Capabilities of digital gamification resources to form the basis of information security

S V Zenkina¹, M S Ivshin², G A Kobeleva³,⁴, E A Mikhlyakova⁵,⁶ and V N Omelin⁷

¹ Academy of Public Administration, Mytishchi, Russia
² Law Institute, Vyatka State University, Kirov, Russia
³ Institute of education development of the Kirov region, Kirov, Russia
⁴ Department of Education Management, Kirov Regional State Educational Autonomous Institution of Continuing Professional Education, Kirov, Russia
⁵ Vyatka State University, Kirov, Russia
⁶ Secondary school with in-depth study of individual subjects of Stulovo, Kirov, Russia
⁷ Department of Criminal Law, Criminal Procedure law and national Security, Vyatka State University, Kirov, Russia

E-mail: svkrotkrotova@yandex.ru

Abstract. The research problem is determined from the need to implement the didactic capabilities of gamification tools to support the study of various aspects of information security and information protection. The study purpose is to identify opportunities for the effective use of digital gamification resources to form learners’ information security competencies that will allow to successfully socialize in a modern digital society in the future. The work methodology includes an analysis of the literature of foreign and domestic authors on the use of gamification resources in cognition, training; the method of systematization and generalization of facts about the problems of individual information security, the concepts of the formation of special digital literacy in the space of new software tools and devices. The potential of digital technologies regarding the development of free orientation skills in the modern information environment, the organization of search activities, the use of various cognition strategies is explored. The revealed opportunities are shown on the example of the organization of information interaction of the didactic process participants in the ClassCraft gaming environment. The conclusion summarizes the possibilities for the effective use of digital gamification resources for solving cognitive, communicative and organizational tasks in compliance with information security standards.

1. Introduction
The educational technologies in the framework of the project “Modern Digital Educational Environment” are undergoing significant changes. The student is involved in information interaction, manipulation and practice-transforming activities with virtual objects from a computer network. A graduate must use the services and digital resources of the Internet information and communication network in his professional activities, observing the requirements and standards of information security culture. So, on the one hand, ensuring the information security of an individual, protecting infrastructure and the results of intellectual activity is becoming an urgent and necessary part of a teacher’s work in a digital school.
At the same time, the new requirements of society, the state and the educational system, which are expressed in relevant standards, indicate that the educational process should focus more on the personality of the student and the changes that occur with him during the training, and not just on the accumulation of the knowledge system. Studies appear, for example, A. D. Ursul, T. A. Ursul [1], in which it is proposed to reorient the informatization of education towards solving the fundamental task of individualizing the educational process [2]. To achieve this, computer games and online gamified services began to be included in the training system, as shown by N. G. Maloshonok [3]. Analyzing various definitions of gamification in international literature, in the works of E. V. Soboleva, A. N. Sokolova, N. I. Isupova, T. N. Suvorova [4], J. Marti-Parreno, E. Mendez-Ibanez, A. Alonso-Arroyo [5], we notice significant agreement among participants who consider gamification to be an approach that uses game functions (elements, mechanics, frames, aesthetics, thinking, metaphors) in non-game situations. The term gamification is used in relation to many aspects - the ubiquity of computer games and video games in everyday life; the need to excite and maintain students' interest in learning to attract users and encourage them to achieve more ambitious goals, compliance with rules and entertainment [6]. The elements of gamification are actively used to acquire skills for solving practical problems, create conditions for the development of independence in cognition when working with information, enhance relationships in the network, expand research tools, improve the decision-making process and provide immediate feedback [7].

Digital gamification resources have a didactic potential for the emotional involvement of students in organizing the process of forming an information culture of a person. At the same time, prerequisites are created for the development of motivation to study the theoretical and legal aspects of information security, to increase the importance of self-study, the development of self-regulation and the activation of cognitive actions, and the understanding of responsibility for health and life in general. Such digital resources include: Scratch, KoduGame Lab, ClassCraft, video editors, animation tools, etc. Thus, digital technologies in a modern educational environment integrate powerful distributed didactic resources, they can provide an environment for the formation and manifestation of key competencies, which include primarily informational and communicative ones [6]. In addition, the tools of these technologies open up fundamentally new methodological approaches in the formation of a human safety culture.

The purpose of the work is to identify opportunities for the effective use of digital gamification resources for the formation of students' competencies in the field of information security. Research hypothesis is that the use of digital gamification resources will increase the level of information culture of the individual as a whole.

2. Materials and methods
When identifying the possibilities of digital gamification resources to form the foundations of information security, we used the method of analysis of gaming platforms, educational services for the gamification of the educational process in the context of the requirements of the state, society, and the personality of the learner. The study of the role of ICT tools in the formation of an informational culture of a person, digital literacy during training was carried out using the method of analysis of specific developments of subject teachers. Various applications of these digital resources for organizing information interaction are presented in Ch. Dichev, D. Dicheva [8], E. V. Soboleva [6], B. Pennington, J. McComas [9]. Researchers, for example, N. I. Isupova, T. N. Suvorova [10] highlight the need for special digital literacy to ensure personal information security in the space of new technologies, tools and devices.

The method of systematization and generalization of facts and concepts made it possible to formulate key ideas for the gamification of learning in the formation of the basics of information security, and to offer specific recommendations. The ideas of the technique, practical methods and techniques for gamification of information interaction in a virtual environment were experimentally tested [11]. As a digital resource for gamification, the ClassCraft gaming platform was used. The main purpose of ClassCraft is to increase motivation, as well as to create a positive environment for information interaction. ClassCraft has a point reward and punishment system. XP are experience points that a
student can earn for completing assignments in a lesson. With the help of HP - health points - the behavior in the lesson is regulated. This is a kind of punishment system, and health points are deducted for non-compliance with the rules. AP are action points. They are needed to use the capabilities of the character. Each time a student decides to use a character’s abilities, AP are deducted. Some characters can use their abilities to replenish action points. The teacher can also adjust these values. It is worth noting that there is such a type of points as GP – gold points. With their help, participants can upgrade their character. Some default parameters are already set in the game, but the teacher can change these values, delete or add new ones if necessary. By default, for example, 75 XP can be obtained for helping a friend in the class. The Game Master can change this value to 50 XP, either change the wording to “help two friends in the class”, or completely remove this condition. If students lose all of their HP and their teammates cannot protect them, they will “fall in battle”. When this happens, the student receives a punishment that must be completed. Punishment will appear in the book of mourning.

An important role in the gaming platform is assigned to the characters. There are three types of characters: Magicians, Warriors, and Healers. They differ not only in external characteristics, but also have different abilities, as well as specified parameters of health and actions points (HP and AP). Students independently choose one of the characters, after which the teacher generates commands. Abilities are usually divided by PP levels (indicated by a hand symbol). For example, the powers in the first row of the character’s power tree are evaluated at one PP each, and the powers in the second row are two PP each; accordingly, the powers on the third row are three PP each. Conventionally, all the abilities of heroes are divided into three levels (BasicPower, IntermediatePower, AdvancedPower). The higher the PP level, the more benefits a character has. With the opening of a new level, it becomes possible to add additional abilities. When a student register in ClassCraft, he has access to first-level abilities. Also, in ClassCraft there are two options available in a free subscription, these are random events and the wheel of fortune. A random event acts as an additional motivation for the student. The wheel of fortune allows you to randomly select one student or one of the teams. The teacher can use this function during a survey, to assign homework and also for the distribution of players in teams. Interaction in the information environment is carried out using messages. The Game Master (teacher) performs several functions in the game: changes the character’s abilities; accrues and takes points; distributes students to teams; controls the game process (uses various functions, creates quests); submits assignments through interactive forums.

3. Results

The topic "Internet Security" was chosen for the gamification of training and the application of ClassCraft features, since digital literacy is an important multidisciplinary skill of the present and future. As you may remember, the purpose of information security is to prevent the influence of adverse events (threats) or to ensure minimal damage from them in the information environment [6].

Four notes have been developed for the pedagogical support of studying the cycle of lessons. The initial parameters of the heroes were left unchanged. A warrior has HP = 80 and AP = 30 at the beginning of the game, Magicians have HP = 30, AP = 50 and Healers have HP = 50, AP = 35. As an additional motivation, students have an opportunity to get an “excellent” mark if they score a sufficient number of points during the lesson, that is, they will complete all the tasks of the Game Master. In addition, measures to regulate classroom behavior with Health Points (HP) were devised.

It was decided to allocate three lessons to study new material and one lesson to consolidate and summarize. Therefore, at least four random events are necessary. Possible examples: Virus (someone picked up a very infectious virus and 5HP is deducted from all team players); First-aid kit (your team has a good day and gets + 5 HP); Living water (it will add strength and energy to you and the team gets + 10 AP); Halt (the team needs to rest and the effect is +10 HP); Spell (the player was bewitched, the evil magician took almost all his strength from him - find out who this is and get extra points).

Lesson 1, “Information Security. Threats on the Internet”. The purpose is to ensure the information security of students by instilling in them the skills of responsible and safe behavior in a modern information and telecommunication environment.
The logic of the lesson. By the beginning of the first lesson, students must register on the platform and select a hero. Thus, depending on the chosen role, each participant receives certain health points and abilities. At the same time, experience points at the initial stage of a series of lessons for all are 50XP. At the stage of actualization, the teacher familiarizes with the system of points that students can both earn and lose. Further in the process of the survey, students learn to send messages to the teacher and earn experience points. The study of new material occurs in the form of a frontal conversation with a simultaneous demonstration of an electronic educational resource. An important moment of the lesson is the division of participants into groups, the “wheel of fortune” tool can help the teacher. A random event creates a game moment, which can lead to the fact that students will earn or lose points of health, experience, abilities. The practical part of the lesson is carried out in the form of group work, its results are outlined in a text document, which is sent through a message for verification to the mentor. Each team member receives up to 50 XP for completing assignments. During the reflection, students repeat the content of the lesson, summarize the activities in the ClassCraft environment, which is an important motivational component of training. When setting homework, the teacher focuses on the distribution of points for solving problems. Thus, in the process of the first lesson, students can gain up to 160 XP. It is experience points that reflect the dynamics of the formation of competence.

Lesson 2. “Protection of personal data. Security on social networks”. The purpose is to ensure the protection of personal data and information security of students in social networks by instilling in them the skills of network communication and safe behavior in a modern information and telecommunication environment.

The logic of the lesson. It is advisable to start the lesson with an update organized using the Wheel of Fortune option to be included in the work. Each participant receives up to 2 XP for answers to the questions of the Game Master. Completing each homework also entails a change in XP value. Points are awarded separately for timeliness and accuracy. Therefore, the Game Master should note those who sent the decision in the message (+ 5XP) at the beginning of the lesson. The teacher evaluates the solution after the lesson (up to 10XP). The study of new material takes place in the form of a frontal conversation, during which students are asked questions. Participants receive additional experience points (up to +10 XP) for active work. Practical work begins with a random event, which, as already noted, affects the change in the number of points. After that, students analyze the state of their hero’s system of points and determine the possibility of using one or another ability. After that, the Game Master offers to undergo testing (+ 16XP), which form of organization is determined by the teacher. The next task involves working in a text editor, you need to fill in the gaps in the table (+12 XP). The task is performed in electronic form and is sent in a message to the Game Master. The pace of completing the tasks for each student is individual, so it will be useful to provide an additional task (up to 10 XP). At the stage of summing up the lessons, a generalization of what has been studied takes place. After that, the teacher formulates homework, clarifies the content, requirements and notes the value of its implementation. Thus, only for the second lesson, players can score up to 115 XP. The teacher should once again draw attention to the fact that it is experience points that affect the final grade.

Lesson 3. “Computer viruses”. The purpose is to introduce students to the types of viruses, methods of infection with viruses, and the basic methods of combating them.

The logic of the lesson. Since it was proposed to prepare a report on the topic of this lesson as homework, points for completion will be awarded during the study of new material. In order to update the material, the Game Master conducts a frontal survey (it is possible to use the Wheel of Fortune option). Players receive additional experience points for active work. The study of new material occurs in two stages, the first of which is a frontal conversation with the message of new concepts and methods of action. This part of the lesson can replenish the box of experience points for each participant (up to 10 XP). The second stage is devoted to the presentation of reports prepared by students. At the discretion of the teacher, the introductory section on the comparison of viruses, worms and trojans can also be submitted as a separate topic of the report. It is logical to start studying the examples of viruses from the very first computer infection in history. To continue the work, the Game Master uses the Random Event tool, after which students are invited to answer questions through messages in ClassCraft. The further
order of performance is determined through the Wheel of Fortune. Since the preparation of the report includes the development of a wide range of competencies, the value of this type of activity increases many times. That is why a participant can get up to 150 XP per performance. In the requirements for the report, speaking time is limited to four minutes. However, it is not always possible to meet the allotted time limit. Therefore, further development of the lesson can go in two ways. If there is enough time, students are encouraged to think about the issue of how to protect themselves from viruses, and prepare rules or tips for users (+15XP). Otherwise, this task is set as homework. The memo must be issued in a notebook. Since the main content of the studied topic has been fully covered, players are invited to get additional experience points for preparing an essay (+90 XP). Themes can be offered by the participants themselves or by the Game Master. Thus, in the third lesson, students can get up to 200 XP.

Lesson 4. “Security on the Internet”. The purpose is to generalize and expand knowledge on the topic “Security on the Internet” obtained in the course of computer science.

The logic of the lesson. It was proposed to write an abstract as a homework, so points for completing this assignment will be awarded after verification. In order to update the material, the Game Master asks problematic question and proceeds to present new material. It is advisable to use an electronic resource. The stage of systematization and generalization is carried out in one of the popular game formats. The choice of a specific form remains with the mentor (for example, “Own game”, “What? Where? When?”, “Brain ring”, etc.). At the end of the quiz, the teacher analyzes the state of the points table that the players have scored to date. Those students who gain more than 600 XP are exempted from the verification test. Control is carried out in the form of a test, for which they can score up to 45 XP. The number of points earned is added to the XP value. The final grade is set based on the following criteria: ≥ 600 - “excellent”, ≥ 500 - “good”, ≥ 400 - “satisfactory”.

4. Conclusion
To summarize, it is important not only to teach students objective analysis and assessment of the information received by them, taking into account the threats that it may contain. In our opinion, one of the most important aspects of communication and interaction in a modern digital society is the formation of students’ skills to ensure information security, integration into the social structure.

As practice shows, working with gaming resources based on the principles of gamification creates additional conditions for the formation of skills and abilities of safe and appropriate behavior when working with computer programs on the Internet, studying the norms of information ethics and law. The implemented information interaction in the gaming virtual space should be aimed at developing students’ competencies in the field of using information and communication technologies at the general user level, including knowledge of the basics of information security, the ability to safely use ICT and the Internet. Using the system of game characters and their abilities allows students to prepare for risk assessment and decision making in non-standard situations. Messaging with the Game Master, team members develop the ability to communicate verbally and in writing form in Russian and foreign languages for interpersonal and intercultural interaction. During the implementation of game tasks, students master methods, techniques and technologies for solving future professional problems. The content of the game world supports the acquisition of fundamental theoretical, natural, scientific and mathematical knowledge.

The described didactic capabilities of the resource will help to increase the effectiveness of training only if the teacher has a well-considered, well-developed methodological system of the course. The content of a specific discipline should be correctly selected and methodological support should be developed in the form of lecture materials (tests, presentations or video lectures), laboratory work, a set of practical, control tasks and tasks for independent work.

The formulated recommendations take into account the didactic potential of new generation digital resources, such as: expanding educational content; support for individualization of learning; enrichment of cognitive activity types; arming with new tools for cognitive activity and engagement; changes in the directions and intensity of the interaction vectors of the participants in the educational process. The results can be used in the scientific and methodological plan for the implementation of the Digital School.
project in the educational system, the development of didactic traditions in the field of the formation of an information culture of a person.

References
[1] Ursul A D and Ursul T A 2015 Education for Sustainable Development: The First Results, Problems and Prospects J. Sociodynamics 1 11-74
[2] Zenkina S V and Sharonova O V 2018 Individualization of learning in a personal educational environment based on information technologies J. Scientific Notes of IME RAE 1(65) 56-61
[3] Maloshonok N G 2016 How Using the Internet and Multimedia Technology in the Learning Process Correlates with Student Engagement J. Voprosy Obrazovaniya 4 59-83
[4] Soboleva E V, Sokolova A N, Isupova N I and Suvorova T N 2017 Use of training programs based on gaming platforms for improving the effectiveness of education J. Nov. State Ped. University Bulletin 7(4) 7-25
[5] Marti-Parreno J, Mendez-Ibanez E and Alonso-Arroyo A 2016 The use of gamification in education: a bibliometric and text mining analysis J. of Comp. Assisted Learning 32(6) 663-76
[6] Soboleva E V 2019 Characteristic features of designing digital learning environments based on gaming technology J. Science for Edu. Today 9(4) 107-23
[7] Soboleva E V, Karavaev N L and Perevozchikova M S 2017 Improving the content of teacher training for the development and use of computer games in education J. Nov. State Ped. Univers Bulletin 6 54-70
[8] Dichev Ch and Dicheva D 2017 Gamifying education: what is known, what is believed and what remains uncertain: a critical review Intern J. of Edu. Techn. in Higher Ed. 14(1) 9
[9] Pennington B and McComas J 2016 Effects of the good behavior game across classroom contexts J. of Applied Behavior Analysis 50(1) 176-80
[10] Isupova N I and Suvorova T N 2019 Gamification of the educational process using the “flipped classroom” technology J. Perspectives of Sci. and Edu. 41(5) 412-27
[11] Suvorova T N 2018 Gamification of the educational process as a phenomenon in the field of modern education J. Inform. of Continuing Edu. 391-5