The technique for future teachers’ digital literacy development

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Abstract. The relevance of the issue is related to the fact that the level of teachers’ digital literacy who transmit their knowledge, skills, and attitudes to the new generation depends on the further development of the Russian digital economy. The social order of society leads to the need for training teachers with high-level digital literacy. This article proposes a technique for increasing the level of future teachers’ digital literacy. The following general scientific methods were used to solve the research problems: analysis, synthesis, generalization, and analogy. A system approach, allowing to consider the relationship and interdependence of all studied elements is important, especially, such a variety as structural-functional analysis, which can represent the phenomena structure under consideration in the dynamic and static slice. Empirical methods such as questionnaires, measurement, comparison, and description are of great importance for the work. The article presents the formation and digital literacy development as a system and a controlled process. A technique for improving the level of future teachers’ digital literacy, based on the practical development of interactive online platforms, is proposed, and its effectiveness is experimentally confirmed. The evaluation of this technique's effectiveness for final year bachelor students was carried out.

1. Introduction

The process of society informatization affects all areas of social development, including education. There are three stages of informatization in the educational sphere. The first stage (electronification of education) is characterized by the introduction of information technologies mainly in the process of teaching technical students. The second stage (computerization of education) is characterized by the use of information technologies in the educational process for various areas of training, including humanities, as well as the integration of information and communication technologies in the organization and management of the educational process. The third modern stage of informatization (digitalization of education) involves not only the use of new multimedia technologies, virtual and augmented reality technologies in the educational process [1], but also a holistic understanding of the ongoing digitalization process, as well as the development of new approaches to learning based on information and communication technologies that provide effective implementation of the goals of training and education.

In Russia, in recent years, there has been a high rate of material and technical infrastructure development, as well as the improvement of software used in the educational sphere [2]. However, the digitalization of education also presupposes high-quality methodological support of the educational
process using new technologies. That is possible if there are teachers who are proficient in the technologies for implementing information processes to ensure the systematization of existing ones, as well as the new knowledge formation in the information society. Specialists are required to master the technologies for processing, transmitting, and converting information for educational purposes. In 1997, the term “digital literacy” was first popularized in the monograph of the same name by P. Gilster [3]. The term has overcome the stages of formation and at present, especially in the program “Digital Economy of the Russian Federation”, is understood as: “a system of knowledge, skills, and attitudes that are essential for life in a digital society, their formation and development should be conscious and controlled, and only under this condition, it is possible to achieve the main goal of digitalization - to improve the life quality of people” [4]. According to the UN definition, digital literacy is “the ability to safely and appropriately manage information, understand and integrate it, share it, evaluate and create information, and access it using digital devices and network technologies to participate in economic and social life” [5].

It should be noted that individual digital literacy does not depend on a specific professional activity. In this sense, a teacher's digital literacy is no different from the digital literacy of any other specialist. However, for professionals in the field of education as a social institution, within which it is possible to purposefully and systematically develop skills in working with information, this quality is of particular importance [6].

In 2019, the analytical center NAFI (National Agency for Financial Research, Moscow) conducted a sociological study “Digital literacy of Russian teachers: readiness to use digital technologies in the educational process” [7]. In the study, digital literacy is evaluated by assessing its indicators: information, computer, communication literacy, media literacy and attitudes towards technological innovation. These indicators were highlighted by experts at the G20 Summit held in Berlin in 2017. For a comprehensive assessment of digital literacy, each of the five listed indicators or components is evaluated in three aspects: cognitive, reflecting knowledge; technical, corresponding to practical skills and abilities; and ethical, characterizing attitudes towards certain aspects of information activities.

Information literacy includes a person’s knowledge about the information impact on social development, skills in working with information from various sources, critical attitude to information, and awareness of the benefits and possible harms of information. Computer literacy is associated with knowledge of computer hardware, the ability to work effectively with various types of digital devices, and awareness of the place and role of computer technology in solving practical problems. Media literacy reflects a person's knowledge of the various information sources available, information forms, ways to distribute it; as well as the skills in finding the necessary information and evaluating information in terms of its reliability. Communication literacy affects a person's understanding of the communication features, using network technologies, a person's ability to use these technologies to organize digital communications, as well as issues of cyber ethics. Attitude to technological innovation is associated with technological trends knowledge, the ability to apply technological innovations, and awareness of the innovation role in solving problems.

The overall level of digital literacy is assessed by evaluating the level of each listed indicators. Thus, in the NAFI study, 634 university lecturers and 555 school teachers were interviewed. The digital literacy index for teachers was 87 points out of a possible 100. The values of private indexes were distributed as follows: information literacy – 93 points, computer literacy – 92 points, communication literacy – 89 points, media literacy – 88 points, attitude to technological innovations – 76 points. The digital literacy index of university lecturers is 88 points out of 100. At the same time, private indexes are represented by the following values: information literacy – 94 points, computer literacy – 91 points, communication literacy – 90 points, media literacy – 90 points, attitude to technological innovations – 78 points. The digital literacy index of both school teachers and university lecturers is quite high. However, when analyzing the values of private indexes, you can see that some of them are characterized by lower rates. For example, the private index reflecting attitudes to technological innovation is the lowest at 76 and 78 points, respectively.
Increasing the teachers’ digital literacy level cannot occur spontaneously under the influence of life factors in the information society. High results can be achieved with a systematic approach to solving this issue. Purposeful work towards the personal qualities development can contribute to the formation of a high-level digital literacy in future teachers.

2. Technique for increasing the level of future teachers’ digital literacy

Mastering hardware and software tools that ensure the active use of interactive educational resources is a modern way to form and develop a high level of future teacher digital literacy. In particular, one of the interactive education forms is the use of interactive online educational platforms. Interactive online platforms allow students to master the material in an exciting way, using audio and visualization tools used by developers in the preparation of subject courses, competitions, and Olympiads, story games, tests, etc. The tools used by developers of online platforms include 1) remote Olympiads, contests, and tests that allow you to test your knowledge or reveal your creative abilities; 2) chat classes, i.e. forms of work that are implemented using chat technologies; chat classes are held with the simultaneous presence of all students in the classroom; 3) web classes – classes via the Internet, it includes conferences, seminars, business games, laboratory work, workshops and other types of training work.

At the moment, there are many online platforms in the ‘information space’ (“Nachalkin”, “YaKlass”, “BIT”, “Uchi.ru”, etc.) that differ in the content of the materials and ways to achieve the goal, the audience, and technologies for providing information. The most popular interactive online platforms used by teachers and learners in educational institutions in Russia are 1) “Uchi.ru” is a Russian online platform where learners from all regions of Russia study various subjects in an interactive form; 2) “YaKlass” is also a domestic online platform and one of the best educational projects in Skolkovo. To date, the platform is used by school learners in Russia, Ukraine, Belarus, and Latvia.

The use of interactive online platforms in the educational process is an effective teaching tool and contributes to the activation of cognitive and creative activities of learners; building an individual educational trajectory for each child, taking into account his/her capabilities and interests; as well as increasing motivation to study subjects. In addition, if there are sufficient material, technical, personnel, organizational, educational, and methodological resources, it is possible to conduct lessons using interactive educational online platforms and other resources for children with disabilities. Consequently, learning to work with online platforms is one of the relevant content areas included in the training process for future teachers.

When analyzing the interactive online platforms “Uchi.ru” and “YaKlass”, a comparative characteristic of learning opportunities was compiled (table 1).

| Possibilities of an interactive educational online platform | Uchi.ru | YaKlass |
|----------------------------------------------------------|---------|---------|
| Educational games                                       | +       | -       |
| Educational animated series                             | +       | -       |
| Use of platform resources for learners with disabilities | +       | +       |
| Classroom assignments                                    | +       | +       |
| Home assignments                                         | +       | +       |
| Free flashcards and tasks                                | +       | +       |
| Advanced course subscription                             | fee     | fee     |
| Participation in Olympiads and competitions              | +       | +       |
| Receiving rewards for active completion of platform tasks| +       | -       |
| Ability to create your own assignments for learners      | -       | +       |
| Monitoring of learners’ tasks                           | Teacher, parent | Teacher, parent |
| Digital homework for a specific learner                  | +       | +       |
| Unique tasks without the possibility of cheating         | +       | +       |
| Interdisciplinary courses                                | +       | +       |
When working with data from online platforms and comparing their features, both the teacher from one hand and learners and their parents form another, the interactive educational platform “Uchi.ru” was chosen for further use [13]. However, given the ability to create their own assignments for other learners within the platform “YaKlass”, we are also turned to this resource in our work.

Teaching students to work using interactive online platforms in order to increase their digital literacy took place in several stages. At the first stage, Russian and international sources on the formation and development of a teacher’s digital literacy were studied, and an analysis of scientific, educational, and methodological literature on the use of interactive technologies in the educational process was carried out. At the second stage, the issues of using interactive online platforms were included in the educational and methodological content of the discipline “Methods of Teaching and Education in Computer Science”. This discipline is contained in the bachelor curriculum of the training "44.03.01 Teacher education", profile "Computer science and information technologies in education". Training in working with online platforms was conducted for 4th-year students. Project activity was chosen as the form of training [14]. Students were asked to develop projects in which they analyzed the following issues: online learning integration into the school curriculum; methodological support for the inclusion of online platforms in the educational process; organization of school homework using online platforms; organization of independent work of learners based on online platforms; creating their own tasks for learners; creating individual tasks for individual learners; conducting Olympiads and competitions using online platforms; introduction of innovative learning tools in additional school education; monitoring of tasks through online platforms.

The approbation of the acquired knowledge was carried out by students in the process of teaching schoolchildren during their teaching practice. The teaching practice was the final stage in the development of a future teacher’s digital literacy. The main tasks at this stage were the following: to train future teachers in the use of interactive technologies, to provide them with practical experience in using interactive online platforms in the educational process, to give students the opportunity to assess the advantages and disadvantages of these technologies, as well as their impact on achieving the learning and education goals. The solution of these problems ultimately contributes to an increase in the level of students’ digital literacy. At the third stage, a quantitative assessment of the future teachers’ digital literacy dynamics was carried out and the effectiveness of the proposed technology for increasing the digital literacy level was identified.

To evaluate the initial level of digital literacy indicators (information, computer, communication literacy, media literacy, attitude to technological innovation) and the overall level of future teachers’ digital literacy, a questionnaire was conducted, including closed and open questions aimed at analyzing each of the five indicators. The obtained data analysis showed that bachelor students of 4th-year have an insufficiently high level of digital literacy formation. There was a contradiction between the students’ interest in modern interactive learning resources and the low level of knowledge about the educational and methodological capabilities of these resources. The obtained conclusion confirmed the need for experimental training and further implementation of students’ new knowledge in the educational process within the teaching practice.

At the next stage, an experiment was carried out in order to identify the effectiveness of the developed technique for increasing a future teacher’s digital literacy. The impact of teaching students skills to work with interactive online platforms on the level of digital literacy was assessed. In a pedagogical experiment, it is rather difficult to achieve an equal composition of parallel groups according to the initial level of available knowledge and formed skills and abilities to select the experimental and control groups. Therefore, in our study, we considered it possible to abandon the comparative experiment and evaluate the effectiveness of the proposed technique, recording the changes that occur at certain stages of the study.

Diagnostics of the digital competence formation level was determined based on the results of a series of control tests. To evaluate the results of the experiment, we applied the $\chi^2$ criterion to the obtained quantitative data, which allows us to compare the percentage distributions of data. The boundary-value of the $\chi^2$–criterion, corresponding to two degrees of freedom ($m=3$) and the probability of an acceptable
error of 0.05, is 5.99, which allows us to conclude that significant changes in the digital literacy level and confirms the validity of the research hypothesis.

Monitoring digital literacy development was divided into two stages, and the results were compared after studying the discipline "Methods of Teaching and Education in Computer Science" and after the students passed teaching practice.

The dynamics of a future teacher's digital literacy level is shown in the figure (figure 1). This allowed us to draw a conclusion about the proposed technique effectiveness.

![Dynamics of a Future Teacher's Digital Literacy](image-url)

**Figure 1.** The Dynamic of a Future Teacher's Digital Literacy.

An empirical study made it possible to test the developed technique effectiveness for improving a future teacher’s digital literacy in the context of informatization and digitalization in modern teacher education.

3. Conclusion

Today, the technological, economic, and social levels of society's development depend on the progress of each citizen's digital literacy. There is a need to form a high level of digital literacy, primarily among teachers as representatives of the cognitive system in which the educational process is carried out. The successful development of a high level of digital literacy requires systematic and purposeful work. The proposed technique of learning the possibilities of interactive online platforms and mastering practical skills of working with them is an effective way to increase the level of future teachers’ digital literacy, allowing them to achieve the required learning outcomes.

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