts on societies is needed. The process of gathering the material was not easy. It is much easier to find research findings, frameworks, 'big pictures' etc. which highlight the opportunities of digitalization than those that challenge digitalization and question its omnipotence.

The paper is organized as follows. In the next chapter, we present some key concepts that we will use as conceptual basis of our analysis. In Chapter 3, we will provide examples of problems and threats related to digital systems. In Chapter 4, we will draw a big picture of issues presented in chapter 3. Especially, we will discuss how the different areas are interrelated. Finally, we conclude our main theses.

2. Sociotechnical approach

Technology and science have been the key driving forces behind modern societies. In fact, technology is a crucial part of the whole human history. This has got *technological determinists* to think that social and societal life is completely determined by technology. In its extreme, technological determinism (TD) sees a society is nothing more than *the* outcome of technological inventions. Karl Marx already said that: "The hand-mill gives you society with the feudal lord; the steam mill society with the industrial capitalist" (adopted from [10]). So, technological determinists think that technological developments follow *the* internal logic of technology, and these developments inevitably cause *the* societal changes. The way TD neglected or marginalized the role of human, social, and societal factors in the development of modern societies, led to the emergence of the school of science and technology studies.

The starting point for science and technology studies, as Wajcman [11] puts it, is that "the content and direction of technological innovation are amenable to sociological analysis and explanation". In short, according to this thinking, there are usually several technological options that can be selected and, therefore, several optional directions for technological evolution. This is contrary to the idea of TD, according to which technology has its internal rules that would force the direction to the certain end. SST (social shaping of technology) that is part of science and technology studies argues that technological development is shaped by public discussions and political decisions [12].

Besides SST, another branch of science and technology studies, SCOT (social construction of technology), provides useful concepts for analyzing technological developments. These concepts include 'interpretative flexibility', 'closure' and 'social group'. *Interpretative flexibility* refers to the cultural interpretation of a technological artifact. Because of this flexibility, technology has

several options to evolve. Social groups are institutions, organizations, and unorganized groups of individuals who share the same set of meanings attached to a technological artefact. Closure means a mechanism that leads to stabilization of the artefact (as considered by the social groups).

The main contribution of science and technology studies to our analysis is the foundational idea of denying the deterministic view of technology. From this perspective, society and, furthermore, the living environment of humankind is not only a result of technological developments, but the technological evolution can be remarkably affected by human interventions that are not technological of their nature but rather social and societal.

Next, we focus on the concept of sociotechnical imaginaries. As presented above, sociotechnical imaginaries are seen as visions of the desired future. "The undesirable/resisted futures" mentioned by Jasanoff [9] seem to have a secondary/implicit role in sociotechnical imaginaries. When it comes to digitalization, this is unfortunate, because considerations of digital systems are remarkably biased towards the benefits of the systems, and they neglect or at least underestimate the threats. As already briefly stated, digital systems themselves may cause, however, several severe problems that need to be resisted.

In their book *Smart Green World?* [4] Lange and Santarius conclude their analysis by presenting the most crucial question: What kind of digitalization do we want? Although this is the ultimate question, we argue that without an explicit consideration of the future *we do not want*, the outcome won't be sustainable. Our argument is this: if we had been more proactive towards the earlier developments of digitalization, most of the unacceptable consequences which occurred, would not have occurred. All undesirable consequences can never be avoided, but their number can be limited to the minimum and their fatality avoided by careful planning. It seems that the *laissez faire* approach adopted so far has benefited old and new businesses a great deal, but other sectors of societies as well as individuals may have been negatively affected in many cases.

In the next chapter, we will provide examples of realized problems that should be resisted in the future. We will make explicit some of the most critical threats of digital systems. By so doing, we aim to help building a little more realistic plan for digitalization. We will focus on the areas already mentioned in the introduction. To find themes or areas that could be relevant to our approach, we conducted several rounds of search by using the following keywords: 'problem(s)', 'threat(s)', 'challenge(s)', 'digital system/transformation', 'digitalization', 'IT', 'ICT', 'information technology', 'sustainable', sustainability', 'responsible', and 'responsibility'. The results were scattered, and they did not provide any overall framework or 'big picture'. In general, it seems that so far there has not been scientific ambition to build such a framework. In this paper, our aim is to show by examples the relevance of a critical framework of digitalization. Our 'big picture' should be considered rather as a starting point than an outcome.

3. Examples of problems and threats related to digital systems

Next, we attempt to open some of the big problems caused by digital systems, as well as concerns which exist in relation to these systems. It is interesting that these problems and concerns have typically been considered separately from each other, and most often solutions have assumed to be rather technological than social or societal.

3.1. Environmental threats

Digitalization has been seen as a crucial means for implementing the green transition. Without a thorough understanding of the environmental impacts of digitalization, *both good and bad*, this assumption is misleading, which can even lead to the worsening of the environmental problems, e.g. [4].

The energy efficiency in terms of performance per watt, has remarkably increased. However, the overall energy consumption of the ICT sector has not declined but rather increased [4]. If we

like to benefit from the improved energy efficiency of ICT, we cannot continuously invent new uses of ICT with a resultant increase in the total energy consumption and emissions. The only acceptable exception is the situation when increased use of digital applications help cut energy consumption and emissions more in other sectors like transportation, travelling or manufacturing [13].

We take three examples of cases of ICT development which brings potentially undesired effects.

Example #1: Videostreaming services. YouTube, TikTok, and similar videostreaming services are familiar to nearly everyone who uses the Internet. Apparently, quite few actively think when watching a streamed video that data transfer and data centers form a main part of the energy consumption and emissions from the ICT sector. A great deal of this is caused by videostreaming [14]. When this is done purely for fun, we should ask: Can we afford this? The potential energy savings of videostreaming as compared to physical products such as DVDs was realized a decade ago but there was also a concern that the savings from streaming may be lost due to the rapidly increasing consumption of streamed videos [15]. This fear has come true.

Example #2; **Shein.** Shein, the Chinese online fast fashion retailer, makes use of efficient digital technologies, artificial intelligence in particular, to boost shopping for clothes. This is done by shortening the lifecycles of fashion trends. This is contrary to principles of sustainable consumption. Shein utilized previously mentioned TikTok in its marketing. Besides environmental concerns, Shein has been accused of several kinds of negligence, exploitation, and illegalities.

Example #3. Bitcoin, and other cryptocurrencies. Cryptocurrency Bitcoin is, for sure, the best-known application of blockchain technology. Blockchain technology is based on a distributed architecture (peer-to-peer architecture) for maintaining a digital, distributed ledger that consists of 'blocks'. The blocks are carriers for information on several kinds of transactions. Since there are no official parties who validate the transaction, the validation is done by the peer-users. This requires huge amounts of energy [16], [17]. Although the validation (mining) methods (of cryptocurrencies) have been improved, the development of blockchain technology, especially cryptocurrencies, should be critically assessed and the threatening developments should be rapidly reacted.

3.2. Privacy and information security concerns

Privacy concerns of the Internet users are real [18]. They originate from several sources – governments, corporations, and individuals. National surveillance is part of national security. However, national surveillance may extend far beyond what we, in general, consider acceptable. The Snowden case revealed the extent of surveillance performed by the United States, but the US is not alone. Similar activities to the same or even larger extent are performed by at least Russia and China [18]. All these actions have global impacts.

Besides national surveillance, another and perhaps even more prominent form of surveillance is commercial surveillance referred to as 'data capitalism', 'surveillance capitalism' or 'digital capitalism'. This form of surveillance is performed in order to get economic benefits and it is based on digital traces everyone leaves when moving on the Internet [19]. It is typical that the customers of an online service can quite quickly forgo his/her rights to privacy [20] and can be convinced to overcome the privacy concerns [19].

Weaknesses in data security may cause severe threats for privacy. For example, in Finland there was a large privacy violation case in 2018-2019. The patient database of a Finnish psychotherapy centre Vastaamo [21] was hacked, and the company was extorted to give money by threatening to publish the sensitive patient records that the extorters had obtained through the breach that resulted from insufficient data security and protection. As the company did not react to the claims, the extorters started to publish hundreds of records a day (the information included very sensitive information, like transcriptions of the conversations between the patient and the therapist). The extorters also sent demands via email to the victims themselves. All this caused remarkable harm to the 30,000 victims affected by the case.

What makes the Vastaamo case particularly repellent is that the victims were already vulnerable due to their health problems. A Finnish study that considers the Vastaamo case [22] argues that the case is not, though exceptional in extent and grossness, a singular case in modern societies. Instead, it should be considered as a natural outcome of surveillance (data) capitalism, platform economy and big data.

3.3. Digital divide

Lythreatis et al. [23] recognize three levels of digital divide (similar phasing can be found in [24], for example). The first-level digital divide is defined as the gap between those who have access to computers and the Internet and those who do not. This level was extensively studied in the late 1990s. Subsequently, researchers found new factors related to digital divide. These factors include accessibility of relevant content, the quality of the Internet connections, and knowledge and skills of the users. This is called the second-level digital divide. Finally, as digitalization started to affect almost all areas of societies, especially economy, scholars started to ask how digitalization would result in equally beneficial consequences to everyone. This is labelled the third-level digital divide.

All the levels of digital divide can be found between the (rich) Global North and the (poor) Global South. This is not, however, the only relevant consideration of digital divide. Digital divide can be found between the rich and the poor in each state. For example, Coleman [25] found evidence of digital divide in schools in the UK. While in private schools access to digital devices was not seen, in general, a problem, most state schools reported challenges, especially the most deprived schools. The study was conducted during the Covid-19 school closures. The problem is not only the access to the devices but also the quality of devices.

In their review on digital divide and health care, Saeed and Masters [6] note that factors leading to digital divide in the health care context include poverty, low health/digital literacy, lack of interest or motivation to use technology, lack of access to technology. Demographic factors such race, ethnicity, and gender seem to correlate with the mentioned primary reasons for the divide. A synthesis of the Saeed's and Masters's review and the Vastaamo case described above brings up an interesting question: How do privacy violations affect the motivation to use IT which has been seen necessary to avoid digital divide?

3.4. Illegal and other undesirable digital behavior by individuals

In digital societies, citizens are sometimes affected by fellow citizens' unacceptable or even illegal, technology-enabled behavior. This can be, for example, cyberbullying, harassment, sexting, or dating aggression. Excluding cyberbullying, none of these forms of undesirable behavior was uncommon in times before digital devices either. However, digital devices and applications, social media in particular have provided effective tools to these reprehensible acts, e.g. [26].

Cyberbullying is an alarming trend among adolescents and children. A systematic review published in 2021 [27] shows that the prevalence of global childhood and adolescent victimization ranges from 13.99% to 57.5%. This means that 1/7 to even 3/5 of young people may be victimized by cyberbullying. Social media, e-mail, text messages and online games are typical means for cyberbullying [28]. Possibly the most problematic situation is when cyberbullying happens in schools, since going to school is basically not voluntary and, young people are there vulnerable to several kinds of bullying [29].

A recent study [30] investigated cyberbullying on Whatsapp at all school grades (from elementary school to high school). Of all school grades, the elementary school students experienced cyberbullying via Whatsapp most (33.1%). In the discussion, the researchers recommend different kinds of interventions like cyberbullying prevention programs. Surprisingly, they do not notice that the age limit for using Whatsapp is currently 16 years in Europe and 13 years otherwise. Should we also consider that the age limit is well-argued and it should be complied with? A relevant question is whether our thinking is so much determined by

the technological imperative that we may be blind to the simplest solutions that are non-technological and those that restrict the use of technology.

Currently, relationships with other persons often start on the Internet. While this has been good for somebody, there is also a lot of undesirable behavior related to the Internet dating. A study by Reed et al. [31] reports that dating abuse and aggression is very common among college students. A study by Henry and Powell [32] reports that technology-facilitated sexual harassment and violence is growing problem also among adults.

3.5. Concerns related to health and well-being

Health and well-being concerns that are linked to ICT use are manifold. They range from mental conditions (e.g. Internet gaming disorder, and other forms of addiction) to physical conditions (e.g. obesity, neck pain, back pain, hearing problems etc. caused by computer game addiction). It ought to be reminded that the same technological artifacts that cause problems to individuals may also provide benefits in certain situations (e.g. video games, [33]).

Addiction is becoming an increasing problem in the digital world [34], [35]. Research that focuses on digital addiction typically considers Internet gaming disorder, Internet addiction, smartphone addiction and social media addiction [34-36].

Technostress is another major concern related to digital technologies. It causes deterioration in health and well-being [37]. Thanks to smartphones, it can be very difficult to keep work and private life separate. In addition, modern work often means responsibility to being available, and doing different kinds of reporting. Finally, there is often a need to answer to a vast number of emails. This leads to decrease in productivity and worsening of working life.

4. Visions of future

In this chapter, we will outline a big picture drawn from the areas dealt with in the previous chapter. In Table 1, we depict both the undesirable/resisted future and the desired future for each area. When analyzing the undesirable visions of future, a systemic approach needs to be followed. This implies that interrelations between different areas must be recognized and analyzed. We will consider these interrelations by giving a couple of examples after the table.

Table 1 Example of visions for digital future

Concern	*Undesirable future*	Desired future
Environment	Supporting or creating inefficient, energy consuming, and polluting industries and activities; improvement in one sector leads to deterioration in some other sectors	Energy efficient solutions utilizing minimal amounts of physical resources and causing minimal emissions and pollution at systemic level (environmental impacts of all sectors and societies affected by the solutions)
Privacy and security	Personal information is misused for different purposes (business, national, individual)	Well-designed and high-quality systems having human rights, such as privacy, as the primary priority
Digital divide	New technologies and the related skills and knowledge are available only to the rich (globally and within a particular society); those who choose "less digitalization" (due to the	Digital societies that provide individuals equal opportunities and rights: digital devices that are necessary for education and public services are available to all who are willing to use them; those who are not able to use digital applications are

	privacy concern, for instance) form the "level B" of the society	being helped and those who are unwilling to use some application for privacy concerns etc. are ensured an alternative way to get the necessary services.
Unwanted/illegal behavior	People do not follow the common rules (laws or ethical) and cause severe problems by using the effective digital applications for illegal and otherwise unwanted purposes.	Public institutions, such as schools and universities organize their activities in a way that minimize risks for cyberbullying, harassment etc. No one is forced to use digital applications that are potential to cause individual threats and ultimate inconveniences
Health and well-being	People are addicted to digital systems (such as social media) or they are forced to use digital applications in their work or in leisure time which can cause technostress and other health problems	Health supporting applications: applications are designed to that the risks for addiction and technostress are minimized; organizational practices and values support a healthy use of digital applications

The interrelations between the areas may be either positive or negative meaning that resolving a problem in one area may either resolve a problem in another area or worsen problems or even cause new problems in the other area. In general, all actions taken in one area should be considered in relation to environmental impacts. This is quite clear to most people. Not so clear, however, may be interrelations between other areas. To clarify these, we take a couple of examples.

Example 1. Privacy concerns and digital divide. We have already mentioned that when a citizen cannot rely on the data security and data protection, and (s)he fears for privacy, a voluntary exclusion of using digital services may follow. Thus, the better data security and protection, the less people drop out of the system, and vice versa, bad quality in data security leads to more dropouts. On the other hand, when trying to diminish digital divide by providing devices without proper education to use and utilize them, as a consequence, privacy problems may occur.

Example 2. Digital divide and environmental concerns. Fundamentally, digital divide is an adverse effect of rapidly developing information technology. When this first-level digital divide occurs in schools (some students do not have necessary devices) a rational attempt to resolve the problem is to provide new devices to all students. This may, however, lead to technological race and replacing well-functioning devices by new ones at an accelerating pace. This is a wicked problem since for environmental reasons the lifecycles of devices should rather be lengthened than shortened but, on the other hand, when students have devices of different quality and properties, they won't have similar opportunities to study.

These examples describe how changes in one area may affect another area. Since digitalization must not be a question of suboptimization, the interrelations must be carefully analyzed and reacted. In Table 1 we have provided a list of most obvious and well-known problems. Most of them are either directly or indirectly linked with economy. Economic and technical arguments for digitalization have dominated social and societal factors and values. This unbalance must be treated with more care in future. What we gain by ICT businesses and ICT-based business innovations, may lead to greater losses in longer term if the other factors do not have the role they deserve.

5. Conclusions

In this paper, we have suggested that digitalization is primarily not a question of building digital systems but rather, of building a societal system where digital systems are implemented and used. This implies that the basic level of analysis of digitalization is societal. Thus, the system we are interested in (a digital society) can and should be exposed to societal analysis. In our analysis, we have borrowed the concept of 'sociotechnical imaginaries' from science and technology studies but we have used the concept in an unorthodox way as we have emphasized the role of 'undesirable/resisted futures' in imaginations of a better digital future. We have provided examples of unwanted outcomes that have already come true, mainly because of an overoptimistic attitude; hoping or believing in that things would not go wrong. Digitalization is such an influential factor that it must not be driven by hopes and opportunities only but by careful planning.

We, information systems scientists, should welcome all the claims for a systemic approach and the emphasis on planning, since we know how systems work, and how systems are developed. Unfortunately, considering digitalization we have missed our mission for building a good SYSTEM. We may have done improvements in a subsystem or in a subsystem of a subsystem, but we lost the overall picture. Unsurprisingly, the efforts on green ICT, for example, has not been efficient enough.

We conclude our paper by stating that significantly more research is needed on the 'undesirable futures' if we like to build a digitalized society that will work in its entirety. This requires brave attitude and independence of research. It also requires new methods that aim to analytically reveal potential threats and to build a synthesis of them.

References

[1] G. Baxter, Gordon, I. Sommerville. Socio-technical systems: From design methods to systems engineering, Interacting with Computers 23.1 (2011) 4-17.

[2] E. Molleman, M. Broekhuis. Sociotechnical systems: towards an organizational learning approach, Journal of Engineering and Technology Management 18.3-4 (2001) 271-294.

[3] P.Savaget, M. Geissdoerfer, A. Kharrazi, S. Evans. The theoretical foundations of sociotechnical systems change for sustainability: A systematic literature review, Journal of Cleaner Production 206 (2019) 878-892.

[4] S. Lange, T. Santarius. Smart green world? - Making digitalization work for sustainability, Routledge, 2020.

[5] L. T. Ha, T. T. L. Huong, T. T. Thanh. Is digitalization a driver to enhance environmental performance? An empirical investigation of European countries. Sustainable Production and Consumption 32 (2022) 230-247.

[6] S. A. Saeed, R.M. Masters. Disparities in health care and the digital divide. Current Psychiatry Reports 23 (2021) 1-6.

[7] S. Lange, J. Pohl, T. Santarius. Digitalization and energy consumption. Does ICT reduce energy demand?, Ecological Economics 176 (2020) 106760.

[8] S. Jasanoff, S-H. Kim. Containing the atom: Sociotechnical imaginaries and nuclear power in the United States and South Korea. Minerva 47 (2009) 119-146.

[9] S. Jasanoff, Future imperfect: Science, Technology and the Imaginations of modernity, in: S. Jasanoff, S-H. Kim (Eds.), Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power. University of Chicago Press, 2015.

[10] R. L. Heilbroner, Do machines make history? Technology and Culture 8.3 (1967) 335-345.

[11] J. Wajcman. Addressing technological change: The challenge to social theory, Current Sociology 50.3 (2002) 347-363.

[12] D. MacKenzie, J. Wajcman. The social shaping of technology. Open University Press, 1999.

[13] M. Koot, F. Wijnhoven. Usage impact on data center electricity needs: A system dynamic forecasting model, Applied Energy 291 (2021): 116798.
[14] K. Widdicks, M. Hazas, O. Bates, A. Friday. Streaming, multi-screens and YouTube: The new (unsustainable) ways of watching in the home, in: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, 2019, pp. 1-13.
[15] A. Shehabi, B. Walker, E. Masanet. The energy and greenhouse-gas implications of internet video streaming in the United States, Environmental Research Letters 9.5 (2014): 054007.
[16] A. de Vries. Bitcoin's growing energy problem, Joule 2.5 (2018) 801-805.
[17] A de Vries. Bitcoin boom: What rising prices mean for the network's energy consumption, Joule 5.3 (2021) 509-513.
[18] R. Anderson. Security engineering: a guide to building dependable distributed systems. John Wiley & Sons, 2020.
[19] S. Myers West. Data capitalism: Redefining the logics of surveillance and privacy, Business & Society 58.1 (2019) 20-41.
[20] J. A. Obar, A. Oeldorf-Hirsch. The biggest lie on the internet: Ignoring the privacy policies and terms of service policies of social networking services. Information, Communication & Society 23.1 (2020) 128-147.
[21] https://en.wikipedia.org/wiki/Vastaamo_data_breach
[22] M. Kortesoja. Tapaus Vastaamo: Symptomaattinen luenta potilastietosuojan murtumisen yhteiskunnallisista syistä ja seurauksista, Tutkimus & Kritiikki 2.1. (2022) 9-32.
[23] S. Lythreatis, S. K. Singh, A.-N. El-Kassar. The digital divide: A review and future research agenda, Technological Forecasting and Social Change 175 (2022): 121359.
[24] S.-C. Liao, T.-C. Chou, and C.-H. Huang. Revisiting the development trajectory of the digital divide: A main path analysis approach, Technological Forecasting and Social Change 179 (2022): 121607.
[25] V. Coleman, Digital Divide in UK Education during COVID-19 Pandemic: Literature Review. Research Report. Cambridge Assessment (2021).
[26] G. Giumetti, R. M. Kowalski. Cyberbullying via social media and well-being. Current Opinion in Psychology 45 (2022): 101314.
[27] C. Zhu, S. Huang, R. Evans, W. Zhang. Cyberbullying among adolescents and children: a comprehensive review of the global situation, risk factors, and preventive measures. Frontiers in Public Health 9 (2021): 634909.
[28] J. Chun, J. Lee, J. Kim, S. Lee. An international systematic review of cyberbullying measurements. Computers in Human Behavior 113 (2020): 106485.
[29] C. Evangelio, P. Rodríguez-Gonzáles, J. Fernádez-Rio, S. Gonzales-Villora. Cyberbullying in elementary and middle school students: A systematic review. Computers & Education 176 (2022): 104356.
[30] D. Aizenkot, G. Kashy-Rosenbaum. Cyberbullying in WhatsApp classmates' groups: Evaluation of an intervention program implemented in Israeli elementary and middle schools. New Media & Society 20.12 (2018) 4709-4727.
[31] L. Reed, R. M. Tolman, L. M. Ward. Snooping and sexting: Digital media as a context for dating aggression and abuse among college students. Violence Against Women 22.13 (2016) 1556-1576.
[32] N. Henry, A. Powell. Technology-facilitated sexual violence: A literature review of empirical research. Trauma, Violence, & Abuse 19.2 (2018) 195-208.
[33] Y. J. Halbrook, A. T. O'Donnell, R. M. Msetfi."When and how video games can be good: A review of the positive effects of video games on well-being. Perspectives on Psychological Science 14.6 (2019) 1096-1104.
[34] D. Cemiloglu, M. B. Almourad, J. McAlaney, R. Ali. Combatting digital addiction: Current approaches and future directions, Technology in Society 68 (2022): 101832.
[35] N. Aziz, M. J. Nordin, S. J. Abdulkadir, M. M. M. Salih. Digital addiction: systematic review of computer game addiction impact on adolescent physical health. Electronics 10.9 (2021): 996.asda

[36] S.-Q. Meng, J.L. Cheng, Y.Y. Li, X.-Q. Yang, J.-W. Zheng, X.-W. Chang, Y. Shi, Y. Chen, L. Lu, Y. Sun, Y.-P. Bao, J. Sie. Global prevalence of digital addiction in general population: A systematic review and meta-analysis. Clinical Psychology Review 92 (2022): 102128.
[37] K. Pflügner. Technostress management at the workplace: A systematic literature review. in: Proceedings of Wirtschaftsinformatik (2022) 2.