Digital Competence and Information Security in Adolescents*

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Abstract

The paper presents the results of an empirical study of digital competencies and characteristics of Internet addictive behavior among adolescents. Received data shows that a low level of digital competence is one of the factors reducing information security and it can be a risk factor in forming Internet-dependent behavior in adolescence. The leading role in providing the information security of teenagers is their ability to recognize content threats and their knowledge of ways of personal information protection in the network. The results of the survey underscore the need for the development and implementation of educational technologies aimed at the formation of digital competencies of adolescents, allowing them to navigate freely in the modern information environment, be critical towards the digital content and use adequate ways to protect information.

Keywords: *digital competence, information security, adolescents*

1 Introduction

The professional and personal success of a person in terms of the digital economy requires new, specific competencies for the information society [Unizhaev, 2018]. Modern researchers define digital competence as the ability and skills to use digital technologies effectively, the ability to evaluate technological innovations critically, the motivation to participate in digital culture, and also technical skills related to computer literacy [Soldatova et al., 2013]. The joint report of UNESCO and the International Telecommunication Union (ITU) presents a set of competencies vital for living in a digital society. It includes basic digital technology skills, that allow the use of digital technology thoughtful, and skills for "advanced", creative and constructive usage of digital technology. There are 5 main areas of competence in the "Digital Competence Framework for Citizens": data literacy, communication, and collaboration, digital content creation competence, information security knowledge, ability to solve problems, arising in Internet communication.

Safe behavior skills in a digital environment constitute skills of using of protective devices, knowledge of techniques and methods of protecting personal data and privacy, the ability to identify gaps in the digital competence, ability to analyze and evaluate the information security threats and risks, the ability to implement measures to counteract information security violations.

The analysis of the interaction of Russian adolescents with information technologies let us suggest, that they actively use the Internet, various gadgets, and communicate intensively in social networks.

However, the level of their digital competence is low as well as their motivation for further development. [Soldatova et al., 2013b]. According to G. U. Soldatova and others, Russian teenagers most often face such information security problems as malicious content, technical problems, and communication risks. At the same time, the possibility of facing the online risks is strongly influenced by a low level of digital competence in such areas as orientation in various sources of information, searching for the necessary digital content and its quality evaluating; communication skills in the information space; knowledge of personal data protection techniques. Furthermore, teenagers often underestimate the negative consequences of careless behavior on the Internet for their further life. It is thus possible to speak that digital competencies of modern students of the secondary school are of increasing interest. In this paper, we present a study conducted among students of the 8th-11th grade of the secondary school on digital competence. The goal was to check whether digital competencies only include knowledge of technical aspects or related to understanding various aspects of information security. We believe that understanding the level of digital competence of students is an opportunity for schools to analyze shortcomings and prepare adequate methods to improve them.

2 Digital Competence and Their Role in Information Security of Adolescents

In several modern Russian and foreign studies, it also justified, the need to have competencies, related to the search for information, its processing and systematization, skills of virtual self-presentation, risks, and digital environment threats understanding. Digital competence implies the willingness of a modern man to use various information technologies effectively and safely in all spheres of activity and communication. It includes a system of knowledge, skills, responsibility, and motivation [Slepova, 2018]. Digital competencies allow us to apply information and communication technologies in various spheres of life – work, communication, and recreation[Shmel'kova, 2016]. Digital competencies are one of the key resources of adaptation and self-realization of a person in modern society; they determine the success of career and professional growth [Yanchenko, 2012].

Some modern works consider the main types of digital competencies. Thus, in the works of Ferrari A., Brolpito A.. Carretero S. et al. [Ferrari, 2013], [Brolpito, 2018], [Carretero et al., 2017] such competencies as digital literacy, the ability to solve technical problems when using information technologies, criticality, the ability to search and process information, the ability to communicate in a digital environment, the ability to use information technologies for creative self-realization, and the ability to interact safely in the informational space are recognized. G. U. Soldatova and others group together four domains of digital competencies: Information, Communication, Technical, and Consumer competency. They include a variety of skills that allow using information technologies fully and effectively and confronting most of the risks that a person can face in virtual communication. The high variability of modern digital competencies enables us to suppose that they can be considered as one of the necessary conditions of information and psychological security. Information and psychological security is one of the components of the system, the higher levels of which are human security in general and information security of the state. Information and psychological security is understood as "an individual's protection (subject, psyche, consciousness) from negative information and psychological influences; development of internal resources of resistance to negative impacts and resources of individual self-development; high-quality informational environment for meeting needs and forming spiritual and moral values" [Lyz et al., 2014].

Information security of children and adolescents ensures their security, the absence of informational risks associated with any harm to their physical and psychological health, damage to personal development [Lyax et al., 2015] Modern teenagers are the most vulnerable group in terms of information security, as communication is their main activity, and with the high availability of gadgets in the Internet environment, that can lead to the formation of Internet addiction and many other negative

effects.

The information environment has significant resources for socialization and self-development of teenagers, but at the same time, it can be a source of risks and threats to their information security. Modern teenagers, as bright representatives of the digital generation, spend a large amount of time in Internet, systematically use various gadgets and mobile devices, but in doing so they often demonstrate a frivolous, careless attitude towards information threats, they have unrealistic ideas about information security and often underestimate risks of interaction in the informational space.

Thus, the risks related to the content of information that is harmful to health and development, with undesirable and potentially dangerous contacts are the most significant for modern teenagers. Commercial and consumer risks, violation of confidentiality and disclosure of personal data are significant for teenagers [Kopecky et al., 2012], [Livingstone et al., 2008], [Selyunina & Gorbacheva, 2017].

In adolescence, an uncritical attitude to information and contacts in the Internet environment can lead to deviant behavior. The illusion of anonymity of the user on the Internet, inherent in teenagers with a low level of digital literacy, can lead to non-compliance with social and moral norms in network interaction, to an increase of aggressive forms of behavior in the Internet environment. In the meantime, teenagers themselves may inadvertently face asocial information content and be subjected to various types of manipulations. Negative content can result in psychological trauma to teenagers [Privalov & Bogaty'reva, 2012], [Bogaty'reva, 2013].

Adolescents with high online activity more often face emotional discomfort during limiting the time spent online, tend to replace real interpersonal communication with virtual, and are more vulnerable to forming Internet addiction [Furnell, 2010], [Lazhinceva and Bochaver, 2015], [Belyakova et al., 2017] Furthermore, confident behavior of teenagers and youth in the network, rapid development of technological innovations can be combined with low information literacy, with the inability to work with large amounts of data, to determine the reliability of the information.

Many adolescents have a superficial perception of information, inability to resist information influences, a low level of readiness to overcome the state of information overload [Brodovskaya et al., 2019].

In this regard, the problem of analyzing the relationship between digital competence and the informational security of adolescents becomes particularly relevant in modern conditions. There was an attempt made in our survey to explore the interrelationship between digital competencies and emotional and behavioral aspects of informational and psychological security in adolescence.

3 Research Questions

Following the results of a theoretical analysis of the interrelationship between digital competencies and emotional and behavioral aspects of informational and psychological security in adolescence, we posed the following research questions (RQ):

RQ 1: Is there any difference between digital competences of adolescents with different severity of signs of Internet addictive behavior?

RQ 2: What is the correlation between digital competency and the characteristics of the Internet-addicted behavior of adolescents?

4 Methods

4.1 Participants

The students of the 8th-11th grade of the secondary school MAOU "Gymnasium № 2" in Velikiy Novgorod were chosen as the subject of the investigation. The number of participants in the survey was 70 people. The age range of the subjects was from 14 to 17 years old. The sample is gender-balanced: 33 females and 37 males. There were selected students of different classes for the survey

(mathematical, humanitarian, socio-economic, technical), so reducing the probability of influence of educational specifics. Based on the Chen Internet Addiction Scale (CIAS) and according to the report by Malygin et al. the cutoff point at a score of 65 to determine Internet addiction via CIAS gave a good performance in respect of reliability and validity [Malygin et al., 2011]. Following Malygin et al., we adopted this cutoff value to classify normal internet use (n = 22, range = 27–42), problematic internet use (n =34, range = 43–64) and internet addiction (n = 14, overall level of IA >65).

4.2 Measures

Digital Competence Questionnaire. As the main research method, the digital competence questionnaire, which was based on the materials of the development of G.U. Soldatova and others were used [Soldatova et al., 2013a] . The questionnaire included 30 multiple-choice questions that covered various aspects of digital competencies:

1. Network etiquette knowledge;
2. Understanding of the terms used in network communication;
3. Competence in the field of communicational risks (bullying, trolling);
4. Potentially dangerous network content recognizing;
5. Knowledge of ways of personal data protection;
6. Knowledge of the basics of legal regulation of Internet communication;
7. Overall level of digital competences.

Respondents rated the statements on a four-point Likert's scale ranging from 1 (Does not match my experience at all) to 4 (Definitely matches my experience). Then the answers were normalized to the number of questions and converted to a scale from 0 to 1. The internal consistency of the questionnaire scales has values between Cronbach's alpha=0.79 to 0.83.

Problematic Internet use. The adolescents completed a CIAS – the self-rating questionnaire comprising 26 items, with a four-point Likert scale ranging from 1 (Does not match my experience at all) to 4 (Definitely matches my experience). The questionnaire was specially developed for assessing internet addiction [Chen et al., 2003]. The scale (IA) is made up of five subscales:

1. Compulsive Use (5 Items);
2. Withdrawal Symptoms (5 Items);
3. Tolerance (4 Items);
4. Interpersonal And Health-Related Problems (7 Items);
5. Time Management Problems (5 Items) And Two Integral Indicators:
6. Key Symptoms of IA (Ia-Sym = (Com+Wit+Tol));
7. Negative effects of Internet use (IA–Rp = (In+Tm)).

The CIAS was adapted for use in Russia by V.L. Malygin et al. [Malygin et al., 2011]. According to their report, the cutoff point at a score of 65 was used to define IA; ranges of 27–42 and 43–64 respectively were classified as normal internet use and problematic internet use (PIU). Cronbach's alpha fell in the range of 0.757 the scale of compulsive use to 0.9 on the scale of time management problems. IA test/re-test correlation on all subscales showed a good performance on reliability (a Pearson's correlation coefficient not less than 0.7–0.75).

4.3 Data Analysis

The chi-square test was used for determining whether the level of PIU and overall level of digital competencies were independent of student's gender. We conduct the ANOVA to examine the digital competencies in different groups of independent variables (normal/ problematic internet use/internet addiction). The samples were homoscedastic (Levene's test, $p>0.05$). The Scheffe test to correct alpha to account for multiple comparisons and Pearson's correlation coefficient to examine the correlation interrelationships of digital competency and the characteristics of the Internet-addicted behavior of adolescents. Statistical significance was set at a level of $p < 0.05$. The Statistica 10.0 software package was used for analyses in this study.

5 Results

In the first stage of the study, we specify that the indicator of PIU does not depend on the sex of students (χ^2 (2) = 0.93, p = 0.62). Internet addiction, especially its prevention in adolescents, and its predictors have been the focus of many studies. Few studies have investigated gender differences. So, in a study by Chinese scientists Y. Ha, W. J. Hwang, which was conducted in 2014 and covered about 50,000 schoolchildren, it was shown that the prevalence of Internet addiction was higher in boys than in girls [Ha & Hwang, 2014].

Our data show that there are no differences in the level of Internet addiction among boys and girls, which may indicate a deeper immersion of modern youth in the digital environment. However, due to the small sample size in this study, this result should be refined.

Table 1: Digital competencies of teenagers

Competence name	Low level		Average level		High level		F	p<
	M	SD	M	SD	M	SD		
Network etiquette knowledge	0,37	0,17	0,53	0,15	0,69	0,09	15,52	00,00
Understanding of the terms used in network communication	0,75	0,17	0,83	0,16	0,99	0,08	9,11	00,00
Competence in the field of communicational risks (bullying, trolling)	0,57	0,27	0,89	0,21	1,00	0,06	16,31	00,00
Potentially dangerous network content recognizing	0,77	0,14	0,84	0,13	0,93	0,07	5,13	00,01
Knowledge of ways of personal data protection	0,93	0,14	0,95	0,00	1,00	0,09	7,31	00,00
Knowledge of the basics of legal regulation of Internet communication	0,89	0,13	0,93	0,13	1,00	0,08	2,67	00,05
Overall level of digital competencies	4,28	0,32	5,02	0,25	5,63	0,13	12,26	00,00

Checking the influence of gender on the level of digital competencies also showed no differences (χ^2 (2) = 5.41, p = 0.06)

Table 1 shows the structure of the digital competencies of teenagers, who were divided into three groups according to the integral assessment based on the results of the survey (20% of adolescents score

low; 64% score medium and 16% of adolescents show a high level of digital competence). The average group assessments of competencies are shown in Table 1. The results show that the competence profiles in each of the groups.

The situation is somewhat different in analyzing the digital competencies in groups of teenagers, who differ in levels of expression of emotional and behavioral manifestations of Internet addiction. The results are shown in Table 2.

These results indicated that teenagers with the most pronounced signs of Internet addiction are the most vulnerable to content risks in the course of Internet communications and they are also versed less in ways of personal data protection.

Table 2: Digital competence of adolescents with different severity of signs of Internet-addictive behavior

	Normal		Problem		Expressed signs of Internet addiction		F	p<
Competence name	M	SD	M	SD	M	SD		
Detection of potentially dangerous network content	0,81	0,13	0,87	0,12	0,75	0,14	4,1	00,01
Methods of protecting personal data	1,00	0,01	0,99	0,05	0,89	0,12	2,61	00,05

The results of the correlation analysis of indicators of digital competency and Internet-addicted behavior in adolescents are presented in Table 3 [1].

Table 3: Correlation interrelationships of digital competency and the characteristics of Internet-addicted behavior in adolescents (correlations in bold are significant when p<0,05; p<0,01)

Name of indicators	1	2	3	4	5
Understanding of the terms used in network communication	-0,20	-0,24	-0,09	-0,11	-0,18
Recognizing potentially dangerous network content	-0,18	-0,11	-0,33	-0,08	-0,17
Knowledge of ways of personal data protection	-0,44	-0,19	-0,09	-0,32	-0,23
Overall level of digital competency	-0,24	-0,12	-0,11	-0,15	-0,18

All the identified relationships are negative and show that adolescents with a higher level of certain digital competencies have a reduced severity of signs of Internet addiction.

6 Discussion

The results, given in Table 1, show that the competence profiles in each of the groups are similar and are characterized by a small variability in indicators. This output is owing to a single socio-cultural scenario, according to which teenagers absorb the digital environment. However, the level of

[1] In Table3: 1- withdrawal symptoms; 2-tolerance symptoms; 3-intrapersonal and health problems; 4-time management problem; 5-key symptoms of Internet addiction

development of digital competencies in the survey groups significantly differs; this can be explained by the specifics of the cognitive sphere of adolescents, the degree of their interest in social communication and a whole range of other reasons, each of which can become the subject of a separate survey.

The most overt in each group are competencies related to knowledge of ways to protect personal data, the least-knowledge is in the field of network etiquette. Perhaps teenagers, who are used to the rules of interaction among themselves, have not yet mastered the rules of behavior in other online communities.

In the results of the survey of the Internet-dependent behavior of adolescents, it was found that for 31% normal Internet use is typical, 50% - problematic, while for 19% it is typically expressed by manifestations of Internet addiction. Yet, there were no significant differences in the emotional and behavioral manifestations of Internet addiction depending on the level of expression of digital competency.

Nevertheless, at the trend level, all the characteristics of Internet-dependent behavior are most expressed in the group of teenagers with an average level of digital competence development, and the lowest characteristic – in the group with a high level.

These results indicated that teenagers with the most pronounced signs of Internet addiction are the most vulnerable to content risks in the course of Internet communications and they are also versed less in ways of personal data protection.

As set out in Table 3, the characteristics of digital competency ownership have inverse interrelationships with the signs of Internet addiction. Thus, teenagers with a low overall level of digital competence and, in particular, who have difficulties in understanding terms used in online communication, tend to experience "withdrawal symptoms" which are negative feelings when it is impossible to go online.

Teenagers who have difficulties in recognizing potentially dangerous online content are more likely to experience intrapersonal and health problems in connection with excessive Internet usage. Teenagers with insufficient knowledge of personal data protection are most vulnerable to the risk of Internet addiction. They display all the key characteristics of Internet addiction the foremost of which is anxiety when unable to access the Internet and problems with controlling the time spent online.

Conclusions

Received data shows that a low level of digital competence is one of the factors reducing information security and it can be a risk factor in forming Internet-dependent behavior in adolescence. The leading role in providing the information security of teenagers is their ability to recognize content threats and their knowledge of ways of personal information protection in the network. The results of the survey underscore the need for the development and implementation of educational technologies aimed at the formation of digital competencies of adolescents, allowing them to navigate freely in the modern information environment, be critical towards the digital content and use adequate ways to protect information.

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