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# Digital Literacy of Future Preschool Teachers

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## Abstract

The basics of digital literacy begin to form at an early age, and as they grow older, digital literacy must continue to evolve, adapting to the rapidly changing digital world. The first (both in importance and in time) after the family cognitive social institution for most people is the educational system, or rather, the system of preschool education. The problem of increasing the digital literacy of preschool teachers, their willingness to use information technology in educational activities is clearly relevant. Studies have shown an insufficiently high level of digital literacy of future teachers. The goal of this work is to strengthen the digital literacy component in preparing future preschool educators. The authors of the article conducted an experimental study on the introduction of a new program of study of the discipline "Information Technology" at the Elabuga Institute of Kazan (Volga) Federal University. This program includes the following modules: "Interactive Didactic Games", "Animation Basics", "Programming Basics" and "Network Technologies". Based on an analysis of the design work for each module, as well as a survey of 68 respondents of different age categories who took part in the study, an increase in the level of digital literacy of future teachers in all indicators, an increase in the number of people wishing to use information technology in their professional activities, as well as a positive attitude of future teachers to the proposed program.

***Key words:*** *digital literacy, preschool education, interactive didactic game, multimedia, programming, practice-oriented training.*

## Introduction

In the modern world, information technologies penetrate all spheres of human life: industry, agriculture, medicine, management, art, science, and education. Today, it is difficult to imagine human life and activity without information technologies. People get knowledge of them in early childhood. Such acquaintance depends primarily on the environment of a child: his/her parents and teachers. It is necessary to form in a child the culture of interaction with information technologies, starting from early childhood. Scientists from different countries have conducted numerous studies on the impact of information technologies on children's health. Some scientists believe that information technologies have mainly a positive impact on children's intellectual development: they develop better memory, attentiveness, spatial imagination, quick thinking

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(Abramov & Zima, 1989; Bolstad, 2004; Siraj-Blatchford, 2003). Other researchers suppose that information technologies can harm children's health: they can cause deterioration of vision, posture, emotional state, and nervous system disorder (Gurjev; Hamilton, 2006; Hancox, Milne & Poulton, 2005; Waddell, Hua, Garland, Peters & McEwan, 2007; Titova et al., 2019). Certainly, it is impossible to completely ban the interaction of children with information technologies, because if used correctly, they can have a positive impact on their development, but the possible harm to children's health cannot be denied, which makes it necessary to achieve the balance in their use in education. Let us try to generate a formula for the application of information technologies in the upbringing of children in this way: the maximum level of the positive influence of information technologies when their negative impact ends to zero. With the reasonable, thoughtful use of information technologies in the educational process, they can serve as an effective tool for training support and development of preschoolers. At the same time, preschool teachers should realize what kind of learning impact they would like to achieve with the use of information technologies and apply pedagogical strategies that are adequate to the goals to be achieved (Sousa et al., 2019). This demonstrates that teachers' digital literacy is an indispensable condition for the effective and adequate integration of information technologies in preschool education. This concept involves the knowledge, skills, and understanding necessary for the proper, safe and effective use of digital technologies for the purposes of teaching and learning in teachers' professional activities and in everyday private life (Kalash, 2011).

The problem of quality training of future teachers has been highlighted in numerous works by modern researchers (Ahtarieva et al., 2018; Anisimova & Ibatullin, 2018; Kontovourki et. al., 2017; Marsh et al., 2017; Mayoral et al., 2016; Riberio, 2019; Sánchez-Garcia, Mena Marcos, GuanLin & Escribano, 2013; Svensson & Baelo, 2015).

The purpose of the study is to strengthen the digital literacy component in the training of future preschool educators (Alajmi, 2019). A preschool teacher with digital literacy skills will be able to competently select the informational support of educational activities (taking into account ergonomics, children's age peculiarities, cognitive nature), and, if necessary, take part in the design and development of information products in the educational process, thereby promoting the effective integration of information technologies in the educational process aimed at the intensive development of the younger generation (Gabidullina et al., 2019).

"Digital literacy is the ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs and entrepreneurship. It includes competences that are variously referred to as computer literacy, ICT literacy, information literacy and media literacy" ("A Global Framework of Reference on Digital Literacy Skills for Indicator", 2018).

However, only the definition of digital literacy is not enough to measure this phenomenon - a meaningful operationalization of the concept, the construction of scales for assessment and objective measurement are required. One of the first attempts at such operationalization was the project DigEuLit (Martin & Grudziecki, 2006), implemented in Europe in 2005-2006. Digital literacy was then determined through four indicators: computer, information, visual and media literacy.

Later, in 2011, a UNESCO expert approach was published describing digital literacy through a set of skills needed to work with digital media and to process and search for information (Wilson, Grizzle, Tuazon, Akyempong & Cheung, 2011).

The Russian research community also has a serious backlog in the study of digital literacy. The first works describing similar knowledge and skills defined them as "information literacy," that is, a person's understanding of the basic ideas of computer science, an understanding of the role of information technology in society, the ability to work with information flows (Ershov, 1988; Mikhailovsky, 1994; Sokolova, 2002).

Later, technocratic studies were published, where much attention was paid to infrastructural, technical indicators and the socio-cultural aspects of digital literacy were hardly measured (critical perception of information, creative thinking, etc.). Moreover, the data collection technique, as a rule, was aimed at an Internet audience and excluded a significant number of citizens for whom the network is not available (Prodanova et al., 2019 a,b; Gerasimov et al., 2019).

In this study, the approach proposed by a group of specialists at the G20 Summit in Berlin in April 2017 is used to assess the digital literacy of educators (Chetty, Wenwei, Josie & Shenglin, 2017). The approach is based on the assessment of indicators of information, computer, communicative literacy, media literacy and attitude to technology. The main advantage of this approach, which became decisive for its choice in the course of a detailed study of international experience in this field, is that the indicators of measuring digital literacy are formulated based on an analysis of the objective needs of the economy - based on big data and machine learning technologies, vacancies

are studied and typologized employers' requirements for digital skills and knowledge of candidates (demand-side analysis). At the time of the study, this methodology seems to be the most developed and practice-oriented, it was the result of the joint work of specialists from around the world. Consider the key indicators of digital literacy.

1) Information literacy allows people in all walks of life to effectively seek, evaluate, use and create information to achieve their personal, social, professional and educational goals ("Overview of Information Literacy Resources Worldwide", 2013; Sokolova, 2012). An information literate person understands the role and degree of influence of information on life, knows how to search and find information on various resources, and also understands the benefits and harms of information.
2) Computer literacy. With the development of digital technologies, the groups of people who have access to them gain more and more opportunities. At the same time, the opportunities of social groups that have less access to digital technologies or do not have it at all decrease, their competitiveness decreases (Aymaletdinov, 2012; Franco and Bedin, 2019). A computer literate person understands the technical components of a computer and the principles of their interaction, easily uses digital devices regardless of platform / interface, and also understands the "purpose" of the computer and the purpose of its use.
3) Communicative literacy is the key to the development and maintenance of social connections and social capital of each person (Sokolova, Aymaletdinov, Ivanchenko, Plakhtiy & Voronina, 2009; Kireev et al., 2019). A communicatively competent person understands the differences between digital communications and live communication, knows how to use modern means of communication - social networks, instant messengers, and also realizes the existence of a special ethics and communication standards in a digital environment.
4) Media literacy allows a person to navigate the media space, search for news, assuming that the media can cover them incompletely or unreliably. The skill of working with the media, like the other skills that shape digital literacy, leads to an improvement in the quality of life (Gambarato, 2017). A media-literate person understands the variety of sources of information, forms and channels of its distribution, knows how to search for news in different sources, check their completeness and accuracy, and is also critical of information messages and news.
5) A person's attitude to innovative technologies is on a par with informational, computer, communicative and media literacy. If a person follows technology, he is more interested in

developing his own digital literacy. A person who takes technology positively is characterized by the fact that he understands technological trends, is ready to work with new and modern technologies - applications, gadgets, and also understands the benefits of technological innovations both for the development of society and himself.

The demand for digital literacy in all areas of professional activity today is quite obvious, it becomes simply impossible not to notice it, since progress requires the development of a completely different level of competencies from a modern person (Korableva et al., 2019). In this regard, a promising measure is seen in strengthening the component relating to digital literacy of students of all areas of training, primarily pedagogical, since the literacy of the students themselves will depend on how competent the teacher is. All these indicators of digital literacy are undeniably important; therefore, it is necessary to work to improve them.

Some researchers have been analyzing challenges to educators' digital literacy.. The authors of the paper (Marsh, Kontovourki, Tafa & Saloma, 2017) identify some of the digital literacy barriers for teachers when working with preschool children, including teachers' traditional beliefs and attitudes, lack of their knowledge, skills and abilities, lack of self-confidence, lack of equipment, software, lack of funding, etc.

Researchers also propose the formation of individual indicators of digital literacy.

The work (Sánchez-Garcia et al., 2013) proposes the organization of advanced training of working teachers on the following modules: information and operating systems, interactive tools and multimedia materials. The results of the experiments showed the high efficiency of the training, as well as high satisfaction of course participants. Moreover, course participants found the module dedicated to working with multimedia materials more useful than the first module. So, this study is aimed at improving information, computer literacy, as well as the attitude to technology.

The work (Sazonova & Alekseenko, 2017) suggested the formation of ICT competence of already working preschool teachers based on improving their skills as well. According to this approach, already working teachers receive basic skills in working with information technologies. This work is aimed at improving information and computer literacy.

The paper (Mayoral et al., 2016) proposes a program to study the discipline "Information and Communication Technologies" for master's students – future teachers of secondary schools. The authors identify three blocks in the program: "Communication, Interaction and Collaborative Resources", "Educational Resources" and "Multimedia Educational Resources Generation". The

experiment results also showed high training efficiency and students' high satisfaction with teaching. This study aims to increase all indicators of digital literacy. However, the program proposed here is intended to train high school teachers.

It should be noted that existing studies on improving digital literacy are mainly devoted to secondary school teachers. For teachers of preschool education, there are practically no works devoted to improving their digital literacy. Therefore, in this study, a program is proposed to increase the digital literacy of future preschool educators. It is based on active work on all indicators (information, computer, communicative literacy, media literacy and attitude to technology) of digital literacy.

## Method

### Research Design

The study was conducted at the Elabuga Institute of Kazan (Volga Region) Federal University. When conducting the study, the following methods were used: source analysis, questionnaires, experiment, project method, methods of mathematical statistics.

### Participants

This study involved students in the direction of "Pedagogical education" and the profile of training "Preschool education. Primary education", belonging to different age categories (68 students in total, age - 21-39 years old). To analyze digital literacy of students belonging to different age categories, students were divided into 4 groups: 21-25 years old, 26-29 years old, 30-34 years old, 35-39 years old (Figure 1). In each group there was an almost equal number of students. The results of the questionnaires, estimates of design work are also given in accordance with age categories.

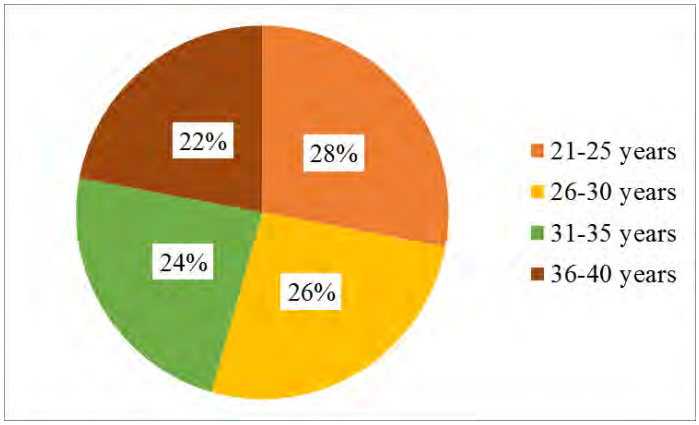



***Figure 1. Age of participants***

**Instrumentations**

For questionnaires, questionnaires were used. Surveys were conducted anonymously. The preliminary questionnaire included 4 questions that determined the desire to use information technology in professional activities and the desire to increase the level of digital literacy. The questionnaire to determine the initial and final level of digital literacy included 15 questions presented in the form of polar pairs of statements describing knowledge, skills and attitudes regarding the five main dimensions of the digital environment: information, computer technology, media, communications and innovation. All 15 indicators corresponding to the questionnaire are assigned the same weighting factors, since at this stage there is no reason to argue that individual indicators are more significant (have more weight) than others.
The final questionnaire included 7 questions that determined the usefulness of the program components of the program and the desire to apply information technology in professional activities.

To conduct an experiment on studying the discipline "Information Technologies", a multimedia audience was used, equipped with a multimedia projector, an automated projection screen, an acoustic system, as well as an interactive tribune for the teacher, a conference microphone, a wireless microphone, a multi-station with a light tablet for a multi-studio, a digital camera, a video camera. The student's workplace includes a computer desk, chair, personal computer, licensed software (Adobe Photoshop, CorelDraw, Microsoft Office, First, Windows Movie Maker, I Can Animate, iStopMotion, Smart Notebook). Each computer has broadband Internet access. All computers are connected to the corporate computer network of KFU and are in a single domain.

**Data Collection**

1. Before starting the study, all students took part in an anonymous questionnaire survey, which contained the following questions:

1) Your age:
    a) 21-25 years old;
    b) 26-30 years old;
    c) 31-35 years old;
    d) 36-40 years old.
2) In your opinion, should information technologies be applied in preschool education?
    a) Yes;

b) No;

c) I don't know.

3) Do you want to improve your information literacy?

a) Yes;

b) No.

4) Will you use information technologies in your educational activities?

a) Yes;

b) No;

c) Not sure.

2. A questionnaire was conducted to determine the initial level of digital literacy of students (Aymaletdinov et al., 2019).

3. Next, an experiment was conducted to introduce a new discipline program "Information Technology".

The proposed program includes the following modules:

1) Interactive Didactic Games;

2) Animation Basics;

3) Programming Basics;

4) Network Technologies.

Let us take a closer look at each module.

1) A game is the main form of activity in preschool age. Therefore, classes in preschool institutions are most effective if they are in the form of a game. A future teacher should be able not only to use ready-made game versions at lessons but also to independently design and develop simple games. In this regard, the first module provides for the training of students – future teachers in the design and development of interactive didactic games. As part of this module, students also acquire basic skills of working with device tools for developing and editing multimedia applications (Adobe Photoshop, CorelDraw, etc.) and an interactive board, the ability to analyze information products in terms of ergonomics and their influence on the harmonious personality development of the younger generation. Within this module, students develop a set of didactic games in Microsoft PowerPoint and Smart Notebook (Borisenko, 2015; Popova et al., 2019; Borisenko & Volodina, 2015; Dong & Jong, 2013). In Microsoft PowerPoint, students learn to work with triggers, animation, and control elements. In Smart Notebook, they learn screen shading technologies

("curtains"), multiple cloning utilities, the Eraser tool, object sequencing technologies. After studying these programs, each student defends the work done (Nagimzhanova et al., 2019). During the defense, the whole group evaluates the work of each student according to several criteria:

- Game ergonomics (0-5 points);
- Originality (0-5 points);
- The quality of artistic performance. The artistic level of the work, design elements, the harmonious color combination, the quality of the compositional solution are assessed (0-5 points);
- The quality and complexity of the technical performance of the work. The validity and reasonableness of the choice of the instruments and tools used are assessed (0-5 points);
- Cognitive nature of a game (0-5 points);
- Fascination of a game (0-5 points);
- Compliance with children's age peculiarities (0-5 points).

The final estimate of the project is the average value of the estimates for all criteria.

Note that the tools for developing and editing multimedia applications within this module are studied as auxiliary tools in the development of game applications. Nevertheless, the importance of learning the basics of working with them for teachers' future professional activity is obvious, although in many reports the work with these tools is not considered.

This module contributes to the formation of information, computer literacy, as well as the attitude to technology.

2) Within the second module, students learn the basics of animation. This module implies the teamwork of students. Each team creates a cartoon based on folk tales. In a team, students distribute the roles on preparing characters and cartoon scenery, creating photographs, dubbing, music overlapping and editing. Cartoon characters and scenery can be made from plasticine, paper, glass beads, etc. Windows Movie Maker, I Can Animate, and iStopMotion can be used for film editing. As part of this module, students also learn to work with digital equipment. After the creation of cartoons, each team defends its work. Students assess the cartoons made by the following criteria:

- originality of content and performance (0-5 points);
- the use of artistic-expressive means (the power of emotional impact) (0-5 points);

- disclosure of a given topic, script (0-5 points);
- level of special effects (0-5 points);
- technical mastery (revision, editing, sounding and processing of the material) (0-5 points).

The final estimate of the project is the average value of the estimates for all criteria.

This module is interesting; after having learned it, a teacher can teach children to create cartoons, work with a digital camera and video camera, as well as with video editors.

This module is also aimed at the formation of information, computer literacy, as well as the attitude to technology.

3) Teachers should also work on the formation of children's logical thinking. Therefore, in the third module, students acquire programming skills in the PervoLogo program. The possibilities of this program as a simple graphic editor, text editor, music editor, as well as a programming language, are being explored. This program allows creating simple algorithms with a performer Turtle. Students learn basic commands: "Go", "Turn", "Change a Pen", "Increase", "Decrease", "Stamp", "Turn Everything off", "Freeze" and the principles of working with the performer. At the end of this module, students also defend the work. The creation of cartoons by each student is envisaged as the final work. Students' final works are evaluated according to the following criteria:

- Originality of the work (0-5 points);
- The quality and complexity of the technical performance of the work (0-5 points);
- Script. Completeness, consistency, detailed elaboration and originality of the script are evaluated (0-5 points);
- The quality of artistic performance (0-5 points).

The final estimate of the project is the average value of the estimates for all criteria.

Thus, when studying the discipline "Information Technologies", students master a technology of developing interactive didactic games, creating cartoons, and study working with graphic and video editors, digital equipment.

This module is also aimed at the formation of information, computer literacy, as well as the attitude to technology.

4) It is useful for a modern teacher to work on the Internet. Therefore, in the fourth module, students become familiar with Internet services: a mapping system Google Maps, an automatic translation service Google Translate, photo editing and publishing service Google Photos, full-text

search service Google Books, a text, spreadsheet and presentation editor Google Docs, a blogging platform Blogger, a geo-information system Google Earth, etc. The final work is the development of a site-portfolio using Google Sites or the platform Wix.com. Site evaluation criteria are as follows:

- Consistency in the same style of fonts, graphics, colors (0-5 points);
- Balance of information on the site pages (0-5 points);
- Graphic quality (0-5 points);
- Text readability (0-5 points);
- Color design (0-5 points);
- Content quality (0-5 points);
- Feedback (0-1 points);
- Convenience of the navigation mechanism (0-5 points);
- Correct work of references (0-5 points);
- Lack of dead-end pages (0-1 points);
- Lack of grammatical and syntactic errors (0-5 points).

The final estimate of the project is the average value of the estimates for all criteria.

This module is aimed at the formation of information, communication, media literacy.

4. After studying the proposed program, a questionnaire was again conducted to determine the final level of digital literacy of students (Aymaletdinov, Baimuratova, Zaitseva, Imaev & Spiridonova, 2019).

5. At the end of the study, an anonymous questionnaire survey of students was conducted; it was aimed at determining the usefulness of the modules studied. The questionnaire included the following questions:

1) Your age:
    a) 21-25 years old;
    b) 26-30 years old;
    c) 31-35 years old;
    d) 36-40 years old.
2) Assess the usefulness of the module "Interactive Didactic Games" (0-5 points): ___ points.

3) Assess the usefulness of the module "Programming Basics" (0-5 points): ___ points.
4) Assess the usefulness of the module "Animation Basics" (0-5 points): ___ points.
5) Assess the usefulness of the module "Network Technologies" (0-5 points): ___ points.
6) Will you use information technologies in your educational activities:
    a) Yes;
    b) No;
    c) Not sure.
7) Your feedback on the course completed:

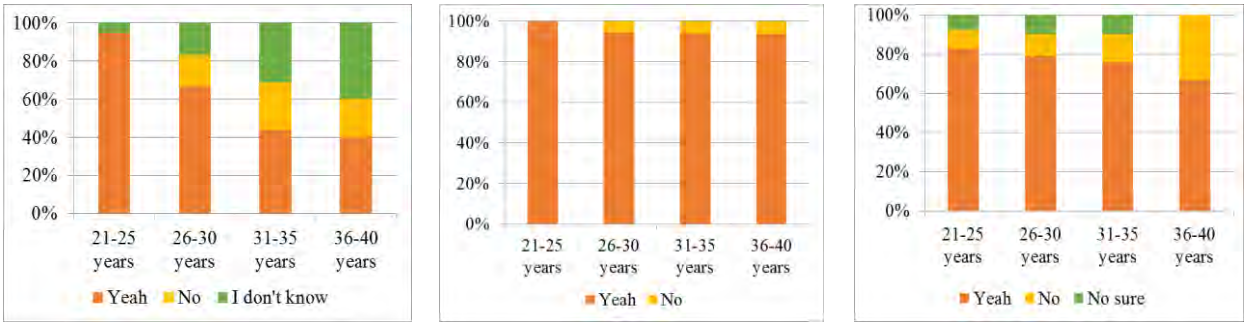
_____.

**Data analysis techniques**

Methods of mathematical statistics were used for the data analysis.

## Findings

1) A preliminary questionnaire was aimed at identifying the level of digital literacy and the desire to use information technology in professional activities. The results of the preliminary questionnaire are shown in Figure 2. Figures (a), (b), (c) illustrate the answers to questions 2-4. Answers to questions are grouped by age category. For each age category, the column is divided into parts of different colors in proportion to the number of answers of students of this age category.




(a) (b) (c)

***Figure 2. Results of the initial survey – answers to the questions: (a) – Is it necessary to apply information technologies in preschool education? (b) – Do you want to improve information literacy? (c) – Will you use information technologies in your educational activities?***

Consider the results of the survey for each age group separately. 95% of the students aged 21 to 25 think that information technologies are necessary in preschool education. All 100% of students

want to improve information literacy. 83% of them are going to use information technologies in educational activities.

67% of the students aged 26 to 30 thinks that information technologies are necessary in preschool education. 94% of students want to improve information literacy. 79% of them are going to use information technologies in educational activities.

44% of the students aged 31 to 35 thinks that information technologies are necessary in preschool education. 94% of students want to improve information literacy. 76% of them are going to use information technologies in educational activities.

93% of the students aged 36 to 40 want to increase the level of information literacy. 67% of them are going to use information technologies in educational activities.

2) Next, a questionnaire was conducted to determine the initial level of digital literacy of students of different age categories. The survey results are presented in table 1.

**Table 1**

*The results of the survey to determine the initial level of digital literacy of students of different age categories*

| | Private Index Values | | | | | Digital Literacy Index |
|---|---|---|---|---|---|---|
| | Information literacy | Computer literacy | Communicative literacy | Media literacy | Attitude to technology | |
| 21-25 years old | 79% | 84% | 86% | 80% | 95% | 85% |
| 26-30 years old | 76% | 77% | 80% | 75% | 90% | 80% |
| 31-35 years old | 70% | 72% | 80% | 72% | 80% | 75% |
| 36-40 years old | 68% | 70% | 75% | 70% | 75% | 72% |
| Whole group | 73% | 76% | 80% | 74% | 85% | 78% |

Columns 2-4 show the average values of private digital literacy indices (indicators), and column 5 shows the digital literacy index, calculated as the average of private indices for each age group separately. The last line shows the average values of private indices and the final index of digital literacy for the entire group as a whole.

The average digital literacy index of the entire group is 78% - this is not a high enough level, so work is needed to increase it. The highest index of digital literacy (85%) is observed among students of the youngest age group, the smallest (72%) is among the oldest, so we see a gap between the digital education of students of different age groups.
3) In the framework of the discipline "Information Technology" mastered the following modules:

1) Interactive Didactic Games;

2) Animation Basics;

3) Programming Basics;

4) Network Technologies.

The development of each module was a project. The project rating is in the range of 0-5 points. To evaluate the projects, a commission was organized from among the teachers specializing in information technology. The results of the development of the modules were grouped by age category. The results include an average score for each age category for each module and standard deviation.

**Table 2**

*The results of the study of modules by age categories*

| | Interactive Didactic Games | | Animation Basics | | Programming Basics | | Network Technologies | |
|---|---|---|---|---|---|---|---|---|
| | Average estimate | Standard deviation | Average estimate | Standard deviation | Average estimate | Standard deviation | Average estimate | Standard deviation |
| 21-25 years old | 4.397 | 0.416 | 4.564 | 0.387 | 4.139 | 0.432 | 3.776 | 0.184 |
| 26-30 years old | 3.989 | 0.682 | 4.289 | 0.392 | 3.869 | 0.396 | 3.692 | 0.345 |
| 31-35 years old | 3.619 | 0.754 | 4.173 | 0.452 | 3.547 | 0.248 | 3.699 | 0.296 |
| 36-40 years old | 3.506 | 0.574 | 4.006 | 0.232 | 3.433 | 0.286 | 3.14 | 0.226 |

The average estimate for the module "Interactive Didactic Games" was 3.91; "Animation Basics" – 4.28; "Programming Basics" – 3.78; "Network Technologies" – 3.60. The highest estimate is observed on the module "Animation Basics", which is probably related to the variety of activities in creating cartoons. The estimate for "Network Technologies" is not high due to the fact that the maximum possible value of a student's estimate for this module is 4.(27).

Below are some of the students' estimates on the module "Interactive Didactic Games".

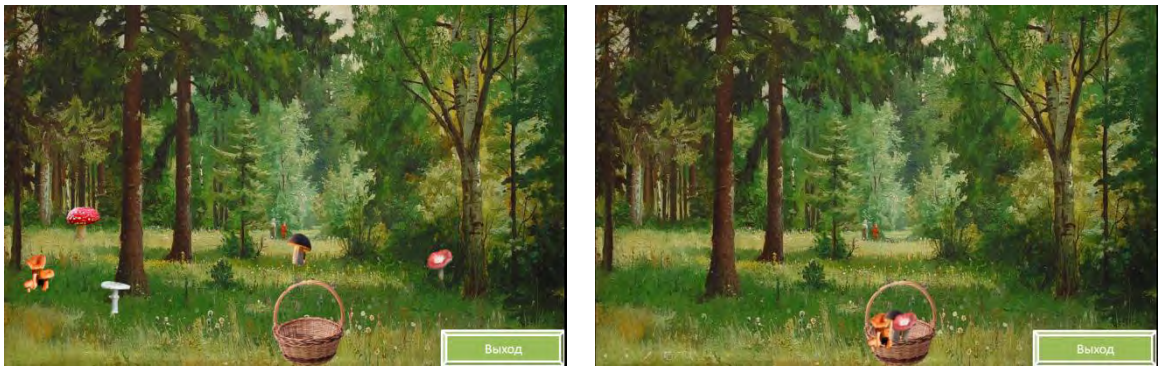
1. An interactive game-presentation "Paint the Animals" was prepared in Microsoft PowerPoint using the technology of triggers. The game consists of several slides, which

depict the outlines of animals: fox, frog, piglet, bear, and wolf. Near the animals, there is a palette with paints of different colors, among which there are colors appropriate or inappropriate for the animal. When choosing a paint of the right color, the animal contour is filled with this color; otherwise, the paint is only "shaking". This game can be used when studying the topic "Colors" during speech development lessons and native language lessons (Figure 3).


(a) (b)

***Figure 3. Slides of the didactic game "Paint the Animals": initial state (a); final state (b)***

2. An interactive game-presentation "Pick Edible Mushrooms", also prepared in Microsoft PowerPoint using the technology of triggers. The presentation slide features an illustration of a forest with trees, plants, and mushrooms. Each mushroom is designed as a separate piece of illustration. When clicking on an edible mushroom, it is sent to the basket for collecting mushrooms through an animation effect, and a sound of applause appears, confirming the correctness of the choice. When clicking on an inedible mushroom (pale toadstool, amanita), it disappears on the slide, which is also accompanied by a corresponding audio fragment. This game can be used during lessons on the world around us (Figure 4).




(a) (b)

***Figure 4. Slide of the game "Pick Edible Mushrooms": initial state (a); final state (b)***

4) After studying the discipline, a questionnaire was conducted to determine the final level of digital literacy of students of different age categories. The survey results are presented in table 3.

**Table 3**

*Survey results on determining the final level of digital literacy of students of different age categories*

| | Private Index Values | | | | | Digital Literacy Index |
|---|---|---|---|---|---|---|
| | Information literacy | Computer literacy | Communicative literacy | Media literacy | Attitude to technology | |
| 21-25 years old | 90% | 95% | 96% | 91% | 100% | 94% |
| 26-30 years old | 88% | 88% | 91% | 86% | 98% | 90% |
| 31-35 years old | 85% | 84% | 90% | 83% | 96% | 88% |
| 36-40 years old | 84% | 84% | 88% | 84% | 98% | 88% |
| Вся группа | 87% | 88% | 91% | 86% | 98% | 90% |

The average digital literacy index of the entire group has increased markedly from 78% to 90% - a high level. The highest index of digital literacy (94%) is observed among students of the youngest age group, the smallest (88%) is among students 31-35 and 36-40 years old, however, we see that the gap between the digital education of students of different age groups has decreased significantly and the smallest the index rose significantly from 72% to 88%, which indicates the positive impact of the proposed program on increasing the digital literacy index. We also see an increase in digital literacy in all private indices, which confirms the effective impact of the program

on each component of digital literacy: information, computer, communication, media literacy and attitude to technology.

5) The final questionnaire was aimed at identifying the desire to apply information technology in professional activities, as well as determining the usefulness of the modules that make up the program. The results of answers to questions 2-5 (Figure 5) are grouped by modules and by age.

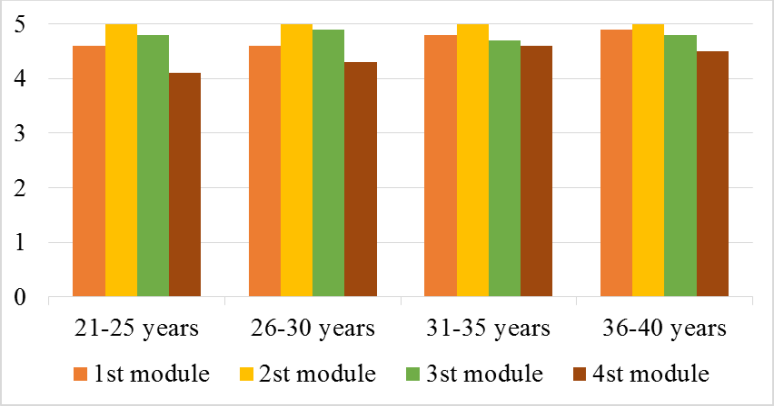



***Figure 5. Usefulness estimates of the modules "Interactive Didactic Games" (1st module), "Animation Basics" (2nd module), "Programming Basics" (3rd module), "Network Technologies" (4th module)***

Thus, the module "Animation Basics" received the highest estimate (5.0) in all age categories of students.

The results of the answers to question 6 are shown in Figure 6. They are also grouped by age category.

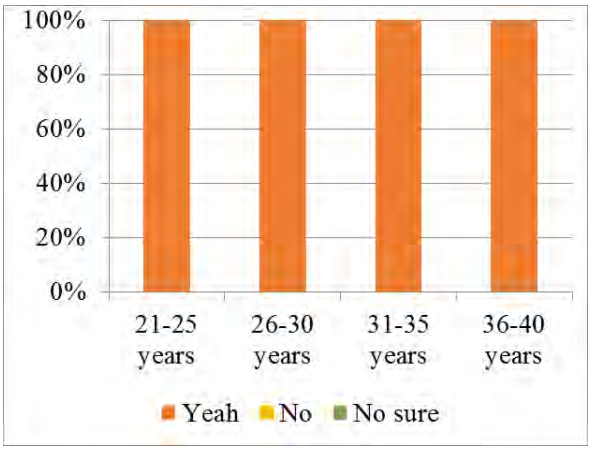



***Figure 6. Results of the final survey – answers to the question: Will you use information technologies in your educational activities?***

Thus, a pronounced tendency to increase the level of digital literacy of all students is observed. 89% of students aged 21-25 feel a high level of digital literacy, 11% have an above average level. 44% of students aged 26-30 feel a high level of digital literacy, 39% have an above average level, and 17% have an average level of digital literacy. 56% of the students aged 31-35have a high level of digital literacy, 25% have an above average level, and 19% have an average level of digital literacy. 40% of the students aged 36–40 have an above average level of digital literacy, 53% have an average level of digital literacy, 7% of students have a below average level. In general, 50% have a high level of digital literacy, 28% – an above average level, 20% – an average level and 2% – a low level. The positive outcome is that all students are going to apply information technologies in their future professional activities.

Feedback from students:

"Thank you for the high-quality and interesting organization of classes in the discipline "Information Technologies". We received really useful skills and abilities to create fascinating applications that we will necessarily apply in our professional activity!"

"The undoubted difference of the course completed is its focus on the use at preschool institutions. We not only worked with the programs, we understood what they are for. We developed complex tasks that demanded great efforts to study several programs at once, we learned to photograph and shoot correctly..."

## Discussion

In the framework of ICT training of future preschool teachers, this paper proposes the program "Information Technologies" aimed at forming digital literacy. The advantage of the proposed program is a practical-oriented integrated approach, within which students are offered project tasks (closely related to preschool education), for which they need to master a set of specific programs. Moreover, they study rather different programs that can be applied at lessons on any preschool discipline. Students study the creation of interactive didactic games, master teamwork on creating cartoons, gain digital skills, learn to program, keep a blog, create websites, and also learn to analyze and critically evaluate software products. Thus, steps are taken to form the digital literacy of future preschool teachers.

A feature of the proposed program is the project method. Previously, it was already applied at the Elabuga Institute of the Kazan (Volga Region) Federal University in 2017-2018. during the preparation of the training direction 44.03.05 “Pedagogical education” and the profile “Preschool

education. The results of the study showed the high efficiency of the application of the project method in the formation of information competence of future teachers. As part of this study, students developed multimedia didactic game projects in the SmartNotebook environment, drafted a lesson plan, and thought out at what stage it is better to use the game, what is its duration, content. At the end of the course, a project defense was organized where each student presented his game. However, the authors of the study put forward the idea that a modern teacher needs to expand and, in a sense, deepen his information and computer skills: he must not only be able to create interactive didactic games, but also know the basics of animation, understand the tools for developing and editing multimedia applications. Critical thinking skills are a prerequisite for digital literacy (Shastina et al., 2019), and therefore, within the framework of this program, the "Fundamentals of Programming" module in the PervoLogo program was proposed. And finally, a modern educator needs to possess a variety of communication technologies and media technologies. For this purpose, the module "Network Technologies" was proposed. The proposed program is fully consistent with active work on all indicators of digital literacy: information, computer, communication, media literacy and attitude to technology.

Thus, the proposed program of the discipline "Information Technologies" is aimed at training future preschool teachers with a high level of digital literacy, capable of effectively integrating information technologies into the educational process aimed at the intensive development of the younger generation.

## Conclusion

The proposed training program for students-teachers "Information Technologies" included the following modules: "Interactive Didactic Games", "Animation Basics", "Programming Basics" and "Network Technologies". The results of the study indicate an increase in the level of digital literacy, an increase in the number of people wishing to apply information technology in educational activities in all studied age categories. Students of all age categories praised the proposed program modules. The gap between students of different age categories in terms of digital education also decreased significantly.

This study was not aimed at teaching students to work with all programs. Certainly, this is unlikely. However, having acquired the skills of working with some of the programs presented here, having understood how to apply them, students will be able to select and master many others.

The proposed program can be considered as a universal tool for the formation of digital literacy of future teachers by adding or removing some modules. The prospect of this study is the possibility of organizing relationships with preschool institutions so that students not only create software applications but also learn how to put them into practice when working with children. Under the proposed program, it is also possible to organize advanced training courses for already employed teachers.

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