Study of Digital Competencies of Teachers for Designing Game Mechanics in Educational Activities

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Abstract: The study focuses on improving the digital skills of teachers' education organizations. They will learn how to design game mechanics using computer role-playing games (RPG) in different subjects of the educational program, using e-learning. Game mechanics in education are a relevant way to engage students, encouraging them to learn independently and make decisions. For the purposes of the study, a model of the structure of the digital competence of the teacher developed, which is built on the results of a selective study of the potential of key digital competencies necessary to create conditions for the implementation of educational programs by the teacher using e-learning, including the design of game mechanics based on computer role-playing games (PRG). The research investigates how teachers acquire digital competencies by using a digital educational platform in a school setting. This scientific study examines teachers' digital competencies, explaining the methods, tools, and outcomes. In conclusion, the importance of using game mechanics for educational purposes to optimize the educational process in a general education organization outlined by using game mechanics based on computer role-playing games (RPG) to implement the tasks and content of educational activities in subject areas.

1 INTRODUCTION

To enhance general education, teacher training is being updated to include "digital maturity" education, focusing on developing teachers' digital skills (Fedorchuk, Gordashnikova, 2023).

In the changing paradigm of the domestic education system, it is advisable to adjust the content of digital competencies of teachers of general education organizations. This will allow productive work on designing game mechanics based on computer role-playing games (PRG) as a tool for increasing the motivation of students to implement educational and social activities (Inamova, Kodirov, 2022).

In digital transformation in education, educational practice is gradually enriched with new technologies, methods of receiving and transmitting knowledge, teaching tools (Shpakovsky, Danilyuk, 2018). Effective education involves fostering student competencies through innovation and creativity. It is necessary to expand the conditions for training highly qualified teachers with relevant competencies in modern technologies, including digital ones (Gordashnikova, 2023). The study focused on how teachers' digital skills affected their ability to design

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game mechanics for computer role-playing games in educational programs (Akchelov, Galanina, 2019).

Incorporating game mechanics in education is a relevant way to engage students. It encourages them to learn on their own and make choices (Morozov, Polyakova, 2024). Teachers are starting to combine traditional teaching methods with new gaming technologies in education (Mukhametzyanova, Khayrutdinov, Aminova, Morozov, Fedorchuk, 2020). Positive aspects of game learning noted, both in formal and informal education, and in the socialization of students, from acquiring new knowledge to developing social skills (Polyakova, Morozov, 2024).

The scientific publication aims to share the findings of a detailed study on teachers' digital skills, including the methodology used, the development of tools, and their practical application. Also, to update the digital competencies of teachers for the design of game mechanics based on computer role-playing games (PRG) and their application.

The objectives of the study, in their totality, specified the goal and focused on:

- Developing diagnostic study materials, including a questionnaire and materials for measuring and testing.

- Assessing teachers' digital competencies using a prototype for a digital educational platform in schools.

– Analyzing the results of the diagnostics of teachers' digital skills in a school.

– Development of an algorithm of actions of a teacher on the use of game mechanics based on computer role-playing games (PRG).

The detailing of the teacher's methodological work on the use of game mechanics in practical activities determines the significance of the study. The acquired results can use to update the professional standard of a general education teacher. This will allow for certifying pedagogical activity. The results of diagnostics of the formation of digital competencies of teachers can become the basis for developing an individual program for their professional development. For effective management of the formation of a digital educational environment in a general education organization. The results of theoretical and practical research are timely for the development of methodological recommendations on the use of game mechanics based on computer role-playing games (PRG) in the educational practice of teachers.

2 METHODS

The study used diagnostic tools to assess teachers' digital competencies, including designing game mechanics using computer role-playing games (PRG). They also used a prototype of a digital educational environment in a school. The diagnostic results helped us develop a customized plan for teachers to enhance their game design skills in digital competencies.

Planning of diagnostic actions included:

- compiling a questionnaire of contextual data on the study participants (characteristics of the place of work, qualification characteristics of the teacher: level of education, length of service, qualification category;

-developing a specification for materials to support national education objectives. The substantive context of the aforementioned professional standard is chosen as the primary criterion for developing control and measuring materials to use digital educational resources to implement educational programs;

- developing a codifier of requirements for the results of the study;

- creating tests to assess teachers' digital competency in using educational resources, digital services, and designing game mechanics for computer role-playing games (PRG).

Work carried out to develop a model of digital competencies for teachers through the selection of advanced training programs and professional retraining programs for teachers.

A sample of subjects was conducted for the study. Homogeneous strata represent the general population by a certain characteristic. The strata were under the jurisdiction of the Russian Federation. 16 subjects of the Russian Federation selected. 2 subjects from each federal district with an indication of the regional operator of programs for advanced training and professional retraining of teaching staff (Fig. 1).

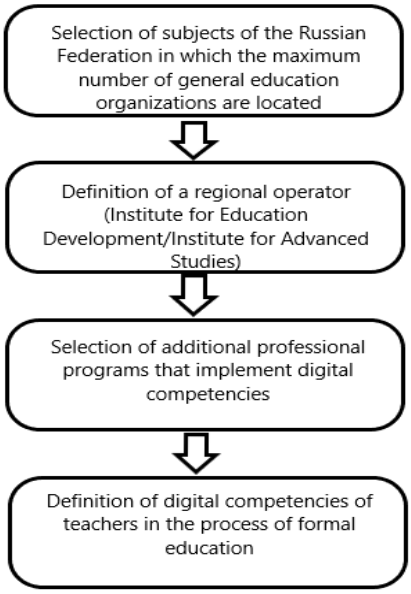

Figure 1: Research sampling instrument.

To make it easier for teachers to use game mechanics from computer role-playing games in their teaching, researchers Inamova and Kodirov (2022) studied how to adapt these methods to fit educational settings and training conditions (Inamova and Kodirov, 2022). In a study conducted by Bessmertny and Gaenkova (2016), they analyzed domestic and foreign sources to explore the use of gamification in education (Bessmertny and Gaenkova, 2016).

3 RESULTS AND DISCUSSION

The study showed a lack of advanced training programs for teachers to improve their digital skills, which hinders their effectiveness in a digital educational environment. The main didactic units of work programs selected, characterizing the set of skills and knowledge necessary for performing work activities using digital technologies.

The study created a model that shows the digital skills a teacher needs (tab. 1). Which was built based on the results of a selective study of the potential of key digital competencies necessary to create conditions for realization of educational programs by a teacher using e-learning. Including the design of game mechanics based on computer role-playing games (PRG).

Table 1: Model format of digital competence of a teacher.

Digital competence	Components of digital competence
Application of modern educational technologies, including information and digital educational resources	Design of the educational process using digital educational resources
	Using digital services to improve the efficiency of the educational process
	Using universal platforms, virtual platforms for organizing and conducting online lessons
	Selection of digital educational resources aimed at solving a specific professional pedagogical task
	Designing game mechanics based on computer role-playing games (PRG)

The model includes creating 3 different versions of control and measuring materials to assess the teacher's digital competencies. This involves using 16 tasks as tests. The tests provided one correct answer from a set, which was estimated at 1 point. A task to which an incorrect answer brings about, or no answer considered incorrectly completed (score of 0 points).

The study used a level approach. Three deficiency levels were identified in relation to the digital competencies of the teacher:

- The first level showed that the teacher had enough digital skills to handle tasks of any difficulty.
- The second level indicates that the teacher lacks proper training in digital literacy, which resulted in being able to complete only basic and partially advanced tasks.
- The third level indicates that the teacher has limited digital skills and can only complete basic tasks.

Experts have developed recommendations for determining the levels of development of a teacher's digital competencies (tab. 2).

Table 2: A level-based approach to the development of digital competencies of a teacher.

Diagnostic efficiency	Deficit level
From 11 to 16 points	First
From 6 to 10 points	Second
From 0 to 5 points	Third

The following are chosen as the fundamental principles for diagnosing teachers: voluntary and anonymous participation; confidentiality of participants; online mode of implementation.

The study sample included 703 teachers (more than 3% of the total number of teachers in 23 municipalities from 2 constituent entities of the Russian Federation). The study included 57.2% of teachers from medium-sized schools (from 501 to 1000 students), 28.6% from small schools (from 101 to 500 students), 9.7% from large schools (more than 1000 students), and 4.5% from very small schools (up to 100 students).

General education teachers actively participated in the diagnostic process (Fig. 2):

- primary general—28.3%;
- primary general, basic general—2.1%;
- primary general, secondary general—0.7%;
- primary general, basic general, secondary general—5.1%;
- basic general—31.7%;
- basic general, secondary general—16.2%;
- secondary general—15.8%.

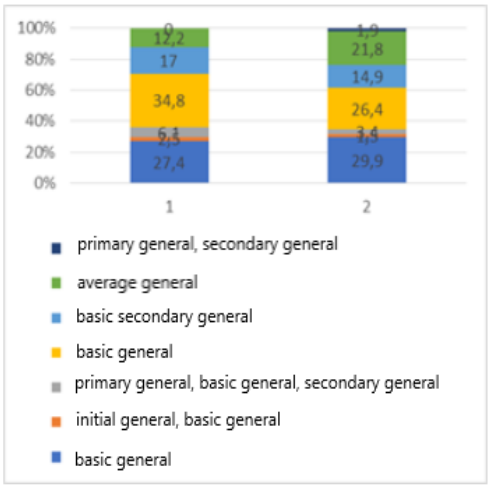

Figure 2: Distribution of participants in the diagnostics of the development of digital competencies of teachers by the levels of general education at which they conduct classes, %.

Out of the surveyed teachers, 35.1% had been teaching for over 20 years, while 17.2% had 5 to 10 years of experience, 16.9% of the surveyed teachers had experience in teaching for less than 3 years. Accordingly, from 10 to 15 years - 12.9%, from 15 to 20 years - 10.2%, from 3 to 5 years - 7.7%.

The distribution of participants in the diagnostics of the formation of digital competencies of teachers by the level of education of the teacher of the general education organization is presented in Fig. 3.

Availability of a qualification teachers category which complements the characteristics of the level of professional knowledge and skills for the position held: 20.1% of teachers have the highest qualification category; 13.2% - the first qualification category; 66.0% of teachers noted the absence of a qualification category.

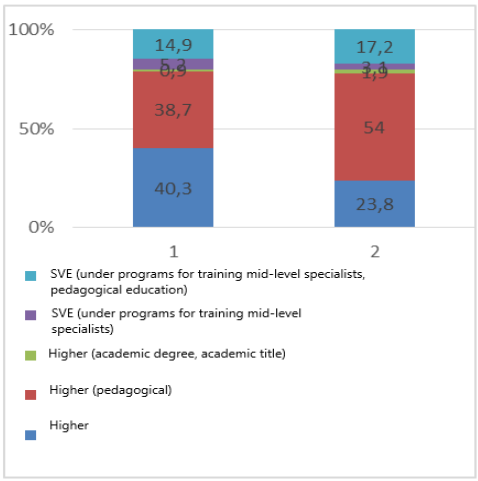

Figure 3: Results of diagnostics of teachers by level of education, %.

In Table 3 presents the deficit levels of development the digital competencies of teachers education organizations in the primary and secondary testing.

Table 3: Deficient levels of formation of digital competencies of teachers.

Test option	Number of teachers, %		
	deficit level		
	first (from 11 to 16 points)	second (from 6 to 10 points)	third (from 0 to 5 points)
Primary	4,3	41,4	54,3
Secondary	11,1	39,2	49,7

The majority of participants, 41.4% and 54.3%, achieved the second and third levels of digital competence development after the initial testing. Following independent work with methodological recommendations in the digital educational environment, re-testing showed improved results in all aspects of digital competence. More teachers achieved the first level, showing that they have

enough digital skills to complete tasks of all levels of difficulty, including designing game mechanics using computer role-playing games (PRG).

4 RESULTS AND DISCUSSION

Overall, the repeated testing showed that over 11% of teachers had a high level of digital competencies, less than 50% had significant deficiencies, and less than 40% had an average deficit level. The dynamics of the results of the primary and secondary testing of teachers is positive. To determine the average deficit levels of digital competencies among general education teachers, various factors were mathematically analyzed using a weighted average formula.

- primary testing - 2.5;
- secondary testing - 2.3.

$$\overline{x} = \frac{\sum_{i=1}^{n} h_i \times x_i}{\sum_{i=1}^{n} h_i},$$

where hi - is the number of teachers with the i-th level of digital competencies,

xi - is the level of digital competencies, i = 1,...,3.

The best result is closer to 1, the worst result is closer to 3

Since the teacher's independent work with methodological recommendations in the digital educational environment of a school didn't yield good results (Level 1 - 5.6%, Level 2 - 43.5%, Level 3 - 50.9%), it's suggested to enhance the training programs for teachers.

When designing game mechanics for computer role-playing games (RPGs), it is recommended to follow this algorithm of teacher actions.

1. Preparatory stage. To solve the problem, we need to define it and choose a relevant subject area. Then, we can align the problem with educational activities and select content suitable for the students' goals and age. Next, we determine the conditions for using computer role-playing games (RPG) and select game mechanics.

2. Corrective stage. Analysis of game mechanics for its compliance with the requirements of pedagogical technologies (goals, results); game technologies (availability of roles, tasks, system of rules); analysis of roles and rules of the game; determination of criteria for the effectiveness of game mechanics based on tasks, content of educational work in the subject area, target guidelines corresponding to the age categories of students (Mazelis, 2013).

3. Practical stage. Discussion of the rules of the game; distribution of roles among the students; explanation of the content of roles, any game processes. Implementation of game mechanics based on computer role-playing games (RPG), directed at motivating students' actions, monitoring game processes, as well as interaction of students in a game situation (Squire, 2006).

4. Reflective stage. Analysis of the achievement of the goals and objectives of realization of game mechanics according to the criteria of their effectiveness. Valuation of the motivation of students' activities; analysis of the degree of implementation of educational results by students; estimate of the actions of students in the process of a game situation. Assessment of the teacher's own actions in the process of implementing game technology; evaluate of the effectiveness of game technology for solving problems and implementing the content of the subject area; formulation of proposals for amendments to the game technology (Loginov, Shikov, 2017).

It is recommended to use indirect pedagogical management, make general comments. At the end of game training, direct indications of mistakes made, analysis of mistakes and optimal solutions are also possible.

5 CONCLUSIONS

The game mechanics and it's used in the educational space - interactive and gaming - is a significant area:

- game mechanics for educational purposes can improve: the motivation and enthusiasm of students for the educational material, increase the level of involvement, improve the understanding and memorization of educational material;
- game mechanics direct at developing the skills of cooperation, logical thinking, and decision-making, which are important for the academic success and social activities of students;
- game mechanics direct at emotional involvement and social (inter-user) interaction of students during the game, competition with other users for a place in the game. Game mechanics imply measurable feedback in the real world;
- game mechanics in the learning process contribute to the formation and development of a worldview, new communications in students, the acquisition of new knowledge and skills in topic;

- game mechanics in the game are the primary tools for interacting with objects within the established restrictions.

Thus, it is advisable to:

1. Optimize the educational process in a general education organization through the use of game mechanics based on computer role-playing games (RPG) to implement the tasks and content of educational activities in subject areas.

2. Updating the game mechanics available in the educational practice of basic general education, whereas the age capabilities of students in order to implement educational, upbringing, social, and developmental functions.

3. Expand the pedagogical toolkit of teachers of basic general education to solve the problems of educational programs.

4. Raise the status of game mechanics based on computer role-playing games (RPG) in educational work with students of basic general education.

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