MIDDLE SCHOOL STUDENTS' INFORMATION AND COMMUNICATION LITERACY DEFICITS STUDY

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ABSTRACT

Some results of the basic school (14 years old) students' information and communication competence (ICC) in the digital environment study are discussed. About 30,000 students (14 years old) took part in the study. Information and Communication Literacy is considered as the ability to use digital technologies to search, manage, integrate, evaluate and create information. It is one of the key competencies that all of basic school graduates should obtain. As the availability of digital technologies grows, the gap in the ability of students to use them productively becomes more and more noticeable. The study identifies the actual students' information and communication competencies deficits at the stage of middle school completion. Performance-based online Information and Communication Literacy test (ICL-test) was the main research tool of the study. An attempt was made to determine to what extent the level of students' ICC is related to the work of the school, and to what extent it depends on the extracurricular environment. The results of the study indicate a strong connection between the ICC of ninth graders and their out-of-school environment and a weak connection with the work of the school. The reasons for the insufficient level of the ICC in a significant part of the graduates of the basic school are discussed and recommendations for its increase are proposed. It was found that ICL-test is a reliable online instrument to measure students' information and communication competence.

KEYWORDS

ICT-Based Assessment, Information-Communication Literacy, Testing, Middle School Graduates

1. INTRODUCTION

As the availability of digital technologies grows, the gap in the ability of students to use them productively becomes more and more noticeable. A new digital divide is growing, driven by inequality between those who are able to use digital transformation for productive work and those who can only use it at the substitution level (Warschauer, 2012). The growth of a new digital divide leads to an increase in the number of "digital outsiders" who are vulnerable to manipulation and attacks in Internet services, hindering their participation in the digital economy. It exacerbates the educational inequality of students belonging to different social groups. The ability of each graduate of the basic school to act productively in the digital information environment (information and communication competence) is a key condition for overcoming the new digital divide. The OECD recommends by law all member countries regularly assess the digital literacy of schoolchildren (OECD, 2021). According to the state educational standard, information and communication competence (ICC) is one of the main meta-subject competencies that the main school's graduates should possess. The formation of this competence is considered as one of the tasks of preparing students for life in the information society. However, until recently, there was no reliable valid tool for conducting a mass ICC assessment of the main school graduates (the ninth grade students). Assessment of information and communication competence of students is the task of assessing educational achievements in a complex subject area and requires the use of ICT tools. To carry it out in a public school, it is necessary not only to develop a new measuring tool but also to create conditions in schools for such an assessment. There are such conditions in public schools today.

According to the national educational standard, ICC of students is one of the main meta-subject competence that graduates of the basic school should have. The full formation of this competence is considered an important task in preparing students for life in the information society. ICC is necessary for young people to increase their readiness for life in a digital economy, and the daily use of cyberspace resources to continue education throughout life. However, until recently, there was no reliable and valid tool for conducting a mass assessment of the ICC among students in the 9th grade (graduates of the basic school). Such a tool was recently developed and proved to be valid (Avdeeva et al. 2017). The task of assessing the information and communication competence of students belongs to the class "Evaluation of learning progress in complex subject areas." To run such an assessment, it is necessary not only to develop a new measuring tool but also to create conditions for such an assessment in schools. Today, most schools have such conditions.

The information and Communication Literacy test (ICL-test) (Avdeeva et al. 2017) was the main tool of our research. ICL-test is a modern intelligent online-based instrument. It uses performance-based assessment and consists of scenario-based items, which simulate the main features of students' real-life situations. The innovativeitems were developed according to an evidence-centered Design methodology (Mislevy et al. 2012). All scenario-based items simulate features of students' real-life situations. ICL-test uses Bayesian networks to process the test results (Mislevy, 2018). The ICC assessment in our study was a low-stakes one. It just informs test-takers, and their teachers about students' actual information and communication literacy levels and gaps in their development found.

The purpose of our study was to assess the extent to which the mainstream school solves the problem of forming the ICC in ninth-grade students. At the same time, it was necessary to check to what extent the achieved level of ICC of schoolchildren is related to the development of the digital educational environment in school, and to what extent it is related to the students' out-of-school environment. In the course of the study, along with the assessment of the ICL of ninth-graders, an Internet survey of teachers and school leaders was conducted on the use of ICT in the learning process. The study also needed to test the extent to which the new online tool is suitable for assessing the student ICC in a public school.

2. METHODOLOGY

The study was conducted in 2020 and covered graduates of the basic school in 21 regions of the country. All ninth-grade students in the selected regions were considered as the general population of the sample. Classes were randomly added to the formed sample (classes less than 6 or more than 30 students were discarded). The selection of classes was carried out separately among urban and rural schools in proportion to the total sample size and their representation in the general population. More than 30,000 ninth-graders took part in the study. Simultaneously with the students' ICC assessment, a survey was conducted of teachers who taught in the classes where the testing was carried out, as well as school leaders.

The students' information and communication competence were considered as the ability to use digital technologies to search, manage, integrate, evaluate and create information (ETS, 2002). The used ICC framework includes seven components:

- Correctly describe the problem for purposeful search and processing of information;
- Search and find information from various sources in different digital environments;
- Organize and classify information according to various criteria;
- Interpret and reconstruct information, highlight the main thing, compare data from different sources,
- Evaluate the quality, relevance, and usefulness of the information and its sources;
- Process, create/adapt information taking into account the problem being solved and give arguments confirming the correctness of the result obtained;
- Communicate information tailored to specific audiences.

The ICL-test developers analyzed the extent to which the results of the ICC assessment make it possible to judge the readiness of ninth graders for life in the modern digital world, including their readiness for education and work (Milsom, Curry, 2017; Kyllonen, 2012; Soule, Warrick, 2015; Tannenbaum et al., 2019). On this basis, the level of ICC was determined, which is necessary for a graduate of a basic school to work with information for further self-development and self-education, continue studies or work in an ICT-rich environment without additional training. A representative group of international experts has prepared a readiness standard that linked the required "readiness" to the five levels of the ICC for ninth-graders (Table 1).

Table 1. Abilities Corresponding to Different ICL Levels of Ninth Grade Students

ICL level	Abilities
Advanced	The student performs the tasks at a high level, related to abilities to: ▪ Formulate the problem correctly; ▪ Find information from different sources; ▪ Organize information according to certain criteria; ▪ Assess the quality of information and the reliability of its sources; ▪ Compare and synthesize information from different sources; ▪ Draw the right conclusions from existing information; ▪ Present information to other people.
Above basic	The student performs the tasks at a high level, related to abilities to: ▪ Formulate the problem correctly; ▪ Find information from different sources; ▪ Organize information according to certain criteria; ▪ Draw the right conclusions from existing information; ▪ Share information with other people. The student performs the tasks at a satisfactory level, related to abilities to: ▪ Assess the quality of information and the reliability of its sources; ▪ Compare and synthesize information from different sources..
Basic	The student performs the tasks at a satisfactory level, related to abilities to: ▪ Formulate the problem correctly; ▪ Find information from different sources; ▪ Organize information according to certain criteria; ▪ Assess the quality of information and the reliability of its sources; ▪ compare and synthesize information from different sources; ▪ Draw the right conclusions from existing information; ▪ Share information with other people.
Below basic	The student performs the tasks at a satisfactory level, related to abilities to: ▪ Formulate the problem correctly; ▪ Find information from different sources; ▪ Organize information according to certain criteria; ▪ Assess the quality of information and the reliability of its sources; ▪ Compare and synthesize information from different sources; ▪ Draw the right conclusions from existing information; ▪ Share information with other people.
Developing	The student fails to perform the tasks related to abilities to: ▪ Formulate the problem correctly; ▪ Find information from different sources; ▪ Organize information according to certain criteria; ▪ Draw the right conclusions from existing information; ▪ Share information with other people.

During the use of the ICL-test, students are immersed in the digital environment of the tool. The ICL-test computer environment uses a common user interface (browser, text editor, e-mail, etc.) that is similar to, but not the same as, the interface of widely used software tools. This made it possible to level the experience of using various specific applications by the testers. The experiments show that ninth-graders successfully operate in the environment with models of general user applications at a basic level.

The ICL-test automatically processes the results during testing, informs the student about the level of his/her ICC, and offers recommendations for its development immediately after the test is completed. Thus, the ICL test can be used both for the resulting (monitoring studies) and for the formative (during the educational process) assessment of the ICC level.

The developed tool became the subject of a patent for an invention (Patent…, 2018). It has gained international recognition: the University of Helsinki is localizing it for use in Finland, while the Inter-American Development Bank is adapting it for Latin American countries.

3. RESULTS

The research show (Figure 1) that about one-third of students (29.6%) have a basic level of ICC. 12.4% are at the level above the basic level, and 3.4% are at the advanced level. Thus, less than half of ninth-graders (45.4%) are fully prepared for life in the digital economy. More than a third of all students are below the basic level (35.3%). There is a need to correct their ICC in order to reach the baseline (and above) level. For those who are at the developing level (19.3%), additional classes are not enough: here systematic work is required for the specially organized development of their ICC.More than a quarter of rural school students (25.6%) turned out to be at the developing level. At the advanced level, they are almost half as many as in urban schools (1.9% versus 4.1%). Unlike a city, in a rural area, a school is practically the only institution to provide all students with the conditions to work with digital equipment, software, and digital resources (individual learning tasks, joint projects, online courses, etc.) to develop of their ICC (search and find information, organize, interpret, evaluate and process it with the help of digital transformation).

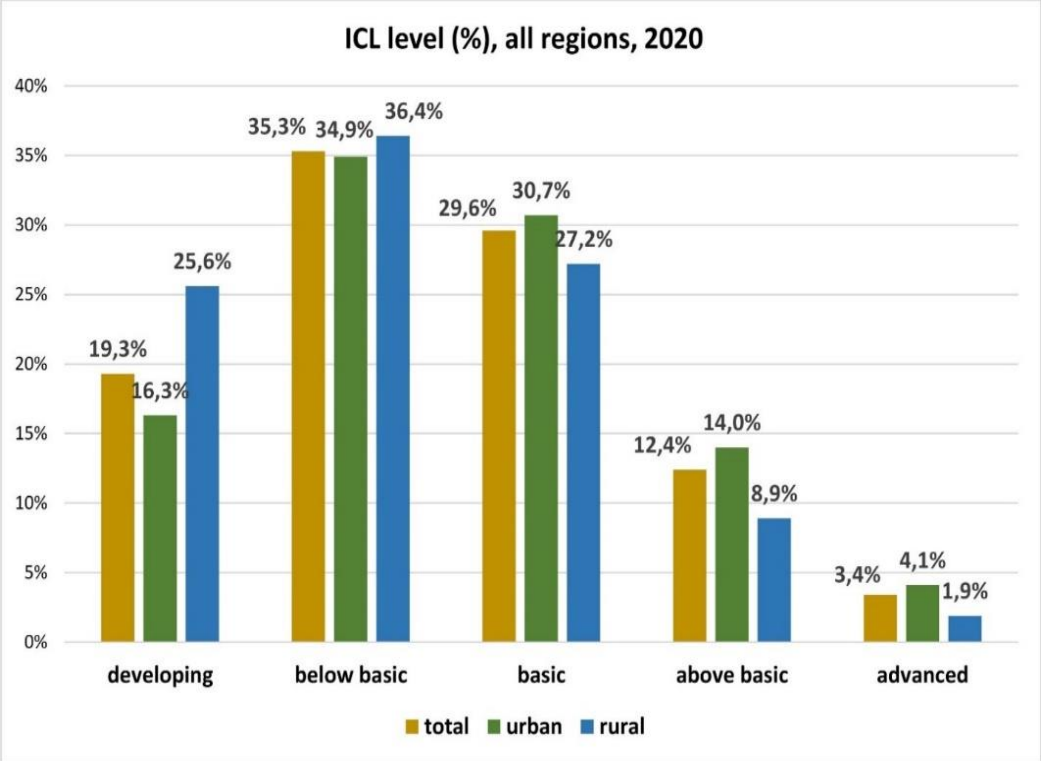

Figure 1. The ICC level of ninth graders in 2020

The study indicates a significant gap between the ICC of graduates from urban and rural schools. Although the type of distribution (left-skewed) of test results for both is the same, the number of graduates of rural schools at the “developing level” turned out to be one and a half times more (25.6% versus 16.3%). At the “above basic” level, graduates from rural schools turned out to be one and a half times less than urban ones (8.9% versus 14%), and at the advanced level, two times less (1.9% versus 4.1%). At the same time, the gap in the share of urban and rural school graduates who are at the “below basic” and “basic” levels is not so large. This gives grounds to assume the presence of a systemic problem that impedes the formation of ICC in the conditions of a mass school.

The ICL test was developed with the method of evidence-based argumentation. Therefore, the analysis of the behavioral characteristics of the test-takers, which is embedded in the patterns of test tasks, makes it possible to indicate the students' abilities they demonstrate freely from those that are difficult to demonstrate.

Many ninth graders were unable to compare and generalize information from different sources, evaluate its quality, and organize it according to specified criteria. Completing the task of preparing an information product (small article) in accordance with the task and using the available material, the majority of those tested (61.2%), despite the detailed instructions (which were an integral part of the task), could not organize the available material in accordance with standard structure (title, introduction, body, etc.). The majority of those tested (85.3%) could not select relevant information for their text (the content of the article they prepared did not correspond to the task).

When completing the slide preparation task (give an informative answer to a question on a given topic), 58.1% of students were unable to formulate a relevant title and insert the missing captions on the graph. 65.7% of students could not select relevant information from the available data array, and 67.6% could not correctly correlate the material they chose with the title. When preparing a presentation on a given topic, the majority of ninth-graders (76.2%) were unable to build a coherent story using the materials available to them (drawings, graphs, texts, and tables). The majority (83.3%) did not cope with the task of linking the materials at their disposal into a coherent information product (sequence of slides in a presentation), which contains complete information that meets the task.

When completing the task of their profile design on a social network (a life situation close to them), 75.1% of ninth-graders were unable to select information in accordance with its purpose and submit it with confidentiality requirements. Not all ninth-graders coped with the tasks of classifying and organizing information. 71.6% of students were unable to sort information objects according to their purpose (organize emails into folders), and more than 85.5% were unable to delete spam (letters containing advertising). More than half of the students (56%) were able to formulate a specific search query to solve their task.

A significant part (about 60%) of the graduates of the middle school turned out to be unable to assess the quality of information and the reliability of its sources, compare and generalize information from different sources, draw correct conclusions based on existing information, integrate information according to specified rules, and interpret the results obtained. The performance of the relevant operations during the ICL test caused significant difficulties for more than half of the students

At the same time, the majority of those tested demonstrated the ability to transfer information to other people, create search queries, and use various digital services. About 80% are able (by chatting) to ask clarifying questions that help solve the problem under discussion. Many ninth-graders can visualize information: 46.6% are aware of the expediency of visualization, and 54.2% used visualization in their information product as arguments.

Students generally demonstrate good technical skills. The majority (91.8%) are able to choose the right tools when working on social networks. Many ninth-graders are able to choose the appropriate tools (in the application interface) to solve the problem they are facing (79.5%). More than half (66.4%) are well versed in digital services. The majority (68.3%) successfully work in the interfaces of e-books, as well as digital learning instruments (68.3%).

The collected data shows, that more than 90% of graduates of the basic school actively use modern digital devices. 93% of students believe that they can freely use the Internet for their own purposes, and the time they spend on the Internet for educational purposes does not exceed 15%.

It can be stated that the technological digital divide is decreasing. At the same time, data on ICT use patterns by ninth graders show that the time they spend watching videos, listening to music, or using various services is weakly related to their level of ICC. The use of ICT to perform routine operations (telephony, video viewing, text exchange, etc.) does not reduce the new digital divide - the inequality between those who are able to use ICT for productive work with information, and those who use them at the substitution level (SAMR). This is also evidenced by the revealed relationship between the ICC level of ninth-graders and their work in office applications and viewing content on specialized sites. The results of the study show a strong relationship between the ICC of ninth graders and their out-of-school environment and a weak relationship with the work of the school.

4. CONCLUSION

1. The study showed that less than half of the graduates of the basic school (45.4%) demonstrate a level of competence that corresponds to readiness for life in the digital economy. Most students were unable to demonstrate:
    - the ability to critically evaluate the reliability and value of information,
    - the ability to make responsible decisions about what information should be published in the public domain and what should not,
    - the ability to make your information products as informative and effective as possible.

2. A weak relationship has been found between the level of the students' ICC and the school's digital educational environment development. This confirms the notion that increasing the availability of digital devices (reducing the technological digital divide) does not lead by itself to bridging the second digital divide. The school focuses mainly on reproductive learning today. Teachers use ICT mainly at the level of substitution and/or improvement level according to SAMR (presentations in frontal learning work). Although over 90% of school administrators declare the importance of the ICT to improve educational outcomes and 78% of teachers say that they have access to ICT at school, more than a third of all respondents (39%) answered that using ICT is not among their priorities.
3. The results show that the ICC level of ninth-graders is strongly related to their out-of-school environment (mother's education, plans to continue education, possession of a smartphone, and number of books at home). At the same time, the connection between the ICC of ninth-graders and the opportunity to work in the digital environment of the school is weak.
4. The study showed that the ICL-test makes it possible to carry out an automated assessment of the ICC of schoolchildren quite simply and reliably. The development of a digital educational environment and the connection of schools to the Internet create favorable conditions for the widespread use of such a tool and its derivatives in a public school. Further research and development are needed, which will allow in real-time give individualized (targeted) recommendations for increasing the level of ICC for each student, his parents, and teachers. The use of AI and big data will automate the preparation of analytical reports for school leaders, heads of education, and methodologists to improve the work of the school and bring continuous formative assessment of students' ICC into the everyday work of the public school.

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