Modern Information Technologies and Skills Improvement in Information Culture

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Summary
The increase of personal information culture acquires particular importance in the information society, which is undergoing significant transformations under the conditions of constantly improving informative interaction technologies. This article **aims** to identify the primary skills in using information technology as a basis for the formation of informational culture. Methodology. We used a method of statistical analysis to assess information technology skills according to the OECD classification (2022): 1) basic process skills (critical thinking, active learning, learning strategies, monitoring); 2) integrated problem solving; 3) technical skills (equipment selection, equipment installation, equipment support, troubleshooting, repairing); 4) system skills (judgment and decision-making, system analysis, and system evaluation). Results. These skills determine the ability to use technology and influence information culture formation. IT and information handling skills can be divided into operational, formal, informational and strategic, involving technical and cognitive ability to use technology. The deficit of basic process skills and system skills, directly related to the ability of complex problem solving, was revealed. At the same time, the article found no deficit or excess of technical skills in using technology and their lack of influence on complex problem-solving. Employees have a sufficient level of skills to select, install, support, repair, troubleshoot equipment with the need to develop critical thinking, the skill to solve complex problems, analyze and evaluate the situation comprehensively.

Keywords:
Information technology, information culture, critical thinking, complex problem solving, technical skills.

1. Introduction

The development of information technology skills has become an increasingly relevant research issue by integrating technology into all areas of society (Barnes, 2018). As Allmann & Blank (2021) note, "ubiquitous digitization marks an important shift in the relationship between society and computing; people are forced to use computers and the Internet to perform basic tasks. Improved personal skills contribute to information culture and security. Many scholars study digital skills and competencies, information literacy, security, and the "digital person" as responsible for information technology use (Milenkova, Keranova & Peicheva, 2019). These terms are popular because of the constant emergence of new technologies, the need to learn them, and the development of skills. As van Deursen & van Dijk (2011) point out, the most problematic issue is the lack of information and strategic skills of Internet users, even among the younger generation, who are often considered experienced Internet users.

Information culture is a new type of communication that enables the individual's free choice in the information space. At the same time, information culture is an information activity, a qualitative characteristic of human

Manuscript received May 5, 2022
Manuscript revised May 20, 2022
https://doi.org/10.22937/IJCSNS.2022.22.5.64

life activity in receiving, transmitting, storing, and using information.

The article aims to identify the basic skills in using information technology as the basis for information culture formation. 2. Tables, Figures and Equations

2. Literature review

2.1 Technological skills concepts

Various terms are used to define the human attributes associated with ICT use. With the spread of digital technologies, such terms as IT, ICT, and computer literacy have become prevalent (Bawden, 2008). Technology plays a dominant role in defining which skills are considered essential. In most cases, these concepts consist of a domain part (e. g., computer, ICT, internet, multimedia) in combination with a specific knowledge perspective (e. g., competence, literacy, skills) (Hatlevik, Ottestad & Throndsen, 2015). These concepts primarily indicate a basic set of skills in using computers or Internet technology, for example, turning off the computer, opening a folder, and saving a file. They do not go far enough to explain the skills an individual must possess to exploit the full potential of ICT. However, those technical skills are a driving force behind the need for 21st-century skills and required for the acquisition of 21st-century digital skills.

2.2 Information technology skills

Currently, information culture is increasingly interpreted as a unique phenomenon of the information society. Depending on the object of consideration can be presented as information culture: community, personality, and social group (organization or individual categories of information consumers) (Helsper & Van Deursen, 2015). In the context of the study of skills necessary for the use of information technology, information culture will be considered in the context of the individual as a systemic form of the individual, integrating knowledge of the primary methods of information technology, the ability to use the available information to solve applied problems, the skills of using a personal computer and technology, the ability to present information in an understandable form, oriented to the expansion and updating of knowledge (Knox, 2014).

Vujičić et al. (2020) explore basic computer literacy using hardware, software, and Internet transactions. The authors also explore specialized IT skills that allow youth to evaluate technology and create content using specialized software critically. Critical Thinking skills as basic process skills according to the OECD classification (2022), which are defined as follows, should be noted in this context: “Critical Thinking means using logic and responding to identify meanings and evasions from alternative solutions, conclusions or approaches to problems”. Skills are developed abilities to facilitate learning or enhance performance (OECD, 2022). Process skills, along with critical thinking, also include:

1) “Active Learning – understanding the implications of new information for both current and future problem-solving and decision-making”;
2) “Learning Strategies Selecting and using training/instructional methods and procedures appropriate for the situation when learning or teaching new things”;
3) “Monitoring Monitoring/Assessing performance of yourself, other individuals, or organizations to make improvements or take corrective action”.

Iordache, Mariën & Baelden (2017) analyzed 13 digital literacy models and identified five categories of digital skills:
– operational, technical, and formal; information, cognition;
– digital communication; digital content creation;
– strategic.

Information skills in the identified models are directly related to cognitive skills, in particular, analysis and evaluation and critical thinking (Figure 1). It means that not only technical skills but also cognitive or, as defined by OECD (2022), basic process skills, which include critical thinking, are essential for forming information culture and rules of technology use. Consequently, the work of Van Laar et al. (2017) supports the view that digital skills are not limited to technical, operational, functional, etc. Using technology to develop an information culture requires a broader range of skills.

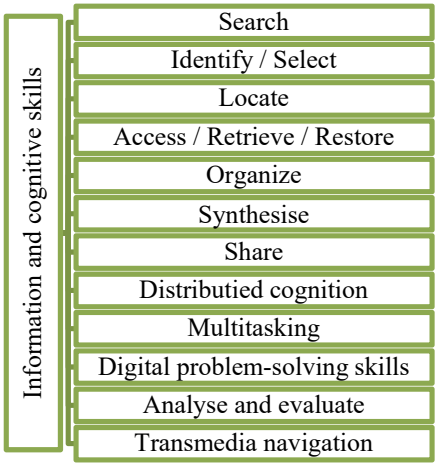

Fig. 1. Information and cognitive skills
Source: Iordache, Mariën & Baelden (2017).

Furthermore, unlike digital skills, 21st-century skills do not necessarily mean using ICTs. Van Laar et al. (2017) identified seven core skills: technical, information management, communication, collaboration, creativity, critical thinking, and problem-solving. Critical thinking represents the skills of using ICT to make informed judgments and select the information received and communicate using reflective reasoning and sufficient evidence to support claims (core components: clarification, evaluation, justification, linking ideas, and novelty). The authors identified the primary contextual skills as ethical awareness, cultural awareness, flexibility, self-direction, and lifelong learning.

Van Laar et al. (2017) defined technical skills as the ability to use (mobile) devices, apps, and applications to perform practical tasks and recognize specific online environments to navigate and maintain orientation. Key components of technical skills (van Deursen, Helsper & Eynon, 2016):

1) ICT knowledge: understand the characteristics of (mobile) devices or applications.
2) ICT usage: operate basic (mobile) application operations and access resources for everyday use.
3) navigation: avoid losing orientation when navigating online.

Information management skills represent the skills of using ICT to effectively search, select, and compile information to make informed decisions about the most appropriate sources of information for a given task. The main elements of this group of skills are (Van Laar et al., 2017): "1. Define: use ICT to formulate a research statement to facilitate the search for information. 2. Access: use ICT to find and retrieve information from various online sources. 3. Evaluate: use ICT to judge the usefulness and sufficiency of information for a specific purpose. 4. Manage: use ICT to organize information to find it later".

Van Deursen, Courtois & Van Dijk (2010) defined information skills as "skills required to search, select, handle and critically evaluate Internet and digital media content", which further confirms the importance of critical thinking as an essential personal process skill. Van Deursen, Courtois & Van Dijk (2010), van Deursen & van Dijk (2011) also defined:

1) operational skills such as the ability to use software, technology, and the Internet, are fundamental;
2) formal skills as the ability to use a standard computer and Internet features, particularly orientation and navigation (e. g., hyperlinking or moving between pages online);
3) strategic skills as the ability to use the Internet for personal gain.

In a more recent study, the team of authors Van Laar et al. (2019) examine the following digital skills: information, communication, collaboration, critical thinking, creativity, and problem-solving. Van Deursen & Van Dijk's (2016) results show the following:

1) traditional literacy has a direct effect on formal and information skills, has an indirect effect on strategic skills;
2) differences in types of Internet use are mediated by traditional literacy and directly influenced by Internet skills. Higher levels of strategic ICT skills provide greater levels of information skills and professional ICT use.

The Digital Skills for Tangible Outcomes (DiSTO) project (Helsper et al., 2015; van Deursen et al., 2016) categorized skills by function and complexity, highlighting the following functional categories: operational skills are basic technical; information navigation skills are search skills; creative skills are content creation skills; social skills are communication skills.

In the context of information skills, "Information literacy", defined as "cognitive skills necessary to evaluate media content critically" (Eshet, 2004), should also be highlighted and further confirm the importance of critical evaluation skills when using information technology.

Iordache, Mariën & Baelden (2017) also identified that the category "information literacy" mainly includes the ability to "search", "identify/select", "find", "access/receive/store", "distribute/disseminate" relevant information, defining the way to manage data and information "in any format and form through different technological tools".

The literature also identifies problem-solving skills that can positively influence the development of digital skills and competencies, helping users identify the right digital tools needed to achieve specific goals, tasks, conceptual or technical problems (Iordache, Baelden & Marien, 2016). Problem-solving skill is defined as the ability to "identify digital needs and resources, make informed decisions on the most appropriate digital tools according to a goal or need, solve conceptual problems with digital tools, use technology creatively, solve technical problems, and update own and others' competence" (Janssen et al., 2013).

Thus, various classifications of digital skills that define the ability to use technology and influence the formation of information culture are presented in the academic literature and international organizations. Overall, skills can be

categorized as operational, formal, informational, and strategic, involving a technical, cognitive ability to use technology.

3. Methodology

This research uses statistical analysis to assess information technology-related skills according to the OECD classification (2022):
1) basic process skills (critical thinking, active learning, learning strategies, monitoring);
2) complex problem solving;
3) technical skills (equipment selection, equipment installation, equipment support, troubleshooting, repairing);
4) system skills (judgment and decision making, system analysis and system evaluation).

The data selected for the analysis is the OECD 2020, which allows analyzing the skills of workers from different countries (OECD Skills for Jobs, 2022). The chosen skill scores will comprehensively assess the information culture level and the relationship between process, technical, systems skills, and the ability to solve problems fully. Positive values of the skill assessments indicate a deficiency, and negative values indicate an excess of skills. The greater the absolute value, the greater the imbalance. Results are presented on a scale of –1 to +1. The maximum value reflects the most significant deficits observed in OECD countries (31) and skill parameters. Correlation analysis based on Pearson correlation was used to assess the relationship, the statistical significance of which was checked using Student's t-statistics.

4. Results

Basic process skills are in short supply in different countries (Figure 1). The most significant skills shortage is observed in the EU countries, the smallest in Argentina, Brazil, Bulgaria, Cyprus, Malaysia, Peru, Romania, and South Africa. At the same time, critical thinking and active learning skills are characterized by the greatest need for development.

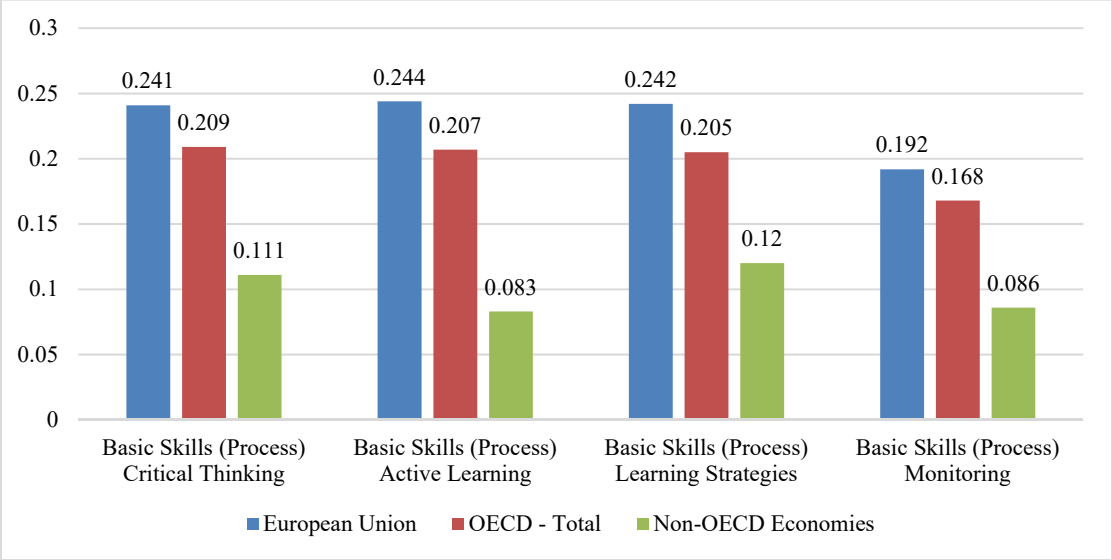

Fig. 1. Basic Skills evaluation
Source: OECD Skills for Jobs (2022).

Compared to basic process skills, a slight surplus of technical skills was found in the EU and other countries (Figure 2). Workers have a sufficient level of skills to select, install, support, repair, troubleshoot equipment.

The lack of system skills in working with information technology was also found in different countries: criticism and evaluation, decision-making, and analysis (Figure 3). The data also show a lack of integrated problem-solving skills. In the future soft skills list published at the World Economic Forum in Davos, the first place is occupied by the complex problem solving (CPS), which means a search for new solutions and conscious responsibility for the result, not just precise fulfillment of the management's instructions. With the constant growth of information volume, this skill becomes more and more critical, as it provides a greater level of responsibility for employees based on their assessment of information in the process of its search, selection, and analysis.

When process skills and system skills are deficient, there was found their solid direct relationship with the skill

of complex problem solving (Table 1): the correlation coefficient is more than 0.7. Most of all, integrated problem-solving skills are related to critical thinking, i. e., the ability to objectively assess information, its search, selection, and analysis. Consequently, dynamic automation in all sectors of the economy provides an ongoing process of training personnel to use technology. Therefore, technology skills are also actively being developed. At the same time, the ability to think critically requires constant development because of the clearly established work procedures.

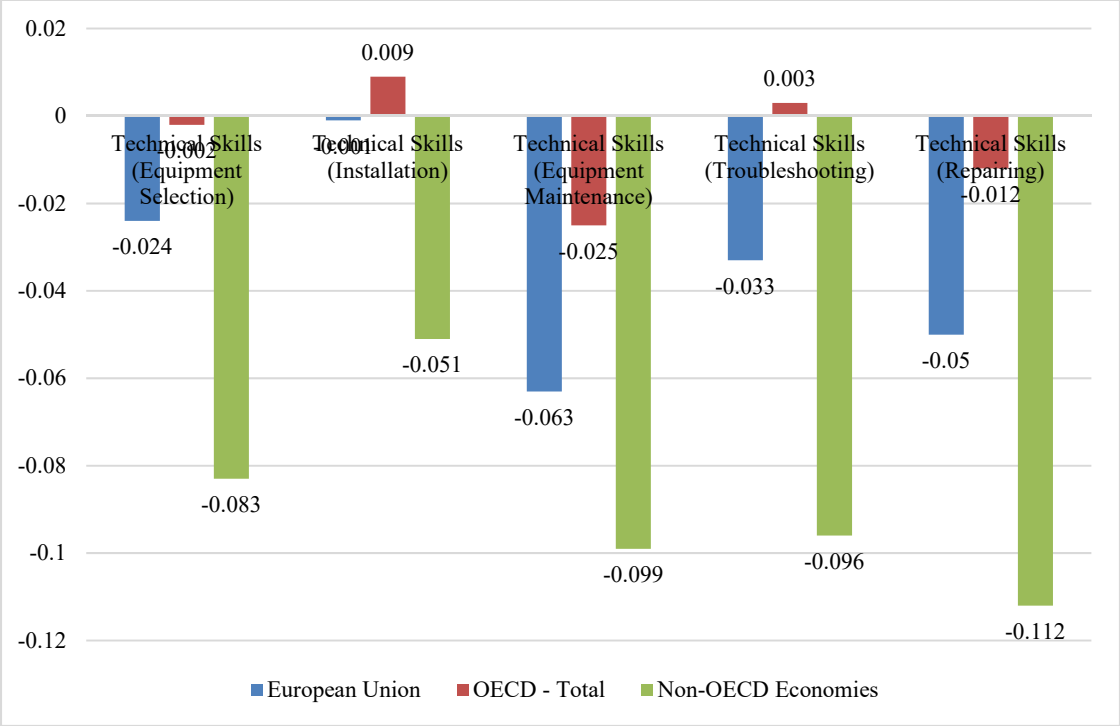

Fig. 2. Technical Skills evaluation
Source: OECD Skills for Jobs (2022).

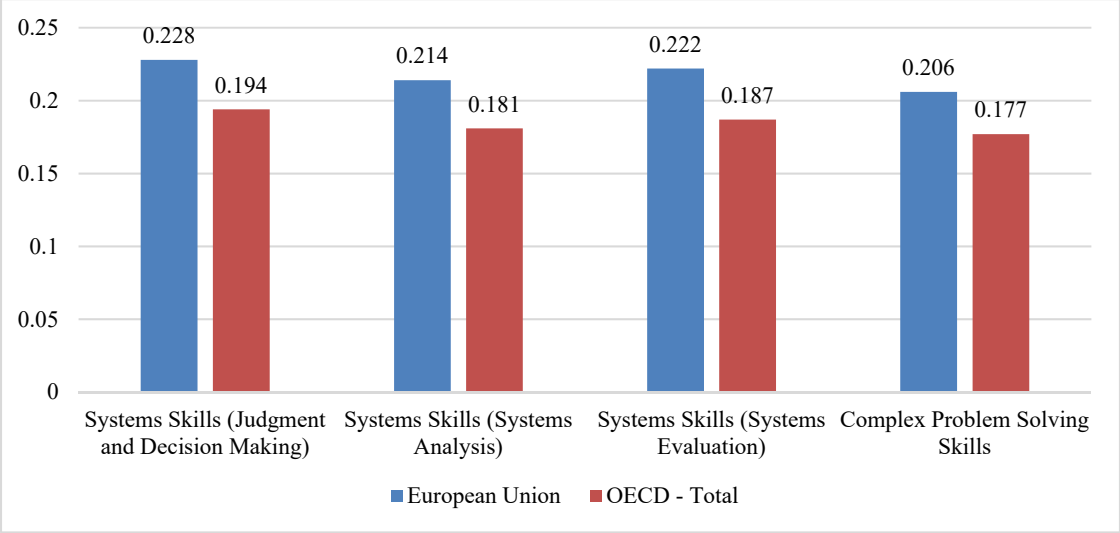

Fig. 3. Systems Skills evaluation
Source: OECD Skills for Jobs (2022).

Table 1: Correlation: basic skills and skill and complex problem solving

№	Skills	1	2	3	4	5
1	Basic Skills (Process) Critical Thinking	1,000	–	–	–	–
2	Basic Skills (Process) Active Learning	0,975	1,000	–	–	–
3	Basic Skills (Process) Learning Strategies	0,838	0,912	1,000	–	–
4	Basic Skills (Process) Monitoring	0,941	0,948	0,927	1,000	–
5	Complex Problem Solving Skills	0,980	0,974	0,838	0,932	1,000

Source: author's calculation based on OECD Skills for Jobs (2022).

Correlation analysis of technical skills and complex problem-solving skills assessments indicates an inverse low level of relationship between skills in the use of technology and the ability to search for the optimal solution. Therefore, a low inverse relationship was found between equipment support skills and complex problem solving (–0.34), repair, and complex problem solving (–0.268).

Table 2: Correlation: technical skills and complex problem solving

№	Skills	1	2	3	4	5
1	Technical Skills (Installation)	1,000	–	–	–	–
2	Technical Skills (Equipment Maintenance)	0,528	1,000	–	–	–
3	Technical Skills (Troubleshooting)	0,597	0,955	1,000	–	–
4	Technical Skills (Repairing)	0,584	0,991	0,961	1,000	–
5	Complex Problem Solving Skills	0,023	-0,340	-0,161	-0,268	1,000

Source: author's calculation based on OECD Skills for Jobs (2022).

A high direct correlation was found between systems skills and complex problem solving (Table 3): the skill to systematically make decisions, analyze, and evaluate information. At the same time, analysis and evaluation occupy an essential place in critical thinking and, therefore, in the formation of information culture.

Table 3: Correlation: systems skills and skill and complex problem solving

№	Skills	1	2	3	4
1	Systems Skills (Judgment and Decision Making)	1,000	–	–	–
2	Systems Skills (Systems Analysis)	0,976	1,000	–	–
3	Systems Skills (Systems Evaluation)	0,979	0,992	1,000	–
4	Complex Problem Solving Skills	0,989	0,982	0,981	1,000

Source: author's calculation based on OECD Skills for Jobs (2022).

5. Discussion

In the information society, the increasing importance of information culture, which is considered as a new type of communication, which gives the possibility of free choice of an individual in the information space, is of particular importance. Moreover, information culture in the new information conditions is considered as information activity in receiving, transmitting, storing, and using information. Therefore, critical thinking skills, active learning, monitoring, integrated problem solving, and decision-making are essential for practical information analysis and processing.

The information culture should not be considered in a psychological or pedagogical context. However, it should be seen as a definition of objective and subjective conditions for adequate mastery of information technology, solving problems that arise during its use. Today, the skills and abilities to use personal computers and information networks are not enough: correlation analysis proves the importance of soft skills to work with technology and information (basic process and system skills).

Information culture, if we understand it from the perspective of the technocratic approach, is the optimal way of handling signs, data, information and presenting them to the interested consumer to solve problems of theoretical and practical direction, mechanisms of improving technical means of production, storage, and transmission of data. To this extent, it is not an indicator of culture in general but instead of professional culture. Information culture includes:

– the stock of knowledge of sciences;
– the use of achievements that are necessary for successful information activity;
– the ability to use the received skills in practical activity.

The sciences that provide the process of informatization can include mathematics, cybernetics, computer science, design theory, and many others. An integral part of information culture in this context is understanding new information technology and applying it

both to automate routine operations and in unusual situations that require deviations from standards and unconventional, creative thinking. In this aspect, information culture is the knowledge of how to obtain, process, store, transmit, and use the information and the ability to work purposefully with information for practical purposes.

To a certain extent, modern information culture results from a new type of thinking formed as a result of an individual's liberation from ordinary information-intellectual work with the help of new information technologies. This new culture has absorbed all its previous forms, combining them into a single whole. Therefore, it is important to consider information culture not only as a phenomenon conditioned by the conditions of the scientific and technological revolution, electronic means of processing, storage, and transmission of information, but, above all, as an active infrastructure that penetrates all spheres of human activity and all stages of development of the individual as a social being and personality.

6. Conclusion

Information culture is a product of a person's diverse creative abilities and manifests itself in the following aspects:

– in specific skills in the use of technical devices (from the telephone to the personal computer and local networks);
– in mastering the basics of analytical processing of information;
– the ability to use computer information technology in one's activities;
– the ability to extract data from different sources (both periodicals and electronic communications, present it in an understandable form and be able to use it effectively);
– the ability to work with various information;
– the knowledge of the peculiarities of information flows in one's field of activity.

Competencies determine the ability to use technology and influence the development of an information culture. Skills in the use of information technology, working with information can be divided into operational, formal, informational and strategic, involving a technical, cognitive ability to use technology.

The deficit of basic process skills and system skills, directly related to the ability of complex problem solving, was revealed. At the same time, the article found no deficit or excess of technical skills in using technology and their lack of influence on complex problem-solving. Employees have a sufficient level of skills to select, install, support, repair, and troubleshoot equipment with the need to develop critical thinking and the competencies to solve complex problems and analyze/evaluate the situation comprehensively.

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