Gamification in the formation of digital skills of future teachers

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Abstract. Global digitalization requires changes in all spheres of human life, including education. Modern trends lead to the introduction of various innovative technologies into the educational process, including gamification, which provokes changes in approaches in order to train a new type of teacher. The stability of society and its future development largely depend on the quality of its preparation. In the context of the general digitalization of education, a future teacher must have certain digital skills that underlie digital literacy for successful professional activity. The purpose of this study is to describe an effective experience in the formation of digital skills by the classification of three groups and three levels when using the elements of gamification in teaching future teachers. In the work, general scientific methods were used: analysis of theoretical sources, collection of information, comparison, generalization, questionnaires, and the study of the products of educational activities of students. The study confirmed the effectiveness of the identified conditions for the successful formation of three groups of digital skills among students of educational institutions of higher and secondary vocational education, which showed an increase in their academic performance in the process of studying the disciplines under consideration and the level of their digital literacy.

1 Introduction

The age of digital education imposes certain requirements on the preparation of future teachers. The digitalization process caused by global trends in the transition to a digital economy and a digital society requires changes in the technologies used by the modern teacher at school and which are used in educational organizations to train the modern teacher.

One of these technologies is gamification. There are various interpretations of this concept: it is a method, technique, approach, and technology. The authors of this study classify gamification as a technology that involves the use of processes associated with the use of game mechanics in learning. Gamification refers to an innovative technology that meets the modern requirements of a digital society.

Currently, the elements of gamification are actively introduced into the educational processes of schools, educational organizations of secondary vocational, and higher education. In the last few years, there were a lot of works describing the research of

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introducing gamification elements into the learning process. Most of them contain a positive experience of such implementation: increasing the involvement of students in the educational process, increasing their academic performance, expanding social ties, developing teamwork skills, individualizing training, etc. [1-4]. However, there are works in which contradictory points are revealed [5] and the ambiguity of the results obtained is emphasized (different learning outcomes for different categories of people: for different areas of training, for students with different characters, with gender differences, etc. [6-7]).

It should be noted that almost all published works in this direction pay great attention to the influence of gamification on three elements of the educational process: cognitive activity, emotionality, and socialization of the student. However, there are quite a few works that investigate the formation and development of ICT competence in teaching with elements of gamification, including among future teachers. The relevance and significance of the ICT competence of modern teachers, including digital literacy, is reflected in the new UNESCO recommendations "ICT Competency Framework for Teachers. VERSION 3" [8]. Recently, quite a lot of works have appeared that consider the competence of a teacher in the field of ICT in the framework of an innovative approach to education [9-10], revealing the possibilities of using information technologies in the educational process [11-14], devoted to the formation of ICT competence of future teachers of organizations higher and secondary vocational education [15-17].

In the new UNESCO recommendations, digital literacy is defined as "the ability of an individual to use digital technologies, communications, or networks to find, evaluate, use, and create information; understand and use information in several formats from a wide range of sources; effectively perform tasks in the digital environment" [8]. Many scientists note that digital literacy includes digital skills, which are essential aspects of living in a digital society.

In the book "Working Group on Education: DigitalSkills for Life and work" (UNESCO), the digital skills that underlie digital literacy are divided into three groups: basic, functional (basic), general, and specialized professional digital skills. The strategic document "Digital Skills Toolkit" (ITU, 2018) presents a classification where digital skills are divided into three levels: basic, general, and advanced.

Some works of modern researchers from different countries are devoted to the problem of the formation of digital skills in the educational process when using elements of gamification [18-21, etc.]. Of particular interest is a study on teaching future teachers to digital culture through gamification [22]. This work proposes to rethink the construction of training courses for students of higher educational institutions, considering the digitalization trends in the world of all spheres of activity, and shows the change in the attitude of pedagogical students to their future professional activities in the formation of general digital skills.

However, in the literature, there are still no works containing research in the field of the formation of digital skills, considering their classification into three groups and three levels. Thus, the purpose of this study is to describe an effective experience in the formation of digital skills by three groups (basic, general, and specialized professional digital skills) and three levels (basic, general, advanced) when using the elements of gamification in teaching future teachers.

2 Materials and methods

The study was conducted in 2015-2021. at FSBEI HE "TransbaikalStateUniversity" and SAPEI "Chita Pedagogical College". The study used the following general scientific methods: analysis of theoretical sources, collection of information, comparison,

generalization, questionnaires, and the study of the products of students' educational activities.

3 Results

The study was conducted based on educational institutions of various levels (higher and secondary vocational education). This made it possible to expand the subject field of research due to the inclusion of students in different areas of training.

At the Transbaikal State University, within the context of the extended group of specialties and training programs "Education and Pedagogical Sciences", five areas of training are being implemented, including 24 educational programs in the direction of "Pedagogical Education" with one and two profiles. Educational programs of a pedagogical orientation are implemented by updated educational standards (FSES HE 3 ++) and structurally have a modular format. Several general disciplines and practices are included in the curricula of all profiles of the training programs under consideration. Thus, the module "Communicative" includes the discipline "Informatics and ICT" (1st semester), the module "Educational and research" includes the discipline "Organization of educational and research activities" (2nd semester) and educational practice (design and technology, 2nd semester). An analysis of the content of the working programs of these disciplines and practices, as well as the learning outcomes of students, revealed several conditions for the successful formation of three groups of digital skills, including when using gamification technology. These are the following conditions: motivation of junior students (for example, profiles "Preschool Education", "Primary Education", "Technology and Economics", "Russian Language and Literature", etc.) to master basic and general digital skills; increasing the subjective activity of students; a high level of their involvement in the educational process. The consequence of this is an improvement in learning outcomes in the process of studying the disciplines under consideration and an increase in students' level of digital literacy.

Here are the examples of usage of gamification elements to form digital skills of future teachers in the framework of the above disciplines.

So, it is necessary to form basic digital skills (basic level) from the first year as part of the study of the discipline "Informatics and ICT". At the same time, in the classroom it is advisable to apply gamification technology based on role-playing game platforms or motivating applications, for example, Classcraft or Habitica. Students can be offered practical and laboratory work performed within the discipline, while the context of such classes will be similar to a computer role-playing game. Performing each task, the student overcomes the "opponent" in the role of a "warrior", "mage", or "healer" or other character. For the completed task, the student receives experience, gold, scores, etc. The more rewards (for example, experience) players get, the more they can prove themselves in the game and the more successful they will be in learning.

The motivational structure of the game based on the use of gamification as a technology is a necessary element in the preparation and conduct of such classes. The advancement of students to the next level should be supported by the proposed tasks. At the same time, it is very important that students can see their status and achievements, can improve their results.

It is advisable to form *general digital skills (general level)* based on the creative use of online applications and services, various software, digital content creation within the discipline "Organization of educational and research activities."

For example, in a practical lesson in the study of this discipline, students can be offered to split into 2 groups and use the Google Forms online service and the MyTestX platform to create questionnaires for schoolchildren on a specific topic. Further, using the elements of a business game, the developed questionnaires should be tested during the lesson when conducting computer testing of students. First, they exchange questionnaires and, acting as schoolchildren, answer questions. Further, acting as teachers, they conduct a comparative analysis of the advantages and disadvantages of digital services used to create questionnaires. Within the framework of this discipline, students should be offered mini-projects for schoolchildren with the inclusion of elements of educational research. When developing mini-projects, students can use mobile applications.

A special role in the formation and application of digital skills of future teachers belongs to educational practice (project and technological practice), implemented in the fourth semester. During the period of study practice, which is held based on two technology parks "Quantorium" (models "Standard", "Mini"), students get the opportunity not only to get acquainted with the content of quantum ("IT-quantum", "Energy-quantum", "Aero-quantum", "VR/AR-quantum", "Hi-tech", "Geo-quantum", "Promrobo-quantum", "Promdesign-quantum"), but also to test the developed mini-projects on topical issues in the field of digitalization of education.

The plans of study of the profiles "Informatics and Physics" and "Mathematics and Informatics" include such disciplines as: "Programming", "Low-level programming languages", "Web-programming technologies", "Computer modeling in project and research activities", "Computer Networks", "Basics of Animation", etc. These disciplines serve as the basis for the formation of *specialized digital skills (advanced level)*.

Significantly, the plans of study profiles under consideration include the disciplines "Modern technologies of teaching informatics", "Modern technologies of teaching physics", "Modern technologies of teaching mathematics" (8 semester). Within the framework of these disciplines, students can be offered tasks aimed at the independent development of various didactic games (computer games, interactive quests, etc.) based on programming languages. In the future, students, as future teachers, can use the developed didactic games in practice at school when teaching physics, mathematics, and informatics to schoolchildren.

In educational institutions of vocational secondary education, when preparing future teachers, it is also possible to specially form digital skills that underlie digital literacy, including using gamification technology. So, in the Chita Pedagogical College, within the framework of the discipline "Game technologies in preschool educational institutions using ICT" of the plan of the specialty "Preschool education", it is advisable to form digital skills of all three groups: basic, general, and specialized professional skills. Here are some examples.

For the formation of *basic digital skills* when studying the discipline, it is advisable for students to offer quizzes, tests, game interactive tasks with the use of gamification elements that students can perform using their mobile devices. The proposed assignments can be developed in specialized digital services such as Quizizz, Kahoot, Triventy, Wordwall, Learnis, etc. These tasks are characterized by the following game components used in gamification: scoring, avatars, progress bars, rating tables.

For the formation of *general digital skills*, future teachers should be taught to create game interactive tasks for preschoolers using specialized digital services. Students need to learn how to create tasks considering the age characteristics of children in various educational areas and implement them using digital services.

For the formation of *specialized professional digital skills*, future educators, students of the specialty "Preschool education", it is advisable to propose to create joint group projects with future programmers, students of the specialty "Information systems and programming". As part of project activities, students, using programming in the C# language or mobile applications, can create interactive quests, didactic games, and educational computer games. Significantly, the formed specialized professional digital skills function in interaction with such "soft" skills as the ability to work in a team, creativity, and critical thinking. Students can present the developed digital products at scientific and practical conferences and competitions of various levels, as well as use in future professional activities.

To determine the final level of formation of digital skills, the sum of points was calculated for these groups of skills. Depending on the number of points scored, students were divided into groups corresponding to three levels of formation of digital skills of future teachers: basic, general, and advanced. The rules for assigning a level were as follows: basic level, if $4 < a < 6$; general level, if $7 < a < 9$; advanced level if $10 < a < 12$. Fig. 1 shows the results of the experiment.

Fig. 1. Dynamics of the levels of formation of digital skills

The results of the experiment allow us to draw a conclusion about the positive dynamics of the levels of formation of future teachers' digital skills.

4 Discussion

Applying digital educational technologies, the teacher must proceed from the learning outcomes, determining the level at which basic, general, specialized professional digital skills should be formed in students as future teachers. It is the learning outcomes that will determine the choice of digital technologies and, as a special case, gamification technologies.

It should be noted that the risks of introducing gamification into the educational process have not been sufficiently investigated. In addition, there is not enough evidence to support the long-term benefits of gamification in the educational context [23].

5 Conclusions

Gamification is an innovative technology, considered a leading trend in education. It has significant potential in the formation of digital skills in students and in increasing their motivation to learn. This work contains a description of the experience of developing digital skills using the elements of gamification in teaching future teachers in accordance with the

classifications into three groups and three levels. The study made it possible to identify a number of conditions for the successful formation of three groups of digital skills in students of educational institutions of different levels.

The effectiveness of the presented experience is confirmed by: control sections, successful testing of the products of educational activities created by students at scientific and scientific and educational events, the results of a questionnaire survey of students and teachers. The study showed an increase in student performance in the process of studying the disciplines in question and the level of their digital literacy.

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