NETWORKING AND NEED OF COMPLEX LITERACY IN THE DIGITAL AGE

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Abstract: The digitalisation of society is a process that is constantly improving. The main reason for this is the development of contemporary technologies (Cloud Computing, Mobile Cloud, Internet of Tings, cyber-Physical Systems, Big Data, etc.) which impose new requirements on working conditions and the necessary knowledge for their use. This requires improving the digital literacy of society by expanding the knowledge and skills to use technologies and to know the need to comply with rules for information security, privacy and personal data protection. In this regard, the article discusses the problem of the need for complex literacy by adding new components to the established understanding of information (digital) literacy, covering the additional requirements for working in the global space. Based on a retrospective analysis of publications in the field of information literacy, the need for a new understanding of digital literacy is substantiated and a structure of the so-called "Complex Literacy" is proposed and the requirements for the new components "Technological Literacy" and "Security & Privacy Literacy" whit extended discussing the issues of information security, privacy and personal data protection in the digital age.

Key words: networking, informatization, digital age, contemporary technologies, information literacy, security and privacy.

1. INTRODUCTION

The contemporary digital age is mainly associated with the development of Information and Communication Technologies (ICT) in the 21st century, but the basics can be mainly related to the last decades of the last century [1]. Even if we talk about digitalization in a general sense, we can go back in history, as for example in [2] we discuss the problem of mass digitization of archival data and draw a parallel with the big data of today. Undoubtedly, the main influence on the digitalization of society has the creation of hypertext technology and the transition to a graphical browser in the early 1990s, which made Internet communications the main means of communication and access to information resources and knowledge. The real consequence is the general informatization and development of the Information Society (IS) in the last 2-3 decades, although the first theoretical proposals appeared in the 1960s and 1970s in Japan and the

United States (Jiro Kamishima, Fritz Machlup, Yoneji Masuda & Konichi Kohyma, Yujiro Hayashi, etc.) [3].

It is adopted that the transition to the Information Society (IS) is made if more than 50% of the population is employed in the field of information and intellectual services, which determine the important role of the informatization for management of information in heterogeneous systems [4]. An analysis of the changes in the contemporary science that have occurred in result of informatization is made in [5]. This research is based on fundamental philosophical principles and socially oriented methods, and by using comparative analysis the tendencies for functional transformation of science under the influence of informatization are revealed. On the other hand, [6] raises the question of the negative impact of informatization and globalization of modern society by launching the idea of violating the "*principle of individual autonomy*", which according to the authors "*leads to deliberation of society*".

The introduction of new ICT inevitably increases the need to develop the digital competencies of individuals and the acquisition of adequate literacy of the population to cope with the challenges of the digital age. Several publications connect informatization to the direct digitalisation of the industry to ensure the necessary level of competitiveness [7], need to form a qualitative change in the requirements for staff competencies [8], adaptation of economic to the conditions of the digital age and realization of requirements for new opportunities and knowledge for serious use of ICT [9]. All this determine the suitable using networking possibilities and need of complex literacy in the digital age.

The main purpose of the article is to present the need for complex literacy of the population in the contemporary digital world, by systematizing the specific requirements for adequate and appropriate use of different network resources and technologies. In this reason the Section 2 includes a retrospective analysis of discussions in the fields of education, medicine, e-government, participation of users in electronic processes, including the ability to understand responsibility in protecting their privacy and personal data. Section 3 is dedicated to the need for complex literacy (not only information literacy) of the users in networking, with extension of the so-called digital literacy with the addition of the components for “Technological Literacy” and “Security & Privacy Literacy”. Section 4 discuss the justification for the need to add the second proposed component by presenting the issues of information security, privacy and personal data protection in the digital age.

2. BRIEF RETROSPECTION OF THE INFORMATIZATION LITERACY IN THE DIGITAL AGE

Informatization is a multifaceted and purposeful process of development of society in the modern digital age, providing the necessary prerequisites for the development of the information society. With the improvement of the means of digital communications, efficiency of routing in networks [10] and the opportunities for remote access to information resources and transfer in the global network increases [11]. This requires

knowing the rules for privacy and personal data protection, including the digital education, modern ICT and media tools. This basic problem of informatization of education is discussed in [12], emphasizing the need to raise public awareness and media literacy.

One of the main tasks of informatization in the digital age is to provide opportunities for free access to information resources in the global space, overcoming possible restrictions of administrative, legal or economic nature, thus ensuring the development of the information society. In fulfilling the basic requirements for sharing information resources, including in the material and social spheres, the state institutions play a significant role. This reflects on the responsibility of the state to create modern e-government to increase the efficiency of government activities in all areas of social development. In this aspect should be evaluate possibilities of e-democracy as a part of contemporary government and their informatization. This part is important for the IS and [13] discuses different prospects, challenges and opportunities. This opportunity of the digital world can only be effective if it is used correctly and in compliance with the requirements for the protection of the data and personal space of the participants [14].

One possible implication is that information literacy in the use of digital technologies, including e-governance, e-democracy and e-communications in general, can provide a more balanced understanding of the practical implications of working in the global network, which increases engagement and responsible for users. Informatization of society is the responsibility of government bodies, as noted in the study presented in [15]. Based on an empirical study of e-government initiatives in the digital age, a system for evaluating the quality of e-resources for digital entrepreneurship is proposed. The digital age has led to significant changes in the entire social system (lifestyle, value system, social communication, etc.). In general, informatization progressively affects the development of society and leads mostly to positive consequences. A certain level of digital literacy is required to avoid some possible negative consequences. A socio-philosophical analysis of informatization reflection to the religion, society and power in the digital age is presented in [16].

The contemporary technologies (network, cloud, mobile cloud, Internet of Things, cyber-physical systems, big data, etc.) have led to an update of the concept of informatization of society, but at the same time set additional requirements for digital literacy. Understanding digital processes and the ability to access and share information resources (information literacy) is no longer a sufficient condition for proper operation in the digital space, but also requires knowledge of the technical organization of processes, as well as consumer understanding of possible risks in breach of information security requirements [17]. It is especially important in the digital age to comply with the requirements to protect the privacy rights of the participants and their personal data [18]. Several publications state that, in principle, ensuring technological literacy is not a trivial process, and there is a clear need for a cost-benefit ratio of the applied processes. This also applies to knowing the rules for personal privacy protection. This determines the need to maintain a certain level of privacy literacy, as in [19] a model of online literacy for confidentiality is proposed, which provides for the availability of factual knowledge, a certain set of skills and requirements for critical literacy.

3. COMPLEX LITERACY IN THE DIGITAL AGE

Different characteristics of digital can be defined, as [20] proposes the definition of "network society" based on the use of the global network in social and industrial life. In support of this, some basic characteristics are defined (social equality, quantity and quality of social relationships, democracy and freedom, richness of the human mind). A summary of the functional characteristics of the digital age discussed in the information space is presented in Table 1.

Table 1. Functional characteristics of the digital age

Characteristic	***Comment***
Knowledge orientation	Knowledge is the main production and main priority
Digitalization	Digital form for presentation of objects and used documents
Virtualisation	Virtual form of the real physical environment through the application of virtual data and systems for "virtual reality"
Extensive functionality	Components for multiple and multifunctional use are created
Integration and interconnections	Construction of a unified universal network infrastructure from separate independent modules for services and manufacturing
Dynamic operation	Implementation of activities in real time with access to all necessary components
Globalisation	Globalization of knowledge and opportunity to implement activities from different places

The variety of functionalities of the digital age generates massive information flows in the global network, and it is not for nothing that there is talk of an "information avalanche". Unfortunately, total informatization also produces undesirable effects, such as: ✓ Devaluation of information; ✓ Obtaining poor quality knowledge; ✓ Spending too much time and attention by users to "surf" the web; ✓ Loss of productivity due to spam; ✓ Additional costs related to data transfer, storage options, etc.; ✓ Security issues.

All this necessitates the need for adequate literacy in the digital age to counteract or at least reduce the negative aspects of informatization. This is important even just for social computing, which occupies an important place in modern digital life. Regarding the terminology of user literacy, various definitions have been defined (digital, network, electronic, internet, user, etc.). In general, however, the concept of literacy in the digital age has a broader content, and in this section a structure of several levels of literacy is proposed - information literacy, technological literacy, and security literacy.

According to UNESCO[1] ***information literacy*** will allow an adequate assessment of the benefits and security of access when working in the global network and the use of various information resources. An important requirement is the possession of the necessary knowledge and experience for Internet use and the use of modern ICT. To this should be added requirements for correct search and interpretation of the received data,

[1] http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/information-literacy/

navigation in the virtual space, correct use of hypertext and multimedia, awareness of the risks of providing personal data, etc.

In a general sense, the term "information literacy" is understood as a set of abilities to solve a problem by searching, accessing and processing information sources (real and virtual). In the digital world, however, new requirements are emerging that expand this understanding, based on the technical and technological components of informatization – electronicization, mediatization, computerization and intellectualization. The contemporary notion of information literacy in the digital age can be represented by the conceptual model in Figure 1. The main elements of the digital world, which have a direct impact on the level of information literacy, can be summarized as follows: information technology, social communications, information retrieval, critical thinking, problem solving and synthesis, correct and ethical information using.

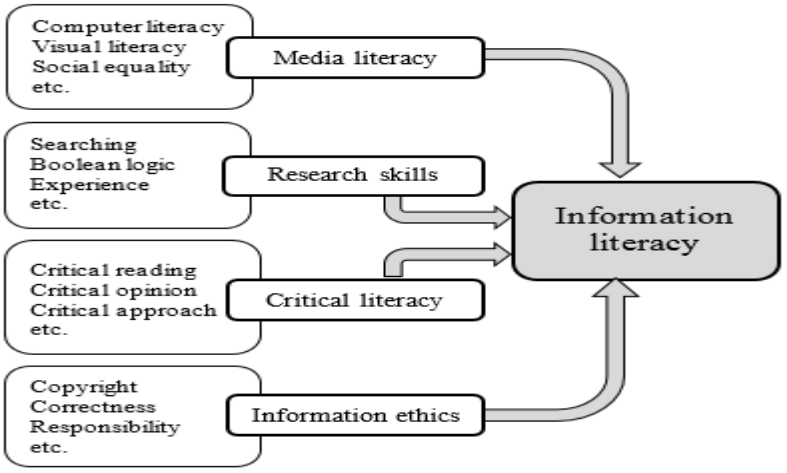

Figure 1. Understanding information literacy in the digital age

The understanding of ***technological literacy*** is varied depending on the specific problems of society. Exemplary components are digital inclusion and mobile broadband coverage, and their low or non-existent level requires non-standard solutions. The growing public interest in the development of broadband access determines, on the one hand, the development of the national policy for digital inclusion of all, and on the other hand, the development of the technological literacy of users of network services. A proper understanding of the essence of technological literacy and the tasks to reach the required level requires knowledge of the principles of network communications, the functions and concepts of system software used at home or at work (including network software), the capabilities of rapidly changing applications to solve problems etc.

However, the question is to what extent society is ready to acquire the necessary level of technological literacy and can we talk about its universality. As stated in [21], the general perception is that people are generally willing to bear the costs of time and effort associated with acquiring this knowledge. The article analyses the cost-benefit ratio of acquiring this literacy from the perspective of the individual subject, with the result that the costs do not justify the potential benefit of technological education. An

adequate education in this direction should aim at acquiring the necessary level of technological literacy corresponding to the modern digital age.

In addition, the clear need to overcome actions that will violate the security and privacy of personal life must be stated, including opportunities to overcome the negative consequences of reckless actions. This determines the third level of the requirements for adequate literacy in the digital age - knowledge of the principles and basic requirements of information security, as well as the possibilities for protecting privacy and protecting users' personal data. These knowledge requirements complement the general concept of necessary literacy in the digital age, defining the necessary skills and experiences that are grouped into relatively independent but related levels with a certain hierarchical relationship between them - Figure 2.

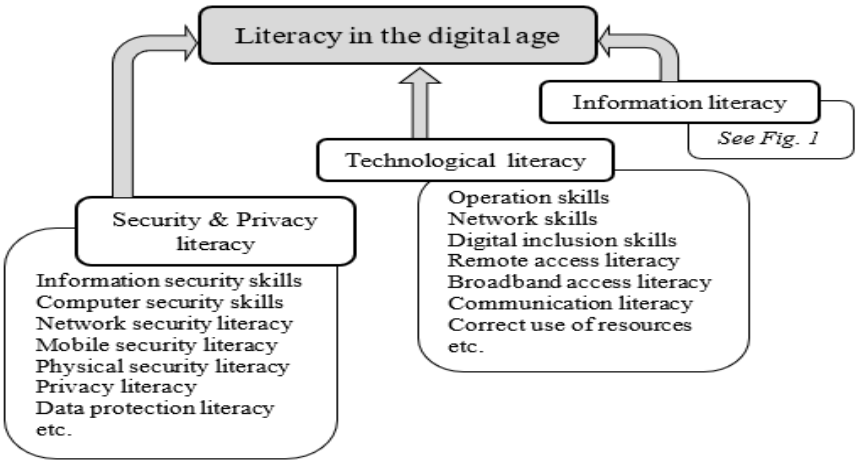

Figure 2. An expanded understanding of the digital literacy

Security literacy is a broad term, but quite often in the digital age it is associated with information security, implicitly including additional knowledge of computer, network and mobile technologies. With the development of network technologies, the need to ensure the protection of personal data and personal space of users is increasing. This also determines the need for ***privacy literacy***. For adequate information security management, serious IT security policies need to be developed, reflecting on the privacy policy of users in the digital world. This requirement determines the need for continuous improvement of national literacy in this area, especially since the digital world is constantly posing new challenges.

The idea of developing private literates is related to society's growing dependence on technology and digital services, which also increases the possible risk for information security and violation of personal space [22]. In this direction, technological solutions using multiple technologies should be added to cloud technologies data access points (sensors) (Internet of Things) [23, 24], "smart" technologies for the home [25], the city, transport, etc. (cyber physical systems), accumulation of big data and their processing [26].

Some key features of information security and personal data protection in today's digital world, which require updating society's literacy in the digital age, are discussed in the next section.

4. SECURITY AND PRIVACY FEATURES AFFECTING LITERACY IN DIGITAL AGE

4.1. Information security and literacy

Information Security is the state of protection of the data processed, stored and transmitted in computer systems from illegal access and / or destruction (as a final degree of modification), as well as the state of protection of information resources from internal and external accidental or malicious effects that cause disturbances in their functions. This protection includes detecting, preventing and responding to these impacts through the use of developed security policies, hardware and software tools and IT services.

In the contemporary digital age, information security is associated with network security, and its goal is defined as the development of a unified security strategy that allows protection of all components of a complex network environment, without affecting ease of use and performance. According to the definition of the European Commission, information security is the protection of networks and information systems against human error, natural disasters, technical malfunctions or malicious attacks

It is necessary to distinguish between individual concepts of security in the digital world: *Information security* – protection of information in any form; *Computer security* – for the functioning of computer systems and networks, incl. the information processed by them; *Information protection* – for risk management practices related to data processes in critical situations. Some basic components and features of information security are presented below.

✓ *Physical security* Protect staff, hardware, software, networks, and data from physical impacts, intrusions, and other events that damage the organization's systems and resources. Physical security includes control of the access to rooms with computers or data centres, restricting the copying of data to a USB device, and physically delivering malware directly to systems. Force majeure events such as natural disasters, fire, theft and terrorism are also included.

✓ *Software security*. Protection against threats aimed at accessing an application for manipulation, theft, alteration or deletion. Countermeasures are applied such as firewalls, encryption / encryption programs, biometric access systems, etc.

✓ *Mobile security*. Protection of portable devices (smartphone, tablet, and laptop) and the corresponding connecting networks to counteract theft, data leakage and malware attacks (also known as wireless protection).

✓ *Network security*. Protect network infrastructure and related devices through the application of technologies, policies and practices, including protection against threats such as unauthorized access and malicious use and modifications. Also includes security of endpoints, which must be connected to a reliable network after certification of compliance with standard security requirements.

✓ *Internet security*. Protect software applications, web browsers and virtual private networks (VPNs) that use the Internet. The goal is to counter data transfer attempts from malware and phishing attacks, as well as denial-of-service (DDoS).

In general, users of network services are not specialists in the field of ICT, and this determines the need for a certain literacy in the components presented above. This need for information security literacy is confirmed by experimental studies and statistical data from them.

4.2. Privacy protection in digital age technologies and literacy

The opportunities used by technologies in the digital society create challenges for data protection due to the specificity of the processes and in particular the treatment of the definition of "personal data" and in cross-border transfer.

Social computing (SoC) is essentially a dialogue between individual computer users using Social Networking Sites (SNS). Various representatives of the latter are social media, social networks, social bookmarks, social aggregators, blogs and microblogs, wikis, multiplayer games, etc. SoC provides a useful tool for connecting with friends, family and colleagues, but also creates the risk of a wider range of users accessing personal information, photos and comments, which in some cases can have financial and psychological consequences, as well as reputational implications. The SNS presets, which operate by default, allow a "wide open door" to information without clear insight for users. Even with a single visit to the page, the user's personal data is saved and automatically sent to the exchange.

Cloud Computing (CC) is a distributed environment of connected and virtual computers that dynamically communicate and provide computing resources based on the negotiation of delivery services between a provider and a customer. The possible risks of storing data in the "cloud" are related to the confidentiality of information that may be violated by multiple hiring, the availability of copies of data in different nodes of the network, etc.

Internet of Things (IoT) is a term used to describe a variety of objects and devices that are connected to the Internet and can send and receive data. For this purpose, the devices and objects have sensors for measuring parameters and monitoring their values in order to control processes at the level of home, city, health status of persons, etc. In this respect, IoT (via connected devices) creates potential opportunities to violate the privacy of users, because the relatively independent communication of devices with the Internet violates the confidentiality of collected data, and security in IoT is a problem because often configuring devices happens with "weak" or standard passwords.

Big Data is a concept that is associated with very large data sets collected from various sources in the digital space based on monitoring. The main purpose is to be stored and used for trend analysis and research, but the idea of "the more data is the better" creates a problem for the CIA triad (Confidentiality, Integrity, Availability) due to the huge amount of information, the variety of sources, the different forms of existence and the possible lowering of supervision over this data.

Big Data Analytics (BDA) is a method for processing the accumulated big data in the formation of certain conclusions. It is a time-consuming task, but it can cause privacy issues, for example:✓ Different sets of data can contain tools that are subject to security

breaches. ✓ Data may have been initially collected for another purpose. ✓ Data that do not fall within the jurisdiction of the personal data protection (court records, personal home records, etc.) can be collected. BDA technology makes the principle of "data minimization" meaningless (the goal is to collect as much data as possible for further processing) and can create problems, for example:

- Some big data analytics and decision-making systems may use rules and algorithms that are not open or publicly available, which impairs the transparency of processing.
- Possibility some obtained from analysis results to lead to violation of the confidentiality of the participants and to cause unpleasant consequences, incl. job loss.
- Violation of anonymity – by collecting so much data and using powerful analysis, it may be impossible to eliminate the inability to identify a person.

Possible problems can be indicated, such as sharing personal data in social communications, providing personal data beyond the specific requirements during registration, claiming activities that violate personal space, etc. The reason for this is an insufficient level of privacy literacy, although there is a lot of talk in the space about the basic requirements for the right to privacy and the right to data protection set out in the General Data Protection Regulation.

Collecting personal data and generating estimates and trends is most inherent to BDA, but SoC (in information sharing) and IoT (internet device connectivity to monitor human behaviour and activities) should not be overlooked. Analyses show that there is an increased risk of security breaches when sharing personal information with company platforms, which is explained by the trust in companies and the maintenance of network services. Unfortunately, this can lead to unforeseen risks in the future, especially when sharing financial and health data.

In the digital era, the transformation of information into an important resource for organizations, institutions and service providers, which creates certain difficulties for users in managing the privacy and protection of their personal data. Possible contradictions between individual and organizational motives in the use of digital technologies and resources can be overcome by a certain level of security and privacy literacy in addition to the legal framework.

In the digital age, the transformation of information into an important resource for organizations, institutions and service providers creates certain difficulties for users in managing the privacy and protection of their personal data. Possible contradictions between individual and organizational motives in the use of digital technologies and resources can be overcome by a certain level of security and privacy literacy in addition to the legal framework. This defines a need for users of digital content and online services to increase their commitment to data protection. This corresponds to the call of state institutions and governments to citizens "Privacy is in your hands", which defines the need for information privacy to become the main priority of users in the digital age.

5. CONCLUSION

The protection of personal data on the Internet is a major problem that has necessitated the development of the relevant legal framework. It is a common practice

for organizations and companies to maintain websites for their own presentation and to connect with customers and users. According to the requirements for privacy protection, the information published in it must be correct, reliable and the necessary organizational and technological measures for protection must be taken. This is the responsibility of the site owner which is the Data Controller and must not be transferred to the Data Subject (owner of personal data). Information published on the sites about individuals, regardless of the manner of its acquisition, becomes publicly available and may in certain cases lead to a risk of financial and psychological consequences, as well as consequences for reputation.

The published information in the social networks, data centres in the cloud, accumulated data sets at BDA, etc. must comply with the requirements for legal and correct processing of personal data, the information must be sufficient and relevant to the goal, to there is the consent of the person. Last but not least, the introduced new paradigm "the right to be forgotten" (replacing the previous "right to be left alone") should be respected, which gives the data subject the right to ask the controller to correct incorrect data, removed or blocked. This also applies to search engines such as Google, as they are also considered a data controller. It must be possible to access the personal data in the profiles and, in case of inaccuracy or incorrect data, to request correction or removal. This requirement imposes an obligation on digital service providers to ensure the necessary privacy and is related to a good level of privacy literacy of users, which must be continuously improved.

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