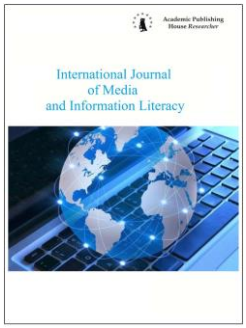


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# Formation and Development of Digital Literacy of the Population Based on Visualization Technologies

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**Abstract**

This study examines the formation and development of information literacy skills of the population in the context of the penetration of information and communication technologies in all spheres of activity and the formation of a global digital space. The analysis of the scientific literature showed a significant interest of scientists in the category of information literacy of various population groups. Based on the analysis, it was revealed that most attention is paid to the development of information literacy among young people. Schools, colleges and universities successfully teach young people modern technologies. As a result of the study, it was revealed that there are practically no training programs aimed at middle-aged people, although they are the active users of information technologies both in everyday life and in professional activities. Based on the results of the review, the study of modern visual techniques for the development of digital skills and methods for evaluating the effectiveness of such training in different conditions can be proposed for subsequent research. In the course of the survey of respondents, three groups of people were identified, to varying degrees focused on the digital environment. The results show that Respondents who are highly focused on the digital environment most often use it in a functional version: they use it exclusively for paying bills, receiving services from the state. Those who are on average focused on the digital environment, most often try to self-actualize in it, to find conditions for self-development. They have the most constructive and creative attitude to the possibility of using it. Based on the results of the study, recommendations were proposed for training centers on the use of visualization technologies, which will help significantly improve the efficiency and quality of information literacy development in middle-aged people.

**Keywords:** digital environment, information literacy, media literacy, digital skills, information technology, training, education, visual technologies, information.

## 1. Introduction

The ongoing changes in economic, political and socio-cultural life due to the rapid development of information and communication technologies initiate the introduction of information technologies and products in all spheres of society. Digitalization of all spheres of human activity is becoming a new trend in the socio-economic development of all countries, including Russia. The most important distinctive features of digitalization are: synthesis cyber psychologist systems that integrate the Internet of things, Internet of people, Internet technology;

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development and use of the Internet technology Web 2.0; functioning within the framework of the concept of "Industry 4.0", as in a conglomerate formed by economic entities, educational organizations, experts in the field of artificial intelligence and scientists; the use of blockchain and NAJM technologies. All the technologies mentioned above have overlapping zones of influence, communicate with each other in a complex way, constitute the essence of the "digital economy" and are related to intellectual capital belonging to society as a whole, diverse organizations, and individuals. The realization of the digital economy concept is based on the intellectual resources' procedures: reproduction, application, exchange, purchase and sale.

That is, the population needs the appropriate knowledge and skills to enable them to exist in the digital economy. The concept of digital literacy of the population is a fairly broad concept and includes a number of necessary skills and competencies, such as technical competence, the ability to use digital technologies in professional activities, in education and in everyday life, the ability to critically evaluate information and digital technologies, the ability to work safely in a digital environment (Ilomaki et al., 2016).

Understanding how modern reality works and the ability to make information and communication technologies a source of development, rather than worrying about the inability to communicate in a technologically complex environment, are provided by a high level of information literacy.

The skills of searching and evaluating information, individual and collective work in networks, and the use of the web environment for learning and leisure are directly related to the processes of learning, education, and social adaptation management. Access to information is determined by the recognition of information sources, the development of ways to acquire the necessary information and its assessment, all of the above being the basic components of literacy.

The information environment drastically increases the amount of potential sources of knowledge, but finding information in this environment requires additional skills of processing this information. Using print publications as sources of information, the credibility of information and the credibility of judgments can be assessed by the author's or publisher's reputation, while too many Internet sites (except for the official websites of publishers or institutions) do not include any indication or proof of a trustworthy producer of the information. In this case, the evaluation of the information plays a special role.

The ability to determine the adequacy, relevance, and quality of information requires the availability of information literacy skills that a person can acquire as a result of training and practical experience. The formation of information literacy in different age groups of the population has its own characteristics. Young people born in the digital age, from an early age, have primary skills in using simple technical devices, communicating in social networks and accessing media content.

People of the older generation, having received primary skills in working with computers and information technologies in schools and higher educational institutions, independently mastered new technologies as they appeared. Most of the development of new information technologies was carried out in the workplace as organizations began to widely implement new technologies in their activities (Ferroet al., 2011). Given that in modern conditions, the formation of information literacy skills is a mandatory component of educational programs in schools and higher educational institutions, the subject of discussion in this article is the content and acquisition of information literacy skills of middle-aged people.

## 2. Materials and methods

The analysis of the literature on the study of the content of the concepts of digital literacy and information literacy was carried out. The logic of the study was to analyze the research of information skills in various contexts, to determine which knowledge, skills and abilities form the concept of information literacy. The review includes theoretical and empirical studies on the problems of information literacy of the population. The empirical data in this article are the results of a sociological survey of middle-aged people regarding their level of information literacy.

The purpose of the study is to analyze the possibilities of using visual technologies in improving the digital literacy of the population.

The study was conducted using a questionnaire that was offered to respondents in a remote format, which allowed to reach a larger number of respondents. The sample was collected

randomly, but there were conditions that the respondents had to meet: age, work or leisure in the digital environment, employment, etc.

## 3. Discussion

In a broad sense, information literacy allows people to identify their information needs, accumulate information, create information and share knowledge, use existing information and communication technologies, and master new ones. Information literacy is the foundation for achieving a person's personal, professional and social goals. In modern literature, there are a number of terms related to, but not synonymous with, information literacy concepts, including computer literacy, media literacyиinformation competence. The Association of College Libraries and Research Libraries (ACRL) defines information literacy as a set of integrated abilities encompassing reflexive information discovery, understanding how information is produced and evaluated, the ability to use information to create new knowledge, and ethical participation in educational communities.

Heidi Julien, pointing to the diversity of terms related to public literacy in the context of information use, defines information literacy as a set of skills and knowledge necessary for effective, efficient and ethical access to information. In a broader sense, information literacy should include knowledge of how to interpret and evaluate information and how to use it in the context of decision-making, in creative activities, in academic activities, in everyday life and in professional activities (Julien, 2016). Information literacy is not limited only to the skills of perception and working with information, in the context of the ongoing digital transformation, the concept of information literacy should include the ability to work in various socio-technical infrastructures of data collection, storage and processing, expanding the possibilities of knowledge of the environment (Gray et al., 2018). Equally important are the issues of media literacy development, since the ability to adequately perceive and critically evaluate information, the ability to express oneself through the media are essential skills of the digital economy (Wallis, Buckingham, 2019).

Media literacy allows a person to design and implement their own vision of an information resource, and for this it is also necessary to be able to work with information and media content. Media literacy includes and even extends the competencies related to information literacy. Renee Hobbs defines media literacy as the ability to make a responsible choice of information from a variety of sources, analyze the information received and evaluate the quality of the source of information and the information itself, create your own content using audio and visual tools and technologies, distribute media content and share knowledge (Hobbs, 2011).

Taking into account the existing approaches to the definition of information literacy, we can agree that information literacy should be understood as technical skills in using computer equipment, mobile devices, the ability to formulate information needs, request, search, select, evaluate and interpret information, and create media content. The need to master information technologies in the context of the formation of national economies based on knowledge, the formation of the international information space is due to the opportunities that these technologies provide for obtaining economic and social benefits, the formation of a competitive personality.

Almost all developed countries, realizing the importance of information literacy of the population, pay considerable attention to the formation and development of knowledge in the field of information technology, developing and improving methods for assessing the level of computer and information literacy (Ainley et al., 2016). Studies of information literacy conducted among schoolchildren who use various mobile devices with access to the network have shown the effectiveness of information technologies in acquiring communication skills, interaction of students with parents and teachers, and increasing interest in learning (McDougall et al., 2018).

Researchers identified the need to provide access to technology and improve information literacy in older adults so that children can communicate with their grandparents at a distance using Skype. Information literacy skills in all age groups allow different generations to find more common ground and provide unlimited opportunities for communication and education. The issues of information literacy development and digital skills formation in various population groups are considered in the modern literature in various aspects.

An active consumer of information technologies is the education sector, which actively uses information technologies and the virtual educational environment. In this regard, a significant part of the research is devoted to the analysis of information literacy in young people, most often students of

colleges and universities, while the subject of study is not so much the level of digital literacy, but the impact of information technologies on the effectiveness of learning (Lacka et al., 2020).

The development of information literacy in the education system is accompanied by the replacement of traditional teaching methods and tools with electronic, multimedia interactive educational resources to improve the effectiveness of teaching. The study of how students use new technologies in the educational process shows a different level of proficiency in such technologies (Dommett, 2018). It is also interesting to study the extent to which young people themselves adequately assess their information skills. Inaccuracies in the assessment of one's own knowledge in the field of ICT can negatively affect the use of this knowledge in the learning process. The researchers suggest using more accurate methods of assessing their own knowledge (Vonkova et al., 2021; Webb et al., 2018).

The ubiquity of personal computers, smartphones and other electronic devices allows you to master the skills of information literacy at an early age. Modern young people actively use the Internet to communicate in social networks, search for necessary information, learn languages, respectively, these skills further contribute to active learning, allowing students to share opinions, receive prompt feedback. The availability of information literacy skills among schoolchildren and students in the context of modern socio-economic development is not in doubt, and practical experience with various information technologies in the learning process is important for mastering technologies that are relatively new, complex and will allow you to better understand the possible negative consequences of turning to certain technologies (Gálik, 2019; 2020; Kassens-Noor et al., 2020).

For the formation of information literacy among schoolchildren, teachers themselves must have a sufficient level of knowledge of these technologies. Considering information literacy as an integral part of the required digital competencies A.D. Olofsson, G., and J. Fransson. O Lindberg's research into the ability of teachers to use information resource skills in Swedish schools has determined that teachers are well acquainted with the functionality of various educational software and digital tools and know what value digital technologies will add to learning. They also have the competence to anticipate possible problems in students ' use of digital technologies and can help students solve their problems. Due to limited economic resources, they will know which digital technologies the school should buy and why, as well as how to search for free digital learning resources and programs on the Internet (Olofsson et al., 2020).

This means that, firstly, school education is able to provide the necessary level of information literacy among schoolchildren, and secondly, teachers were able to master the necessary technological knowledge because their professional activities require it. Nevertheless, the problem of forming information skills in the middle-aged generation is still debatable. The availability of information and media technologies implies their widespread use in the practice of teaching and improving information literacy both in school and outside of it, expanding the opportunities for knowledge exchange (McDougall, Potter, 2019).

The technical tools used to teach information literacy should be intuitive, then their effectiveness will be significantly higher (Tonyan, Piper, 2019). In the process of studying the formation of information literacy of various groups of the population, it is important to determine which factors and to what extent will affect the effectiveness of teaching information literacy skills (Williams, Evans, 2008).

Conducting research among college students, Michelle Hale Williams and Jocelyn Jones Evans found that during college students acquire information literacy skills, the improvement of students to some extent depends on their specialization. One of the strengths of the approach used here is quasi - experimental design. Measuring students 'information literacy at different time intervals during the semester allows us to determine the nature and evolution of students' learning. Data from Michelle Hale Williams and Jocelyn Jones Evans show that knowledge about information literacy depends on content. Not only is information literacy largely linked to multiple performance indicators, but it also appears to be discipline-dependent.

Studies on the formation of information literacy skills in the adult population have shown that in addition to anxiety about mastering the technologies of working with information resources, older people experience stress about the fact that they have to learn to use computers or other equipment with which they are not familiar (Grandy, 2019). A study of the process of teaching adults to use electronic library resources, conducted by R. Grandy at the college library, showed the

effectiveness of training and reduced anxiety in students with the active help provided by librarians and teachers.

The analysis of research on the problems of forming information literacy skills of various population groups showed a large amount of accumulated information on the organization of information literacy training in schools and higher educational institutions, rich traditions and experience of schools, universities and libraries in preparing citizens for life in the information society. Some researchers turn to the problems of information literacy in the elderly. The question of the current state and development of information literacy in middle-aged people remains poorly studied. In this regard, it is advisable to develop research on information literacy of the population in this direction.

Traditional ways of teaching and developing information literacy are the use of electronic textbooks, contact work with teachers, online training, and interactive training. For example, modern universities form an electronic information and educational environment, in which information systems and training technologies, electronic document management systems, and various databases are integrated (Ilchenko, Onufrienko, 2017). Undoubtedly, these funds are quite effective in universities, libraries and other organizations that teach information literacy. However, given the age characteristics of the students, it is advisable to use other teaching techniques, such as visualization techniques.

## 4. Results

As part of the study of modern research, literature reviews, we can say that the development of digital literacy goes in several directions: on the one hand, it is information literacy-the ability to actively interact with information in the digital environment (collect, process, analyze the data of interest, competently dispose of them, broadcast them to society), on the other, - literacy in working with digital resources and gadgets (creating an external digital space around you-accounts, selecting "smart" devices, a clear understanding of how and what needs to be used). There is a third direction-the development of safe digital behavior (which includes the ability to safely communicate your data and leave digital traces, as well as the ability to safely and culturally interact with other people in a digital environment).

In the near future, the "real self" and the "virtual Self" are expected to converge more and more – that is, a person will not be able to think about himself or imagine himself outside of the digital space. All this has a significant impact on the purposeful development and formation of a system of knowledge about the digital system, working with information, data, etc.

Currently, more and more children, teenagers and young people are showing interest in the digital environment, actively living in it and socializing. All training programs are mainly focused on them and are aimed at learning to "live in a digital world". At the same time, children and adolescents are not active users of the digital space for receiving services, creating websites for business development, interacting with business partners, social structures and government institutions. All these functions are implemented by middle-aged people (30-60 years). It is important to increase the digital literacy of middle-aged people, as this is the economically active population, the main working-age part of the country, which is the main consumer of digital services. There are practically no training programs that would purposefully form the necessary level of digital literacy for them. There are practically no methodological techniques and forms of work that would help middle-aged people to work effectively and assimilate in the digital environment, especially since the effectiveness of their training opportunities has not been analyzed. All this makes this study appropriate and relevant.

The research program was divided into several main stages:

1. Questioning people between the ages of 30 and 60 about their attitude to the digital environment, using it to improve the quality of life, including questions about the need for training and understanding how it could be.

2. Analysis of the survey results and development of methodological recommendations for the training program to improve digital literacy.

3. Implementation of these recommendations and evaluation of their effectiveness.

4. Summing up and discussing the results.

All the results of each stage are described sequentially below.

The survey included answers to closed and open-ended questions about the respondents ' attitude to the digital environment, their understanding of their place in it, and their motivation to learn how to work in this environment. All questions were divided into 4 blocks:

– attitude to the digital environment;
– a picture of yourself in the digital environment;
– the amount of consumption of digital products;
– behavior and relationships in the digital environment.

A total of 729 people aged 30 to 60 years were questioned, conditionally they were divided into three groups: young people (30-40 years), mature people (41-50 years), conditionally "elderly" (51-60 years). All respondents are employed, have a professional education (secondary or higher); 87 % are married, 72 % have children; regularly use the digital environment as part of their needs. The respondents took part in the study voluntarily, all were in an even mood and normal physical well-being.

According to the results of the survey, all respondents were divided into three groups (Table 1).

**Table 1.** Data on the results of the survey

| Group type | Qualitative characteristics | Socio-demographic majority |
|---|---|---|
| highly focused on the digital environment (10 %) | - positive attitude to the digital environment;<br>- clearly represent their place in the digital environment (what they do, what they use it for);<br>- the amount of consumption of digital products (thoughtfully and competently use digital products, have the necessary information about digital products);<br>- behavior and relationships in the digital environment (easily find new friends, build connections, behave politely, sincerely and kindly) | Most of all in this group of people aged 35-45 years, have a family, children, a permanent job (most often in the specialty) |
| medium focused on the digital environment (41 %) | - neutral attitude to the digital environment;<br>- they have a vague idea of their place in the digital environment (what they do there, what they can use it for);<br>- the average amount of consumption of digital products (do not always use digital products, do not always have the necessary information about digital products);<br>- behavior and relationships in the digital environment (they cannot always find new friends, there are difficulties in building relationships, in general, they often behave politely and kindly) | Most of the people in this group are aged 40-45 years and 50-55 years, have a family, children, a permanent job and hobbies |
| little focused on the digital environment (49 %) | - negative attitude to the digital environment;<br>- they do not represent their place in the digital environment (what they do there, what they can use it for);<br>- the average amount of consumption of digital products (do not use digital products, do not have information about digital products);<br>- behavior and relationships in the digital environment (they can't find new friends, there are difficulties in building relationships, in general, they often behave coldly and aloof) | Most of the people in this group are aged 30-35 years and 56-60 years, do not have a family, hobbies, but are employed |

In general, we can say that there is not so much pronounced orientation towards the consumption of digital products and orientation in the digital environment. Most likely, this is due to the fact that there is no purposeful conscious attitude to understanding the digital space and the possibilities of implementation within it. It is worth noting that respondents aged 30-35 years also have little focus on the digital environment, except for the sake of communication and entertainment content. Respondents who are highly focused on the digital environment most often use it in a functional version: they use it exclusively for paying bills, receiving services from the state. Those who are on average focused on the digital environment, most often try to self-actualize

in it, to find conditions for self-development. They have the most constructive and creative attitude to the possibility of using it.

At the next stage, the results of the survey were analyzed and the methodological recommendations of the training program for improving digital literacy were developed.

The results of the survey can be explained by the fact that excessive focus on the digital space or almost complete disregard for it is reflected in the motivation for its study and use: material or consumer motives, which are inherent in high and low-centered groups, always distort the perception and evaluation of any process. Active, but moderate use of the digital environment, a constructive attitude to it, which are inherent in a medium-oriented group, allow you to use the digital space more fully. This is because mindfulness always accompanies greater understanding and a desire to learn and develop in any mood, particularly in the use of the digital environment.

Therefore, it is necessary to develop a training system that will increase digital literacy, form a conscious attitude to the possibilities of self-realization in the digital environment. Such training programs, of course, depend on the goals and desired results, as well as on the scope and subject of training, but they have approximately the same structure and general mechanisms.

Within the framework of the study, training centers were offered methodological recommendations based on the results of the survey and taking into account the peculiarities of the cognitive sphere of modern respondents (involuntary attention, quick switching, orientation to the emotional component of information, orientation to practicality in using the obtained data). In addition to these recommendations, visual methods of presenting information and working with educational material were proposed. Before and after the training, respondents were questioned who were trained with and without all the proposed recommendations.

Among the recommendations listed for the digital literacy training program were the following:

1. Always explain the purpose of the training, the benefits and the possibilities of applying the acquired knowledge in practice.

2. Break down the information in the training into small pieces, often using forms of work - such as a lecture-workshop-creative task (about once every half hour).

3. Take into account the field of activity or the sphere of interests of students, if possible, link all the data provided to it.

4. Constantly give feedback, focusing on student achievement rather than mistakes.

5. Use images and metaphors in teaching, as bright and emotionally colored as possible.

6. Use only up-to-date and up-to-date information for learning how to work in a digital environment.

The recommendations listed above are universal, they are suitable for any training program, including those related to improving digital literacy.

In addition, the training should use the following methods, which can be divided into two groups:

A) used by the teacher:

-storytelling-inventing stories on a given topic, they form the most vivid images in the minds of students, which contribute to the memorization of the material;

-infographics - a form of presentation of data in the format of small images, symbols, which allows you to organize the data, highlight the main thing.

B) used by the student:

- sketching-drawing in the format of small images, it is convenient to remember the sequence and relationships between objects, objects, phenomena;

- scribing-arrangement of data representation in a visual format (complex data in the form of simple diagrams and graphs, with a focus on the main key idea);

- active mental work with cognitive constructs-the representation of an idea or task in the form of an object, the mental modification of which can lead to a solution.

Thus, 4 educational centers that teach digital literacy were offered recommendations and training methods in working with groups. In each center, 2 groups were selected: in one group, recommendations and training methods were applied, and in the other, they were not. Before and after the implementation of the programs, students were questioned to assess the effectiveness of the recommendations and the use of methods.

At the third stage, the implementation of these recommendations and the evaluation of their effectiveness were carried out.

## 5. Conclusion

Based on the results of the work carried out, the following conclusions were made:

A) in groups where recommendations were applied and training methods were used:

- both teachers and students noted that the efficiency of memorizing and structuring the material, as well as its comprehension and application in work practice, in life, in general, increased by 90 %;
- students noted a more personal attitude to the material, a desire to apply it in practice, an increase in motivation and interest in learning;
- teachers noted the greater involvement of students, the growth of professional inspiration, and their own interest in the taught material;

B) in the groups where the recommendations were not applied and the training methods were not used, no similar results were obtained.

At the fourth stage, the results were summed up and discussed.

In general, it can be said that the use of visual technologies makes qualitative changes in the assessment of the knowledge and skills that a student receives as part of improving digital literacy, since it is based on the use of images. Any cognitive image always has an emotional color and personal meaning for the person who represents it, so it becomes part of his inner world, is remembered.

In addition, all methodological recommendations are also based on working with information, forming an emotional attitude to it.

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