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## **Formation of Critical Thinking of Future Teachers While Designing Quest Rooms for Didactic Purposes**

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### **Abstract**

The actual problem of higher education is the search for effective forms of education. Such forms have didactic potential for intellectual development (systemic, critical and foresight thinking) along with creativity, teamwork in the training of future specialists. This study aims to explore how engaging next-generation teachers in the creation of inquiry spaces influences the formation of their critical thinking abilities.

An analysis of scientific papers on the problem of learning gamification, the use of digital resources for the formation of critical thinking was used to obtain theoretical generalizations. The escape room is designed using interactive technologies.

Research results. The manifestation of critical thinking perception becomes apparent in the context of equipping specialists for the digital economy. Quest rooms is described as a tool with large educational potential for the formation of critical thinking. In their work, the authors provide a clear definition as well as a comprehensive overview of the principles and mentor guidance for students actively participating in designing quest rooms to achieve didactic outcomes.

In conclusion, student participation in the development of educational escape rooms will enhance the opportunities for fostering critical thinking skills as a universal competence in the preparing specialists in demand by the digital economy.

**Keywords:** quest technology, digital school mentor, university challenges, information and analytical activities, educational space, digital resource.

### **1. Introduction**

1. As part of the UNESCO World Conference 2022, an official report on science was presented. It is published every five years. Its motto is "The Race Against Time for Smarter Development". It reflects the vector of global transformations identified by the UN in

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17 sustainable development goals until 2030. A roadmap, which describes the principles, goals and objectives of higher education around the world, was also adopted. According to the roadmap, universities have a certain social duty. The authors formulated six principles for the higher education system. They are: inclusiveness, equality and diversity; academic freedom and participation of all stakeholders; development of critical thinking and creativity, etc. Like any other, the technology for developing critical thinking has its own principles of construction, which are based on specific types of human mental activity (Vzglyad YUNESKO na..., 2023).

The reports, devoted to the need to develop critical thinking so that the user can understand the information flow from the Internet; could protect himself from fake news, were also made at the XXV St. Petersburg International Economic Forum (Itogi Peterburgskogo..., 2022). So, on the one hand, critical thinking is becoming a very important learning outcome for university students.

2. A.V. Dmitrieva, A.N. Malakhov point out that the project of an educational program must begin with an in-depth study of the labor market. Designing educational programs in higher education is a complex process that requires compliance with certain standards (Dmitrieva, Malakhov, 2017). But in this process, there is always a place for creativity: communication with experts in different fields, creating individual trajectories that not only make the student sought after in the labor market, but also cultivate an interesting, harmonious personality.

According to those interviewed by E.V. Moskalenko, for the introduction of new educational standards, for the formation of a truly new school, a future teacher preparation can be greatly enhanced by implementing a competency-based approach, leading to high effectiveness. (Moskalenko, 2022).

We can conclude that an integral factor in the development of the formation of a digital society is the widespread introduction of information technologies.

3. An educational quest is a pedagogical technology that includes a set of problem tasks with elements of a role-playing game (Isupova, Suvorova, 2018).

According to E.M. Bonsignore, the problem of preserving and developing the educational motivation of schoolchildren is now the most pressing. Nowadays, it is difficult for teachers to find the right approach to children, because “nothing will surprise them,” and it is difficult to interest and motivate them. This problem is solved to some extent by the use of “web quest” technology, which takes into account the active use of computer technologies by schoolchildren in everyday life (Bonsignore, 2016).

The mentor of a modern school is supposed to be a responsible and active member of society. Therefore, he is expected to achieve personal values through certain professional practices. These practices also include the use of interactive services and digital applications. Further, the teacher, when building a professional career, will be able to imitate those teaching technologies that he “tested on himself”. According to E.V. Soboleva et al., the acting mentors need (Soboleva et al., 2022):

- game forms and teaching methods;
- e-learning resources that will enable them to develop scientifically based objectives, content and tools for digital learning assessment;
- information interaction services, in the space of which you can prepare highly qualified professionals, who will also be full citizens in a complex and interconnected world;
- the means of defining objectives, designing their own educational trajectory and jointly solving complex problems that can be used by students.

However, as N.N. Vekua, A.A. Lubsky, M.S. Perevozchikova, Yu.N. Folgerova persuasively show, the main problem for the design and implementation of a didactic quest room is changing the usual stereotypes of lesson organization. Thanks to the use of technology, students have the opportunity to independently select and structure material, analyze the information received, and learn to make independent decisions in choosing topics and presenting them for discussion in class. In the space of a quest lesson, students comprehend the elements of scientific and practical work (Vekua et al., 2020). At the same time, students, in the process of working on such a quest project, comprehend real processes and experience specific situations.

So, on the one hand, higher education teachers tend to actively use web quests as a game form of learning to form students' professional competencies.

At the same time, students of pedagogical specialties need additional experience in developing didactic quests to work in a digital school. Experience in additional research activities is

required to enable them to learn to filter information, focusing on the material necessary to find the right solution, and discarding irrelevant details.

The hypothesis of the study is that the design of quest rooms for didactic purposes will help to increase the level of critical thinking among future teachers if the principles of the “quest” technology and the specifics of the work of graduates are taken into account.

### **1.2. Purpose and objectives of the study**

The purpose of the work is determined by the need to study the influence of the participation of future teachers in the design of quest rooms on the level of formation of their critical thinking.

Research objectives:

- to specify the features of designing educational “quest rooms” for the acquisition of in-demand advanced professional skills by future teachers;
- to expand the range of requirements for the development of critical thinking of graduates in the field of preparation “Pedagogical Education”, taking into account the highlighted features;
- propose content for the stages of work of future teachers in designing a quest room;
- check the effectiveness of the proposed option for additional work during the experiment.

## **2. Relevance**

### **2.1. Literature review**

#### **2.1.1. Analysis of Russian scientific and pedagogical literature**

According to S. N. Mironenko, L. P. Tikhonova, N. P. Sirotina, a low level of critical thinking can lead to unpredictable and even tragic consequences associated with harm to health, financial well-being, and impact on relationships (Mironenko i dr., 2020). In the summer of 2022, a Decree of the Government of the Russian Federation was signed on the launch of a unified information portal “My School”. It will contain information about students, their parents and teachers of all Russian educational institutions (Federal'naya gosudarstvennaya..., 2023).

To implement technologies as smoothly as possible and to avoid general panic, it is necessary to be prepared for changes at the state level. E. Ya. Varshavskaya, E. S. Kotyrlo consider the main employment trends of the future, comparing them with the current situation in the labor market and suggesting the necessary adjustments (Varshavskaya, Kotyrlo, 2019).

A.D. Korol, Yu.I. Vorotnitsky note that new methods and mechanisms for the formation of spirituality, ethics, morality, morality in a network society, the center of which is a person who is capable of limitlessly expanding knowledge, a set of connections, directions and methods of interaction, are acquiring fundamental importance (Korol, Vorotnitsky, 2022).

E.V. Soboleva, N.L. Karavaev, N.V. Shalaginova, M.S. Perevozchikova (Soboleva et al., 2018) indicate that, based on the presented skills of the future, the demand for university graduates as professionals largely depends on success in the areas of communications and interaction. Trends in recent years show that the expected future comes earlier, so today it is necessary to build self-development and development system in the digital society, focusing on key competencies.

I.A. Shcheglova, Yu.N. Koreshnikova, O.A. Parshina substantiate that students' involvement in class work, participation in scientific projects and extracurricular activities are positively related to the development of critical thinking skills (Shcheglova i dr., 2019).

The competency orientation of the educational process is highlighted by D. A. Aleksandrov, V.A. Ivanyushina, D.L. Simanovsky (Aleksandrov dr., 2017) along with its informatization and individualization aspects; they also underscore the need for diversified forms, methods, and technologies in teaching. This led to the accumulation of a large number of new didactic facts that have not yet received full scientific understanding.

The scientific realm is actively engaged in conducting diverse studies on how gamification tools can be utilized effectively in modern education, encompassing the establishment of a detailed model for gradually incorporating these tools into educational settings and pinpointing key aspects associated with the implementation of quests.

For example, K.V. Tarasova, E.A. Orel note that gamified learning, a multiplicative approach, and active use of the media space actively contribute to the development of people of generations Y and Z (Tarasova, Orel, 2022).

A. G. Sidenko exposes that the use of gamification technologies in the process of teaching high school students the specific topics in the school computer science course has not been sufficiently studied. At the same time, the use of this technology, as well as technologies associated

with the use and application of various gaming environments, can significantly increase the effectiveness of teaching computer science (Sidenko, 2020).

N.N. Askhadullina, I.A. Talysheva prove that the use of active teaching methods in educational processes presupposes a personal focus of interaction between subjects of the educational environment on the development of soft skills (Askhadullina, Talysheva, 2022). The design of the educational process of professional training of a future teacher must be built in accordance with the special principles noted above for the use of active teaching methods. The organization of pedagogical interaction based on these principles will in some cases be ensured by the use of game teaching methods. The advantage of using the “quest” method in teaching is the involvement of students in the educational process based on competition and passion. Students’ participation in quizzes helps them develop skills in collective search for the right solution and cognitive activity in the process of communication between team members and the development of leadership qualities.

N.I. Isupova, T.N. Suvorova demonstrated how some Internet gaming services can be used for research purposes (Isupova, Suvorova, 2018). The authors note that you need to start developing a quest by creating an interesting storyline – a story that will captivate users as they get to know it. E-learning should feel like an exciting journey. For example, you can imagine vocational training as a path to preventing a global catastrophe or solving a problem. Add characters to this story so that the person can improve their avatar.

Yu.N. Koreshnikova notes that if a teacher plans to develop critical thinking skills in students, then he should treat students not as recipients of information, but as active users (Koreshnikova, 2019). A learning environment in which students are actively involved in seeking information and applying what they have learned will help develop students’ critical thinking skills. One of the ways to organize such an environment, in her opinion, is project-based learning.

M.A. Tishina explores the didactic potential of mobile technologies for the development of the following skills: problem presentation; reframing complex problems through reduction and transformation; problem abstraction and decomposition; heuristic reasoning; planning (Tishina, 2020). She emphasizes such didactic properties of mobile technologies as interactivity, informativeness and metainformativeness, which allow using them to create problematic tasks that involve cooperation between students in their thinking.

N.N. Vekua, A.A. Lubsy, M.S. Perevozchikova, Yu.N. Folgerova observe that a crucial aspect of fostering critical thinking skills via a web-quest entails promoting the formation of thematic and interdisciplinary associations, enabling students to effectively construct and apply their knowledge across various contexts. To achieve this, the teacher provides links to Internet resources from different and sometimes opposing contexts (Vekua et al., 2020).

K.A. Kuzoro, M.M. Zhukova note that the quest may include tasks of various types: indicative, informational, creative, intellectual (Kuzoro, Zhukova, 2021). The choice of genre, materials and theme depends on the author of the quest, who thinks through what he wants to show and tell future players, what tasks and technologies he can use. According to the authors’ conclusions, web quests are gaining popularity. The most popular of them involve targeted search activities using Internet information resources to complete tasks and quest excursions – walking with elements of an adventure game.

### **2.1.2. Analysis of foreign studies**

As stated above, the problem of developing critical thinking skills is at the center of UNESCO’s attention. At the 1996 symposium in Bern, the Council of Europe defined five key competencies that modern school and university graduates should possess (Hutmacher, 1997). Among them are competencies due to the “increase in the informatization of society”, which presuppose the ability of students to think critically. D. Beer, M. Matthee indicate that in connection with the spread of false information through digital media platforms, it is extremely important for all people to have developed critical thinking skills (de Beer, Matthee, 2021). The authors perform a systematic review of the literature, highlighting the main approaches to identifying fake news; and how these approaches can be used in different situations. Some approaches are illustrated with an example as well as problems.

Trying to highlight the main features of critical thinking, Sh. Bailin et al. reach a conclusion that critical thinking is used so that a person can decide for himself what to believe or what to do (Bailin et al., 2010).

Ju. Surjanti, A. F. Prakoso, R. Y. Kurniawan et al. substantiate that modern education, the vector of development of which is established taking into account the direction of development of Russian society, has begun to experience the need for the formation of critical thinking in both students and teachers (Surjanti et al., 2022). The expansion of almost all areas of production and the introduction of increasingly innovative forms and methods requires the educational process to constantly develop and introduce the most effective techniques and approaches to training future specialists.

Critical thinking, according to the conclusions of M. Kubiato, K. Balatova, E. Sustekova et al., is necessary for future specialists to understand the content of academic disciplines and for effective professional activity (Kubiato et al., 2022). The purpose of their study is to identify the dependence of the development of critical thinking among university students on a set of factors. These factors include: gender, age, media use, media need, current information, current professional information, and online health information. As you can see, the effectiveness of using critical thinking skills depends not only on the level of their formation, but, presumably, is determined by subjective factors, namely, the development of multi-level properties of a person's individuality, which act as a necessary and sufficient condition that ensures the formation of universal competence – the ability to think critically.

M. Kubiato, K. Balatova, E. Sustekova et al. determine the factors for the critical thinking development. They are: gender, age, media use, need for media, up-to-date information, current professional information, and online health information.

M-T. Nagel et al. study the information activity of students in the Internet space (Nagel et al., 2020). For example, the duration and frequency of visits to individual web pages. The authors propose to further study in detail on which sections of the visited web pages the students lingered most of all, what actions they performed (for example, read the text or watched the photo/video).

In their research, O.L. Liu, L. Frankel, K. Roohr identify a set of skills that characterize critical thinking and contribute to the construction of independent judgments: analysis, evaluation, interpretation, explanation, logical conclusion, self-regulation. Thus, scientists are confident that to achieve a goal, critical thinking skills will help select methods for effectively working with information depending on the situation. Using the necessary skills will lead to truthful judgments and productive solutions to life or professional problems (Liu, Frankel, Roohr, 2014).

S. Woodcock and co-authors note that in modern conditions, in order to meet the constantly changing requirements for professionalism, teachers need to constantly improve their level of skill, engage in self-education, and look for new teaching methods (Woodcock et al., 2023). In order to meet modern requirements, teachers need to constantly improve their level of professional competence, engage in self-education, and look for new teaching methods.

U. Khan focus lies in examining how a person-centered approach affects the advancement of critical thinking (Khan, 2020). The author points out that with this approach teaching is required to think analytically, because appropriate thinking involves the use of facts and information. Every professional needs to develop critical thinking in order to:

- objectively evaluate the information received;
- determine what information is important and what is not;
- identify problems and determine opportunities to resolve them;
- consider situations and events from different points of view in order to formulate alternative goals;
- use reasoned arguments when making decisions.

According to A. Rubin-Vaughan et al., the actual way to attain the objectives of modern education is to use the “quest” technology (Rubin-Vaughan et al., 2011). The popularity of technology is growing every day. Since in the space of quests, participants learn to consider fundamentally, solve complex problems, weigh alternative opinions, make thoughtful decisions on their own, and take charge for their implementation in a form of a game.

The Canadian school CanadaZoom.School has launched an online project to increase digital competence and develop the creative potential of teachers and students (Canada Zoom School, 2023). As part of the project, teachers, methodologists, and employees of educational organizations can take part in the international quest competition “Web-Quest”.

M. Chang and his colleagues specify an educational quest as a complex task, this necessitates the development of various standards for its assessment. The emphasis is placed on the specific type of task problem and the form of the result presentation. The teacher uses the same criteria (Chang et al., 2019).

S. Jarmak, and co-authors indicate that quests contain an element of competition, as well as the effect of surprise (unexpected meeting, mystery, atmosphere, scenery) (Jarmak et al., 2020).

L. Amali, N. Kadir, M. Latief list selections for designing quests: using the project method, competitions (Amali et al., 2019). The plot of the quest helps students decide how they can learn techniques for relieving psycho-emotional stress, self-regulation, increasing self-esteem, and coping with this or that life situation. A quest is a game situation in which not only erudition is involved, but also ingenuity, creativity and innovative thinking, the development of a sense of responsibility, trust in a partner, and the promotion of life-affirming principles.

Z. Zainuddin and co-authors mark that the most popular are interactive forms that can exist as separate elements, or can be combined with each other (Zainuddin et al., 2020).

The described situation in educational practice, of course, does not satisfy the challenges of the digital society and the didactic resources of web-quests.

### **3. Materials and methods**

#### **3.1. Theoretical and empirical methods**

Software options for learning gamification and specific applications for creating quests were analyzed: Quest-maker, Urban Quest, PowerPoint, Joyteka.com, Surprise me, Genially, QuizWhizzer, Seppo, audio tours, etc. Materials of the All-Russian Quest Competition "In Search of Knowledge" and the Canadian schools CanadaZoom.School.

The basis of the educational quest is a problem task with elements of a role-playing game.

Criteria for comparing digital resources for developing web-quests:

- how the learning process using this product works, starting from the moment of user registration and beyond;

- what you need to start using this product;

- what technical requirements do these solutions impose;

- what is missing in this resource so that it can fully ensure the learning process in the quest format;

- cost of the solution.

To develop critical thinking among students, the efficacy of involving them in the design of quest rooms was examined through empirical methods like observation, testing, analysis of gaming applications, and evaluation of their performance.

In order to assess the extent of critical thinking skills, the authors' test materials were utilized. Questions for measurement before the experiment, as in the case after, were designed taking into account Bloom's classification (Bloom, 1956). At each level, certain algorithms of operations of mental activity are mastered: operations of comparison, analysis, synthesis, concretization and abstraction, formation of concepts, construction of judgments and conclusions, classification, generalization, systematization. Based on this provision, 5 types of questions were formulated (each type was incorporated twice for enhanced control accuracy): to search for the main information (task 1); to work with sets of objects (task 2); to evaluate information (task 3); to eliminate redundant information (task 4); to modify the object (task 5).

To fulfill the rules of probabilistic selection of subjects, the same teacher used digital technology to design quest rooms during the experiment.

Activities for designing quest rooms were carried out using the interactive capabilities of the Power Point presentation development tool. Since the development program is only a tool for gamification, it was decided not to use a complex technical solution. Any quest can be presented with high quality even in a simple Power Point presentation. The main thing is to choose a beautiful and eye-catching template.

Other advantages of this component of the Microsoft office application suite: wide functionality, versatility and widespread use. One can place virtually any type of digital object on each slide of the project. At the same time, creating them directly in the program or importing them from other software. Special attention is paid to such tools as animation, audio and video effects, triggers, and hyperlinks.

The study involved 54 students of the Vyatka State University of the training program 44.03.01 Pedagogical education (bachelor's degree level). The mean age for the respondents was calculated at 18 years old, with slightly more than half being girls (52 %) and almost half being boys (48 %).

Applications for creating quest rooms for didactic purposes are studied in the sections of the disciplines “Modern information technologies”, “Technologies of social and professional interaction”, and are used in the course of introductory educational practice.

In order to analyze the modifications within the pedagogical system, the Pearsons chi-square coefficient –  $\chi^2$  is applied during the stage of statistical processing.

### **3.2. The base of research**

The experiments central focus revolved around examining whether involving students in the design process of didactic quest rooms enhances their development of critical thinking, a crucial skill for well-trained instructors.

54 students of the Vyatka State University were involved in the direction of Pedagogical Education (bachelor's degree level). All respondents are first-year students.

In the “Modern Information Technologies” classes, there was a practical use of a digital service for designing a quest room for didactic purposes.

Before and after the experiment, a measurement of the level of formation of critical thinking of students of pedagogical specialties was carried out, according to the ideas described in p.p. 4.3.1.

The content definitions for the test assignments and questions were made by the authors according to the norms of the current standards of higher education.

### **3.3. Stages of research**

At the first stage of the study the problematic issues of gamification, the complexity of using quest technology for studying at a university, were revised. In addition, 20 questions for the control testing of the work were compiled. The examples are presented in p.p. 4.3.1.

A set of 10 tasks was presented in both versions of the test, each task being assigned a value of 2 points. The key to processing and interpreting the results: high level – if a student of a pedagogical specialty scored more than 18 points; average level – if a future teacher scores from 9 to 17 points (inclusive); low level – if a participant scores less than 8 points.

Thus, it was possible to collect data on 54 students of the pedagogical specialty. They create both experimental and control groups. Each has 27 people. The sample was not random. The proportion of females in the experimental group was 52 %, while males accounted for 48 %.

The second stage of the experiment was devoted to determining the structure of the course. As part of the stage, the interactive capabilities of the digital application are explored. The base for the development of quest rooms for didactic purposes in this study is the concept of triggers.

At the third stage, the positive aspects of using quest rooms for the critical thinking growth of teachers are highlighted (for example, to gain experience in formulating a problem taking into account the uncertainty of the future, students analyze the educational space of the school, determine the development of the plot for different conditions, etc.). Options for putting into practice of the research results are proposed.

## **4. Results**

### **4.1. Key concepts of designing didactic games**

The game mechanic in the quest room is a set of rules and procedures that guide the actions of the characters. For example, the “Random event” mechanic: the characters start to act, and the events in the quest occur when a particular door opens, a window or a book on a shelf opens.

The game mechanics in the proposed study assume that the student is active and independent in cognition. In addition, the game characters appear according to the development of the plot.

The number of characters, their character, and didactic purpose are determined by the future teacher based on the needs of the quest space.

For example, after turning the key, a door may open to a new room, to a new dimension, or it may turn out to be a “false” move.

Critical thinking assumes that the student, when designing, will be able not only to make a “selection” of characters and their characteristics, but also to distribute their occurrence throughout the quest.

Analysis of the result at each level of the quest room can contribute to: gaining skills in working with redundant or missing information (available at that particular moment); gaining

experience in modeling based on two or three tests; developing the practice of independence in planning activities for an uncertain future.

A quest room can be interdisciplinary in nature or highly specialized. Designing a quest room using Power Point, on the one hand, does not require any special technical characteristics of the educational space. On the other hand, apparent simplicity determines high requirements for filling the levels of the quest room: introduction, problem statement, plot development, evaluation of the result and one's own activities.

The search for a "key," "artifact," or level in a quest room depends on the level of academic performance of the student, on the competence of the game teacher (game/quest master), on the theme and plot. However, we should not forget about the need to prepare the future teacher for the challenges of Industry 4.0: developing his readiness to use artificial intelligence to solve professional problems, choosing the appropriate tools for implementation. In this regard, triggers, the creation of control buttons, and links to relevant Internet resources can help.

It was determined that in order to achieve the goals of international and state policy, it is useful for higher educational institutions to include in the training programs:

- interactivity features, innovations from the field of science and technology. For example, to involve teachers and future teachers in active educational and cognitive activities with training programs on gaming platforms. In this case, you can use such methods and tools as AR/VR, three-dimensional graphics, etc.

- information interaction, which involves participants in the didactic process. However, the following characteristics should not be lost:

- a. Reliability, scientific character, and connection with the reality of the reported knowledge;
- b. Availability of knowledge depending on the psychophysical characteristics and abilities of students.

In the process of developing the skills that make up the essence of critical thinking of future teachers, the following factors must be taken into account:

- the student knows the essence of the critical thinking of the individual and its pedagogical understanding;

- the student knows the criteria for the level of formation of critical thinking and can determine it by indicators;

- the student can apply forms of cognitive activity that contribute to the most effective form of critical thinking;

- the student owns both traditional methods and techniques for organizing educational activities, as well as those developed by him;

- the student can evaluate the actions carried out by both their peers and themselves built on Bloom's taxonomy;

- the diligent student endeavors to establish a knowledge-driven learning environment under the obstacles of society and time;

- the student himself is a critically thinking person.

PowerPoint functionality was used to design quest rooms for didactic purposes. PowerPoint is a versatile tool for preparing visual digital presentations that has become widespread in various industries. The service has many design templates that are easy to edit. You can quite easily give the presentation personality (replace the background, and splash screen, apply different fonts, add effects and animation).

The main PowerPoint tool used for designing escape rooms is triggers.

With this animation tool, you have the ability to set an action or time condition for any chosen element. The animated sequence initiates upon a single click.

Using a trigger, you can set an action for any object in the quest room. Moreover, we can choose the sequence of these actions depending on the desire and situation. You can open the task as it is completed. Clicking the left mouse button on an object animates it, causing it to perform a predefined action. Incorporating triggers into the presentation greatly amplifies its interactive nature.

Each new problematic task is a new level in the game. Increasing the level is not necessarily an increase in difficulty in solving the task. A new level means a new character, the use of a new element of the interior, the application of new theoretical knowledge.



#### **4.2. The system of practical classes for the design of quest-rooms of didactic purposes by students of pedagogical specialties**

Design stages:

I. Correlating the requirements of employers, UNESCO priorities, planned educational results with the possibilities of digital services.

This activity was carried out by the participants in the classroom and during extracurricular work in the course :Technologies of social and professional interaction.:

At the first stage, the mentor of the digital school faces the tasks of the international format. Future educators must have practical knowledge of digital technologies, various information sources; experience in formulating and solving professional problems; collaboration skills; formed skills in terms of time management (for example, to plan their professional and career prospects, engage in self-education and self-development).

II. The students study a digital resource, its functionality. Correlating them with the labor functions of a teacher, the capabilities of educational institutions and the needs of students.

Let's describe a variant of studying the use of triggers within the course lesson.

1. Open PowerPoint. Create an empty presentation.

2. The title page of the presentation will open in front of us. Remove all text fields from it.

3. Find a picture, which, for example, will depict a computer. Let's try to create a game in which we will need to find the means of input.

4. Insert the found picture on the slide.

5. Now you need to create a "button", when pressed, the information "Correct" will be displayed.

6. Create such an action for pressing the keyboard. To do this, do "Insert-Shapes-Rectangle". Draw a rectangle so that it covers the entire surface of the keyboard.

7. Now set the parameters of the figure. Right-click on the shape and select Format Shape.

8. Next, select the "Fill" item and make the transparency 100 %. In the line item, select "No lines".

9. Now add a sign that will appear when you press the keyboard. For example, "That's right, it's an input." To do this, we do "Insert – Text". Enter a sign in the field that opens.

10. Now comes the creation of the trigger itself. To do this, add the animation "Occurrence" to the inscription. Then the trigger "On click" – "Rectangle".

Check the trigger.

Then, in a similar way, you can add the required number of triggers so that the task is completed.

III. Further in the classes, students studied the principles of quest room design and used digital services to implement it.

Let us describe the main ones that they adhered to:

The story of the quest room should be short and memorable. Long quests with a twisting plot with many sudden turns in the narrative can be confusing even if you dive into it for fun. In the learning process, you shouldn't even get close to this. This can mislead the player and discourage them from delving into the essence of what is happening.

You need to tell the plot of an adventure game in an informal, accessible language. No matter how valued complex words and their various derivatives and phrases are among the scientific community, they can only scare students away.

Trust in the quest room leader. This is the foundation of any dialogue. Without trust, there is no proper understanding of the quest plot, as well as the establishment of strong connections between the facts presented and their reliability.

The plot shouldn't be boring. The story of the quest should capture the imagination and keep you on your toes.

It is important to "put completeness." The story of the quest, after its completion, cannot be allowed to raise questions such as: "What was that? What was the quest all about? What did the author mean? What next?"

IV. Technological map of the quest room.

Consider the student results in the two previous stages. Let's describe a variant of the designed "quest room" – "Computer World".

Plot. One day, Mary, a college student, receives a message from an Unknown to check her mailbox. Going to the mailbox, Mary receives an interesting letter: “Can you go back (?)”, and an unsigned CD.

Without thinking twice, the girl decides to see what this incomprehensible disk keeps in herself. The game is loading. On the screen appears the sign: “Start the game?” and a single “Yes” button.

Mary presses the button. The heroine does not have time to look back, as she begins to be drawn into some space that is already outside the monitor. Unable to cope with this force, she moves to another dimension.

Mary now faces an unknown blue room – a long corridor, on the walls of which are sequences of binary codes. And there is a small door in front of her. To open it, you need to enter a code with numbers only “0” and “1”. Carefully examining the door, you can find three numbers: 123, 35, 87. Only binary numbers can be entered into the combination lock. Therefore, the Heroine decides to translate all these numbers into a binary number system. However, only one number is the correct key. There is a development of the rules for transferring numbers from one positional number system to another.

Methodical recommendation. The inclusion of such a task will contribute to the creation of additional conditions for the development of logical and spatial thinking; for the formation of skills to analyze, compare, generalize.

If the Heroine receives  $1111011_2 = 123_{10}$  or  $1010111_2 = 87_{10}$ , then the door will not open. If she enters the code  $100011_2 = 35_{10}$ , then the girl will receive a message: “Feed the rabbit.” This is a task of the first level of difficulty.

At the next level, the girl finds herself in a petting zoo. Around the paddocks with rabbits, puppies, kittens. Remembering that the clue was about a rabbit, the Heroine approaches him. The rabbit enclosure is made in the form of a labyrinth. There is a bundle on his back. This is a task of the second level of difficulty. But in order for the rabbit to get closer to Mary, he must go through the maze. To stimulate the rabbit, you need to find a carrot and beckon the animal with it. The heroine opens an enlarged plan of the labyrinth and, using the arrows “←”, “↑”, “→”, “↓”, she completes this task.

Methodical recommendation. Completing the task, participants develop visual perception, learn the ability to analyze, draw logical conclusions.

When the rabbit comes closer, Mary removes the bundle from his back. She finds a task of the third level of difficulty.

Task: The performer Rabbit has two commands, which are assigned numbers: 1. Add 2; 2. Divide by b (b is an unknown natural number;  $b \geq 2$ ).

By executing the first one, Rabbit increases the number on the screen by 2. By executing the second one, Rabbit divides the number by b. The program for the Rabbit executor is a sequence of command numbers. For example, program “12111” is known to translate the number 54 into the number 20. The heroine needs to determine the value of “b”.

Methodical recommendation. When completing a task, participants get the opportunity to consider the variety of approaches to solving the problem as a whole through an assessment of their effectiveness. Everyone has the opportunity to comprehend the information received from the point of view of its usefulness.

Mary finds a solution and gets the value “4”. Then she returns to the familiar corridor. Paintings with numbers from “1” to “6” now hang on his walls. Sequentially sorting through them, the girl finds a picture with the right number. On the back of the painting, she sees a hidden cipher “@??@??@” and a note with the decryption. This is a task of the fourth level of difficulty.

With the help of this hint, the Heroine must unravel the encrypted word “Poppy”.

Methodical recommendation. Completing the task, participants learn to work with information, train logical and non-standard thinking.

Fifth level of difficulty. There are bedside tables with vases in the corridor near the doors to the rooms. In some cases, for example, daisies, poppies, roses, etc. Having received the answer “Poppy” in the previous task, the Heroine assumes that she needs to approach the vase with poppies. Under the vase, she finds the key to the door.

Mary opens the door to the room. The strong wind is picking up again. And the girl returns to her room, to the computer.

After completing the quest, you need to organize a reflection. For example, you can create a survey in advance, send a link to computers/gadgets to students. Further, their answers are summarized in a single table. Such work will provide everyone with the opportunity to express (argue) their opinion. It is important for the teacher not only to evaluate each participant, but also to comment on the received answer.

It is useful to provide questions in the survey so that students can list comments, wishes, emotions, impressions, etc. It is important in terms of determining the effectiveness of critical thinking resources of quest technology to include the following questions:

- evaluate (on a scale) what caused you the greatest difficulties;
- rank (arrange in order of importance for yourself) the levels of the quest room that were completed in the gaming environment. Justify the significance of each level in one or two words.

As an encouragement, awards can be:

1. Letter of congratulations. For example, the Heroine receives a letter that just now she tested a new computer game with real immersion. And according to the results of the tests, Mary receives the title of “Best Cyber Sportsman”.

2. New opportunities for Mary's information educational and cognitive activity. For example, during online classes, she can use the hint in the chat.

3. Invitation for an interview.

V. Presentation and presentation of the project. Its application in the course of educational introductory practice.

Within this stage, specific criteria to evaluate the quest room project, focusing on its adaptability in different academic subjects: persuasiveness of the reflection of the idea with the help of digital resource tools; the realism of the proposed development.

So, the students organized a photo quest “Theatrical Trouble” among 6-7 grades of school No. 16 named after. A. Likhanov in Kirov. The purpose of this quest is to learn interesting and useful information about different types of theaters through the gameplay and informal communication with the characters. The tasks of the students are to get acquainted with the characters of the theater and try to help them, get the necessary things for them. To cope with the tasks, participants need to get to know the heroes of the quest, solve puzzles and pass interesting tests. According to the results, they received a theatrical guide containing information about the regional actors' fate and concert teams during the Great Patriotic War.

VI. Generalization of the results obtained.

For example, it was determined that a quest room held in an educational institution must follow the rules:

- task, question or problem statement. In this part of the escape room, a problem or problem is presented for solution. The format and details of the final product that the participants will present are also specified here. At the end, participants must provide a photo report of their experience in the quest room and present their project;

- process. This part of the quest room contains step-by-step instructions to help participants complete the task. Each step should be described in detail;

- assessment. It is worth describing in detail the requirements by which the work will be assessed. An assessment model is used, with given criteria, scores and verbal description. In this way, the assessment becomes transparent and participants have a clear understanding of how it will be carried out;

- conclusion contains a summary of the results of completing the quest room: the knowledge that the participants will receive, ideas for continuing work on this topic, feedback/reflection;

- report forms on the implementation of quests can be different: a series of photographs, drawings, a video, a virtual excursion, a photo album, a library entry, etc.

### **4.3. Experimental assessment**

#### **4.3.1. The ascertaining stage of the experiment**

To assess the input conditions (the level of formation of critical thinking), author's testing was developed. The testing phase involves a set of 10 tasks, including memorization, understanding, application, analysis, evaluation and creation.

Task 1. To search for the main information. Point out the answer selections that properly convey the main content found within the text. Write down the numbers of these sentences.

Or another option. Using a text editor, find out how many times, not including footnotes, the word “measures” or “Measures” appears in the text of the Convention on the Rights of the Child.

Task 2. To work with sets of objects. Given a logical expression that depends on  $N$  logical variables. How many different sets of variable values are there for which the expression is true?

Or another option. What objects can be considered as systems? (a person, a tree, a house, a system of education at a university or school, the solar system, a book, a table ...).

Task 3. To evaluate information.

In order to attract the attention of the “digital generation” the text should:

- a) have a clear structure with division into small paragraphs;
- b) include visual elements (drawings, photographs, diagrams, infographics);
- c) be interactive (with the possibility of feedback);
- d) all options are correct.

Task 4. To eliminate redundant information. 30 bags of cement, 50 kg each, were brought to the school for repairs. Immediately, 20 bags were taken for work, and the remaining 10 bags were taken to the warehouse. How many kg of cement was taken to the warehouse? Can this problem be solved using the following expression “ $50 \cdot 30 - 50 \cdot 20$ ”?

Is there redundant data in this difficulty?

What data from the condition of this issue should be used so that the solution consists of one action?

Task 5. To modify the object. Participants are offered a program in an algorithmic language. It is required to modify the program in such a way that when solving a problem on a computer, if necessary, checking the input data for admissibility – compliance with the domain of definition. For example, given sides  $A$  and  $B$  of a rectangle, determine its area.

Another option is to adapt the resulting algorithm so it can be used to determine which side of the rectangle more.

Correct completion of each task – 2 points.

To interpret the results we describe the following levels.

The high level: the student knows how to offer his ideas on the formulation of the proposed problem situation in the quest space and develop various options for its solution. Justify, prove the correctness of your ideas in resolving a problematic quest situation, and also independently formulate problems. They should no longer work with “ready-made” information, but offer their own ideas on the proposed quest topic. These skills begin to develop at the ideological-problem level, since when working with information, namely when putting forward your ideas on a proposed topic, you need to be able to formulate a problem, look for a solution to the proposed problem, and summarize the available information.

The average level: the student knows how to work with information that needs to be supplemented, changed, and most importantly, be able to justify his point of view when answering a question posed in the space of an quest room. This is exactly what students at this level should be able to do with information, since the next step in working with information after analyzing the “given” information is its modification and addition. In addition to justifying his own point of view, the student must establish cause-and-effect relationships in the plot of the game situation. In addition, when working with information, you need to be able to find relationships between data in order to supplement and change the proposed information in the desired direction for the development of the quest.

The low level: the student must be able to evaluate and analyze incoming information to design an escape room. Demonstrates the following skills: analysis of the information under consideration from different points of view, assessment of each point of view of information based on comparison on the same grounds. These skills were chosen as basic, since the first thing a student should be able to do with information is to learn how to evaluate it comprehensively based on analysis and comparison, and then carry out further actions with it in the quest space. In addition, these skills are needed by a person in future everyday life, since every day a fairly large amount of information is received, which is often unverified. Therefore, before doing anything with the incoming information, it is necessary to select valid information. These are mainly tasks for choosing the correct answer according to the outline of the plot, which satisfies the conditions of the task. As well as tasks in which you need to find and indicate an error. Thus, at this level the student must demonstrate the ability to work with “given” information.

Thus, based on the results of the processing of materials, it was possible to collect data on 54 students of pedagogical specialties. They formed experimental and control groups.

#### 4.3.2. Forming stage of the experiment

The students developed the following types of resources: social quest (to support and strengthen the musculoskeletal system – “Health Path”), educational quest (learning the rules of netiquette), lesson-quest (built on the works of A.S. Pushkin), a computer quest (a video game constructed on the story by L. Carroll).

During the design of quest rooms, participants must:

- 1) justified the relevance, purpose, and objectives of the quest;
- 2) formulated the idea and concept;
- 3) determine the target group (for whom the quest is designed).
- 4) described the mechanisms for the implementation of the quest and chose the tools of the digital service for their implementation;
- 5) searched for information and developed a series of problems, tasks, and questions;
- 6) assumed what could be the expected results (social and educational effect) from the implementation of the quest room.

The control group students successfully acquired expertise in the materials covered in the courses “Modern Information Technologies”, “Technologies of Social and Professional Interaction”, underwent an introductory educational practice. But they were not involved in the activities organized according to the described stages and the design of didactic quest rooms.

#### 4.3.3. Control stage of the experiment

At the control stage of the work, testing was also carried out in accordance with the tasks indicated in p.p. 4.3.1. Information is presented in [Table 1](#).

**Table 1.** Assessment of the critical thinking formation level

Level	Groups			
	Before the experiment		After the experiment	
	Control group (27 students)	Experimental group (27 students)	Control group (27 students)	Experimental group (27 students)
Low	11 (40.7 %)	10 (37.0 %)	8 (29.6 %)	3 (11.1 %)
Average	14 (51.9 %)	15 (55.6 %)	16 (59.3 %)	14 (51.9 %)
High	2 (7.4 %)	2 (7.4 %)	3 (11.1 %)	10 (37.0 %)

The accepted statistical hypotheses are as follows:

H<sub>0</sub> – the level of critical thinking development among students of the experimental group is statistically equal to the level of the control group;

H<sub>1</sub> – the level in the experimental group is higher than the level of the control group. For  $\alpha = 0.05$   $\chi^2_{crit}$  is equal to 5.991. Thus:  $\chi^2_{observ.1} < \chi^2_{crit}$  ( $0.082 < 5.991$ ), and  $\chi^2_{observ.2} > \chi^2_{crit}$  ( $6.175 > 5.991$ ). Consequently, the shift towards an increase in the level of formation of the skills that form the basis of critical thinking can be considered non-random.

## 5. Limitations

Let us dedicate our attention to the potential constraints for this study:

1. Because the students in the sample were not accidental, it is impossible to generalize the entire student population using experimental data. Therefore, it would be more correct to use the term “quasi-experiment”.

To guarantee that both the control and quasi-experimental groups possess identical knowledge, skills, and abilities essential for critical thinking, the questions formulated for authors testing aim to establish equivalency.

2. An essential requirement is that throughout the quasi-experiment the same teacher:
  - explained a digital platform tools for design;
  - supervised the design of didactic quest rooms;

- helped future teachers with the formulation of the plot, when working with information sources;
- organized educational introductory practice.

The development of a didactic quest room took place in the same classrooms. The game design tool in the virtual educational environment has not changed either.

## 6. Discussion

Performing a quantitative analysis of the obtained data, we can conclude that after completing the course, the level of “High” among students in the experimental group increased from 7.4 % to 37.0 %.

The positive shift, of course, was recorded for the “Low” level: from 37.0 % to 11.1 % of future teachers. The fluctuations in the average level are not particularly significant.

Note the changes in the control group. For example, the level of “High” increased from 7.4 % to 11.1 %. Shifts in the “Average” level were also recorded: from 51.9 % to 59.3 %.

The curator of the course noted that if you do not constantly devote time to the development of critical thinking, then no fundamentally qualitative shift will occur.

In the process of designing a quest room, future teachers not only performed independent educational and cognitive tasks, but also acquired skills:

- explanation of data, opinions, situations, rules;
- information investigation and consistency of sources;
- discovery and confirming facts;
- assessment of the plausibility of statements and the logic of arguments;
- formulation and substantiation of reasoning;
- checking, making the necessary adjustments to their own reasoning;
- formulation of conclusions.

The skills growth formed the basis of critical thinking, which was facilitated by the following factors: high creative activity, participation in discussions, selection of sources and search for information, analysis of one’s actions (opinions, decisions), individual and group work on a series of quest problems-rooms. The students of the experimental group were involved in the search for missing and redundant information, made and evaluated logical inferences, evaluated the sequence of inferences, etc.

The research materials correspond to the provisions, principles, goals and objectives of the road map adopted by UNESCO ([Vzglyad YUNESKO..., 2023](#)). The findings can be used in the work of the unified digital platform of the FSIS “My School” ([Federal'naya gosudarstvennaya..., 2023](#)). The author's results on the didactic potential of quest rooms for the development of students' thinking are consistent with the conclusions of M. Chang and his colleagues ([Chang et al., 2019](#)). In addition, the presented work supplements the system of principles formulated by N.N. Vekua, A.A. Lubsky, M.S. Perevozchikova, Yu.N. Folgerova for designing a quest environment ([Vekua et al., 2020](#)).

The following areas are currently being considered as research prospects:

- 1) expansion – transfer of the ideas of the proposed methodology to network educational programs, adapting them to professionally oriented network courses. The resulting training modules will be posted on the Moodle platform for the relevant areas of training;
- 2) and, conversely, a narrower specialization – involving students in the practice of developing quests in the puzzle format (for example, the Questodel service).

## 7. Conclusion

During the study, the conditions were determined under which the involvement of students in the design of educational quest rooms will donate to the formation of the critical thinking as:

- The potential transfer of experience gained from modeling the interaction of virtual characters and objects in the quest room to the real educational space is being explored;
- Self-education and self-development can be achieved through recognizing the value of independently studying necessary languages and ways to interact with ones environment (remote) people and events);
- Assessment and self-assessment of the formulated tasks (organization of discussions, argumentation);
- Collaboration (work on the plot, practical implementation of the quest room).

The effectiveness of involving future teachers in the design of educational quest rooms for the development of skills that form the basis of critical thinking depends on many factors, among which the most significant is the ability to provide information interaction between students within a group, between students and a digital service, students and a game teacher.

Equally important is the quality of information materials (sources) for self-study.

The quasi-experiment participants also emphasized the difficulties of the suggested novelty. The imaginative character of the activities to develop the subject matter and content of the playground, the dependence on software, the technical glitches of the equipment and the long process of building a team of like-minded people to design and implement the task. Another aspect worth noting is the accentuation on the obstacles associated with implementing technology in the education of forthcoming educators. Digital school leaders must be aware of a variety of conceptual tools and games with pedagogical content when making technology decisions, as well as gain expertise in designing, developing, and assessing creative projects.

The fact that gamification elements can foster essential 21st century skills in future professionals illustrates the practical significance of these research findings.

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