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SPATIAL CONCEPTS IN THE DESIGN OF ESCAPE ROOMS TO ENHANCE ADAPTATION AND TEAM INTERACTION

The article aims to study the influence of architectural solutions, sensory environment and narrative elements of escape rooms on the emotional state, behaviour, perception of space and adaptation of players. The objectives of the study include analysing the impact of individual elements of the escape room on the spatial perception and emotions of the game participants, studying the relationship between the elements of the escape room and the level of stress, and assessing the impact of the escape room on enhancing adaptation and team interaction of players. To achieve the research goal and solve the outlined tasks, general scientific methods of the theoretical level (analysis, synthesis and systematisation of scientific research) and methods of experimental research (logical and systematic analysis, experiment, statistical methods of data processing) were used. In the course of the study, the concept of 'quest room' is revealed, and the role of spatial design in organising a game in the format of such a room is clarified. The article presents the spatial design of escape rooms, including thematic design, interactive design, immersive design, and technological space. The concept of game design as a process of planning an interactive gaming space is also revealed. It has been proved that an effectively planned game space in the quest room contributes to developing several skills and competencies. The experiment evaluated the impact of architectural solutions, sensory environment and narrative elements of escape rooms. It has been proven that the skilful use of escape room design elements (darkness, mirrors, artificial lighting, wall decoration, floor temperature, sound effects, and smells) positively enhances team interaction among game participants. Players demonstrated an increase in adaptation skills as well as skill levels. In terms of teamwork skills, players showed an increase in medium and high levels of teamwork, as well as in the level of skill. At the control stage of the experiment, there was a decrease in the number of players with low levels of adaptation and teamwork skills.

Key words: *spatial design, game design, emotional state, environment, levels.*

Юнко Тарас. ПРОСТОРОВІ КОНЦЕПЦІЇ В ДИЗАЙНІ КВЕСТ-КІМНАТ ДЛЯ ПІДСИЛЕННЯ АДАПТАЦІЇ ТА КОМАНДНОЇ ВЗАЄМОДІЇ

Метою статті є дослідження впливу архітектурних рішень, сенсорного середовища та елементів наративу квест-кімнат на емоційний стан, поведінку, сприйняття простору та адаптацію гравців. Завдання дослідження передбачають здійснення аналізу впливу окремих елементів квест-кімнати на просторове сприйняття та емоції учасників гри, вивчення взаємозв'язку елементів квест-кімнати та рівня стресу, а також оцінювання впливу квест-кімнати на підсилення адаптації та командної взаємодії гравців. Для досягнення мети дослідження та розкриття окреслених завдань було використано загальнонаукові методи теоретичного рівня (аналіз, синтез і систематизація наукових розвідок) та методи експериментальних досліджень (логіко-системний аналіз, експеримент, статистичні методи оброблення даних). У ході дослідження розкрито поняття «квест-кімната» та з'ясовано роль просторового дизайну в організації гри у форматі такої кімнати. У статті представлено типи просторового дизайну квест-кімнат, зокрема тематичне оформлення, інтерактивний дизайн, імерсивний дизайн, а також технологічний простір. Також розкрито поняття геймдизайну як процесу планування інтерактивного ігрового простору. Доведено, що ефективно спланований ігровий простір квест-кімнати сприяє формуванню та розвитку низки вмінь, навичок та компетенцій. Під час експерименту було здійснено оцінювання впливу архітектурних рішень, сенсорного середовища та елементів наративу квест-кімнат. Доведено, що вміле використання елементів дизайну квест-кімнат (темрява, дзеркала, штучне освітлення, оздоблення стін, температура підлоги, звукові ефекти та запахи) позитивно впливає на підсилення командної взаємодії учасників гри. Гравці продемонстрували підвищення рівня навичок адаптації, а також рівня майстерності. Щодо навичок командної взаємодії, то у гравців спостерігали підвищення середнього та високого рівнів командної взаємодії, а також рівня майстерності. На контрольному етапі експерименту спостерігалося зниження кількості гравців з низьким рівнем навичок адаптації та командної взаємодії.

Ключові слова: *просторовий дизайн, геймдизайн, емоційний стан, середовище, рівні.*

Introduction. The innovative development of modern society has created the preconditions for the transformation of the sociocultural sector and the emergence of new formats of leisure activities, which is closely related to the widespread use of information technology, artificial intelligence, and virtual and augmented reality. Quest is a technology that includes a set of problematic tasks with elements of role-playing [1, p. 144]. Quest technologies in the leisure sector relate to the integration of digital and interactive tools to increase immersion and the dynamics of solving a given problem. From a scientific point of view, quest technologies use the principles of human-computer interaction, cognitive psychology, and game design to optimize player interaction, cognitive stimulation, and teamwork [2, p. 17].

Virtual quests such as escape the room or guest rooms are equipped with innovative technologies and modernized design; they enhance realism, regulate the complexity of tasks, make the game more exciting, and increase the interest of participants. Audiovisual effects can create an emotionally rich atmosphere, involving players in the storyline [3, p. 175]. It is believed that these techniques stimulate the development of critical thinking and teamwork and create a sense of adventure that traditional quests may lack. At the same time, according to N. Kolosova and K. Nikoliuk [4, p. 212], using modern design elements increases the aesthetic appeal, and therefore players feel more motivated to engage in leisure activities. Given this, the topic of spatial design of escape rooms for the development of specific skills, in particular adaptation and team interaction, deservedly attracts attention.

Materials and methods. In the course of studying the influence of architectural solutions, sensory environment, and narrative elements of quest rooms on the emotional state, behavior, perception of space, and adaptation of players, general scientific methods of the theoretical level were used, in particular, analysis (to assess different types of space in quest rooms and their impact on the dynamics and adaptation of game participants; to identify patterns between the process of forming skills and abilities and the plot of a game in the format of an escape room), synthesis (to analyse the scientific problem of the study in the context of interdisciplinary research; to develop generalised conclusions about the impact of space on team interaction and adaptation) and systematisation of scientific research on the peculiarities of using escape rooms in education and professional development, as well as modeling escape rooms by means of design. To assess the impact of the quest room design on enhancing adaptation and team interaction of players, the following experimental research methods were used: logic-system analysis to study the principles of spatial design of quest rooms and determine the role of its individual elements; an experiment to obtain objective data on the relationship between the design of the quest room and the skills and competencies of players; statistical methods of data processing.

Analysis of recent research and publications. The topic of quest technologies in education as an effective means of learning and developing the necessary skills has been addressed by domestic and foreign researchers, including O. Khvashchevska, V. Khorunzha [1], T. Trofimuk-Kyrilova, A. Karpiuk [5], P. Fotaris, T. Mastoras [6], A. Spatafor, M. Wagemann and S. Sandoval [7]. Important for our study are the scientific developments of O. Vinoslavska and M. Kononets [2], which revealed the prospects for the use of quest rooms for future specialists in crisis situations. At the same time, N. Kharchenko [8] studied the problem of using quest technology and the features of effective game design as a prerequisite for organising a favourable educational environment.

It is worth noting that the interior design of an educational institution was the subject of research by N. Kolosova and K. Nikoliuk [4]. The role of spatial design of game quest rooms was studied in detail by R. Kucher [9]. In his work, the researcher not only describes the design elements of escape rooms but also reveals the figurative, stylistic, and technical factors characteristic of such design. O. Krupa and O. Gubernator [3] focused their research efforts on analysing the use of audiovisual media in cultural and leisure events. Among foreign researchers, it is worth mentioning G. Eukel and B. Morrell [10], who detailed the modelling of educational

escape rooms and considered the possibility of introducing a cyclical process of designing the interior of escape rooms.

Identification of previously unsolved parts of the overall problem. Given the growing interest in the impact of escape rooms on learning and changes in the psychological state and cognitive processes of players, the problem of spatial concepts of escape room design is becoming increasingly relevant in modern scientific discourse. As escape rooms gain popularity in both entertainment and educational settings, researchers are increasingly recognising their potential for developing problem-solving, collaboration, and adaptation skills. However, despite the fact that various studies have examined game-based learning and teamwork dynamics [8; 10; 11], the role of spatial design in the context of developing adaptation skills and improving teamwork remains insufficiently understood.

Most existing studies focus on the development of a game scenario or the creation of special tasks for an escape room [2; 5], the cognitive activity of players, and the creation of an interactive game space [6; 10]. Often, researchers do not pay attention to the importance of room layout, placement of objects, and spatial constraints that affect human behavior and determine their actions. An analysis of recent studies and publications has shown that there is currently limited systematic analysis of the problem of spatial arrangement and its impact on group work, team role distribution, and stress management. We believe that understanding these factors can contribute to the development of an effective interactive escape room environment that will optimise learning and enhance team interaction. Of particular importance is the study of the impact of architectural solutions and elements of escape rooms on the emotional state, behavior, perception of space, and adaptation of individuals in the context of a full-scale Russian invasion when people have a high level of stress.

Given the complexity of human interaction with physical space, a more detailed study of spatial concepts in escape room design is an important issue in the scientific discourse in the fields of art, leisure, and gamification. Recent pedagogical and psychological research shows that factors of the educational environment play an important role in shaping human experience, but these aspects are rarely addressed in the study of escape rooms [4]. Therefore, we believe that a comprehensive analysis is needed to develop methodological foundations for designing spaces that are used to form and develop specific skills and competencies. In addition, describing the potential of escape rooms for training future professionals, advanced training, and modeling professional tasks is an important aspect of developing effective game scenarios based on design solutions. Actually, the analysis of spatial concepts of quest room design and evaluation of their impact on enhancing adaptation and team interaction of game participants will be considered in this study.

Thus, **the article aims** to study the impact of architectural solutions, sensory environment, and narrative elements of escape rooms on the emotional state, behavior, perception of space, and adaptation of players.

The objectives of the study include

1) to analyse the impact of individual elements of the escape room on the spatial perception and emotional state of the players;

2) to study the relationship between the elements of the escape room and the level of stress;

3) to show the impact of the escape room game on enhancing adaptation and team interaction.

Results. The escape room combines game design and theatre art elements, which are based on a clear structure of the external composition and the internal logic of the action [9, p. 155]. P. Fotaris and T. Mastoras [6] explain quest rooms as a new type of player-oriented activity designed to improve the skills of the XXI century and effective in primary, secondary, and higher education and the implementation of professional development programs. The use of modern technologies in the quest room makes it a unique type of leisure activity [2, p. 18]. The quest is to find a way out of the room by completing various tasks and following instructions from the characters. Spatial design influences the formation of functionality, aesthetics, and the overall impression of the escape room environment. A well-thought-out spatial design

increases comfort, promotes efficient movement, and affects the emotions and performance of players [10, p. 20]. Elements such as lighting, color, furniture arrangement, and wall or floor materials create a certain atmosphere – calming or stimulating – depending on the game goal [11, p. 26].

Based on the analysis of the scientific literature [6; 10, p. 19], we can distinguish different types of spatial design used to create various scenarios of escape rooms. They include thematic design, interactive design, immersive design, and technological space. In particular, the thematic design of the room focuses on a specific theme or scenario to immerse players in a unique environment. Elements of this type include detailed props, realistic scenery, and special constructions. Interactive design encourages players to interact with the environment through puzzles and hidden mechanisms (moving furniture, rotating walls, secret doors, magnetic locks, etc.) The multi-room design divides the quest into several interconnected spaces to increase the complexity. At the same time, immersive design requires sensory effects to enhance realism and emotional impact. In this case, developers can use such elements as fog, temperature changes, sound signals, smells, and dim lighting. It is worth adding that, according to R. Kucher [9, p. 154], immersive design ranges from simple scenery to complex multisensory environments. Technological space allows the integration of digital technologies to create dynamic tasks.

In analysing the design of an escape room, it is advisable to analyse the game design concept. Some researchers argue that it is the process of conceptualising, planning and structuring an interactive game space where players interact through rules, instructions and scenarios [7]. Game design is applied to various formats, such as video games, board games, role-playing games, and escape rooms. It is characterised by interdisciplinarity, combining elements of art, psychology, technology, and narrative development [12]. Quest developers should consider factors such as scaling complexity, clarity of instructions, player motivation, and the ability to adapt to different play styles [6]. In addition, modern game design combines such advanced technologies as virtual, augmented, and artificial intelligence to increase realism and interactivity [9, p. 155].

Escape room game design aims to create interactive games with puzzles that force players to solve problems quickly [8, p. 36]. Unlike traditional video or board games, escape room design relies heavily on physical space, real-world interaction, and environmental characteristics [10, p. 20]. Designers integrate mechanical and technological elements, hidden clues, and psychological tools to enhance player interaction. Escape room decoration, lighting, sound effects, and even smells can be used to enhance the realism of the theme and create a dynamic atmosphere. Researchers argue that a well-designed escape room balances difficulty and forces players to cooperate, enhancing teamwork, critical thinking, and problem-solving skills [13].

It has been found that classes in escape rooms help to improve players' various skills and competencies, making quest technologies not only a part of leisure activities but also a valuable tool that positively affects players' personal and professional development (Table 1).

During the experiment, the results of the levels of formation of skills and competencies in the experimental group (EG) (127 people) and the control group (CG) (121 people) were compared. The following indicators determined the analysis of levels: 1) productivity; 2) level of independence in performing tasks; 3) cognitive activity; 4) social and communicative interaction; 5) emotional stability; 6) technical readiness. To determine the level of skills and competencies, the players were offered several diagnostic methods: 1) observation, in which the experiment organisers watch the participants during the quest and evaluate their behavioural patterns; 2) self-assessment, which involves filling out a questionnaire about the experience of participating in the quest room; 3) mutual evaluation, when team members evaluate each other's contribution according to certain criteria; 4) testing to determine the levels of skills and competences before and after the experiment.

The experiment was conducted in two escape rooms – The Mystery of the Dark Room and The

Table 1

The influence of the escape room on the personal and professional development of players

Skills, abilities, competences		Authors
Critical thinking	Analysing situations, identifying patterns and drawing logical conclusions	[8, c. 36; 13]
Creativity	Search for non-standard solutions	[5, p. 142; 9, p. 155].
Decision-making	Choosing the best course of action under time constraints	[12]
Team interaction	Working with others to achieve a common goal	[9, p. 156; 13; 14, p. 68].
Leadership	Ability to take initiative and lead a team	[14, c. 69]
Adaptation	Adapting to new environmental conditions	[3, p. 174; 10, p. 21; 15, p. 1199].
Stress management	Prevent, control and reduce stress levels	[2, p. 20; 6; 15, p. 1200].
Communication skills	Ability to express ideas and instructions clearly	[11, p. 30; 10, p. 21].

Source: developed by the author.

City Without a Sun. Let us analyse them in more detail.

The Mystery of the Dark Room escape room by Secretorum offers a unique experience where participants spend 60 minutes in a room without natural light. Players complete tasks while exposed to mirrors, cold surfaces, red lighting, and sound. The room creates a surreal atmosphere, allowing particular objects to glow or reveal hidden elements. The mirrors are positioned in such a way that they can reflect and refrain from light, adding an extra layer of complexity. The lack of natural light forces players to rely on their other senses, particularly their hearing, as various sound effects and ambient noises are played throughout the room. This combination of audio-visual stimuli forces players to develop problem-solving, communication, and teamwork skills as they navigate the room.

"City Without Sun" is an escape room designed by Secretorum to immerse players in complete darkness and force them to navigate in conditions of sensory deprivation, acoustics, and tactile sensations. Participants must rely solely on their senses, such as touch, hearing, smell, taste, and effective communication within the team. Players have 60 minutes to uncover the room's secrets and ultimately "find the sun". Importantly, this game is not a horror scenario but a test of sensory perception and teamwork. Figure 1 shows the "Mystery of the Dark Room" escape room.

Skills and competencies were assessed in five levels, each with clear criteria, namely low, sufficient, intermediate, high, and mastery levels. At the low level, players know the need to develop a skill or competence and can follow simple instructions. At a sufficient level, players understand basic principles or processes. Players

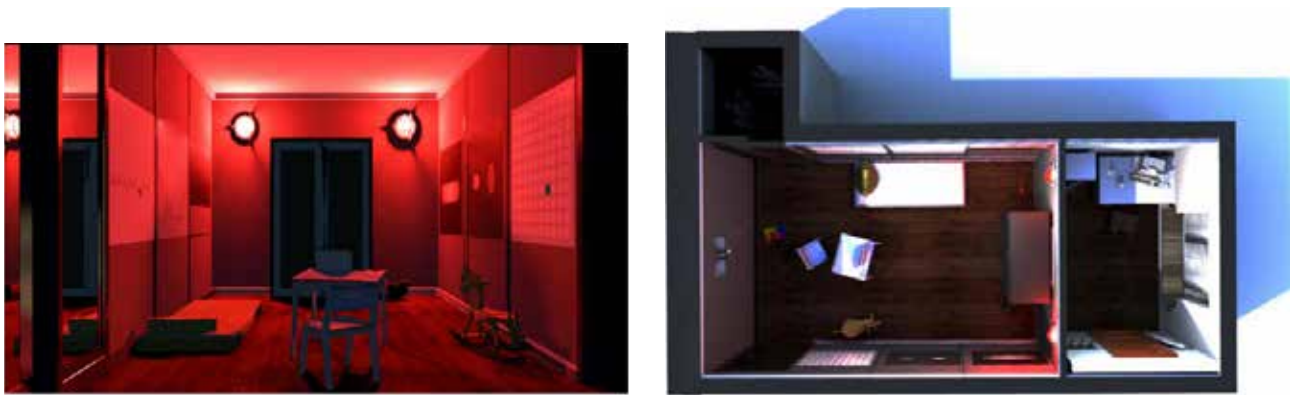

Fig. 1. Escape room "The Mystery of the Dark Room"

Source: [16]

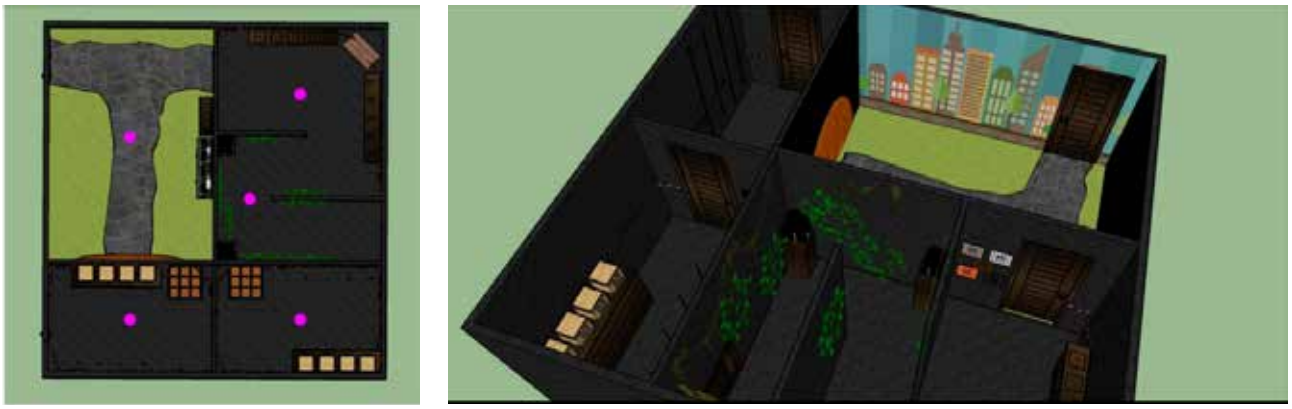

Fig. 2. Quest room "City without the Sun"

Source: [17]

can explain concepts and answer basic questions about the skill or competency. Intermediate means players can apply knowledge or skills in practice, independently or with minimal guidance. They can perform tasks and solve problems in everyday or professional activities. At a high level, players can combine different skills, abilities and competencies to create new

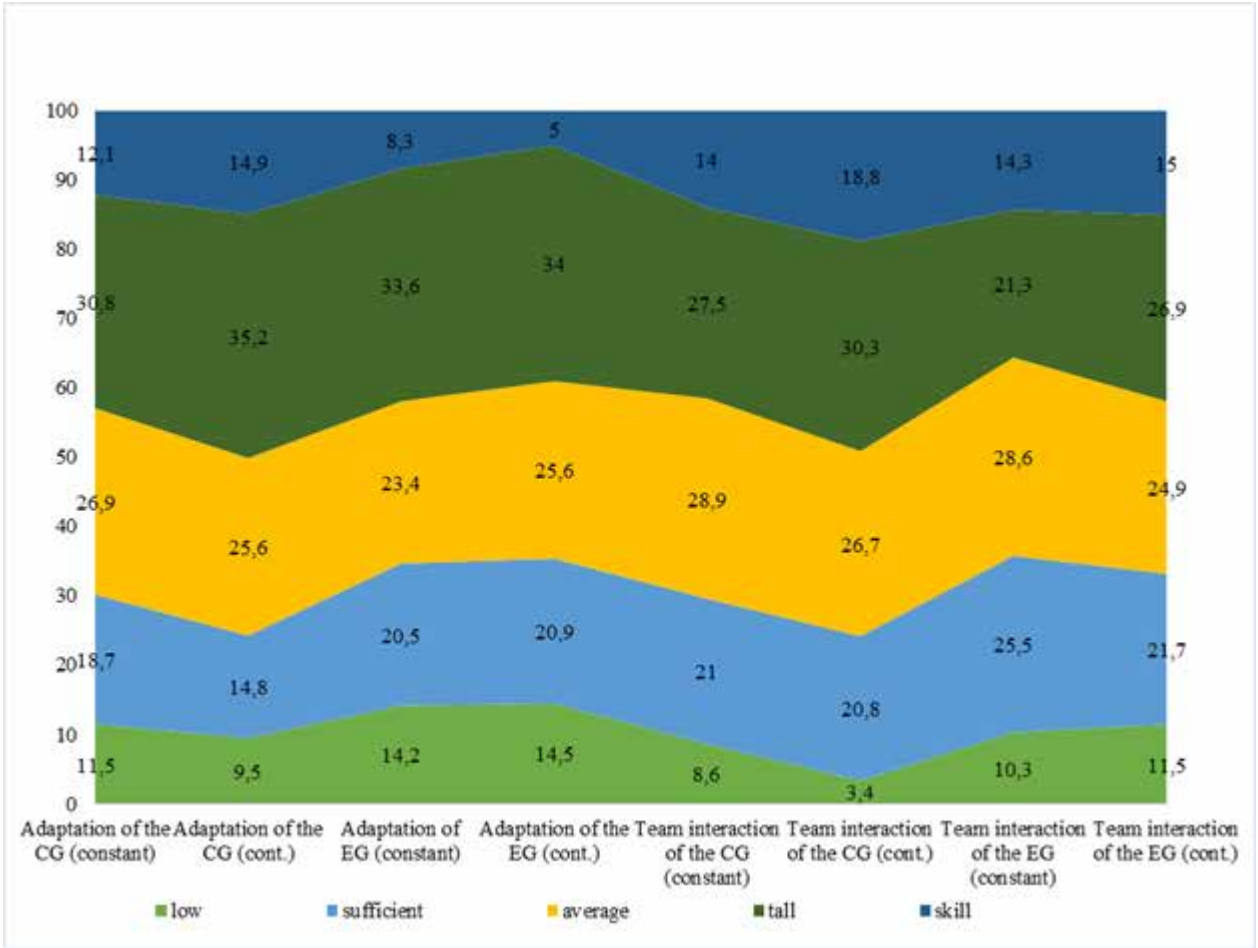

Fig. 3. Comparative analysis of changes in the levels of adaptation skills and teamwork by quest room players (in %)

Source: developed by the author

solutions or improvements, analyse complex situations and develop strategies to overcome a problem. The mastery level implies the ability of players to solve complex and unpredictable tasks, lead a team to adapt to unexpected changes in the escape room, or create a new strategy for solving complex problems.

At the ascertaining stage of the experiment, eight skills, abilities, and competencies were assessed, namely critical thinking, creativity, decision-making, teamwork, leadership, adaptation, stress management, and communication skills. Based on observation and self-assessment methods, it was found that quest technologies have the greatest impact on adaptation and teamwork skills among players. The CG used a traditional quest technology methodology that was not focused on the formation and development of adaptation and teamwork skills. The CG players acted according to an unstructured scenario and did not have a clear distribution of roles in the team. The EG used escape room elements such as darkness, mirrors, artificial lighting, wall decoration, floor temperature, sound effects, and smells to assess players' adaptive skills and teamwork. EG players performed structured tasks according to predefined instructions. Figure 3 shows a comparative analysis of the change in the levels of adaptation and teamwork by players in the experimental and control groups at the baseline and control stages of the experiment.

The study identified positive changes in the EG at the control stage of the experiment. The players demonstrated an increase in the high level of adaptation skills (+1.2%) and the skill level (+8.9%). The average level of adaptation skills in the CG and EG remained unchanged. As for teamwork skills, the players demonstrated an increase in the average level by 1.8%, the high level by 4.6%, and the level of mastery by 3.8%. In addition, in both groups, at the control stage of the experiment, there was a decrease in the number of players with low levels of adaptation and teamwork skills.

The analysis of the sensory elements of the escape room during the experiment showed that darkness, mirrors, artificial lighting, wall decoration, temperature, and sound effects affect the emotions, perception, and cognitive processes of players and contribute to the development of adaptation skills and teamwork dynamics. For example, 27.8% of escape room participants noted that darkness, limiting visual perception, forces players to rely on other senses, such as touch, hearing, and spatial awareness. When visibility is minimal or completely absent, players demonstrated increased attention, and a sense of vulnerability made them adapt quickly to environmental changes. At the same time, 11.7% of players felt insecure and slightly afraid in a room without natural light. 29.5% of players, describing their experience of using mirrors in the escape room, said that it was difficult for them to perceive the size of the room and the placement of light sources. Mirrors created the illusion of additional movement and the presence of other people in the room. The experiment results show that the use of mirrors positively impacted the development of teamwork skills, as players had to adapt to the space, coordinate their actions, and use effective communication strategies to complete the task. 37.6% of the participants claimed that the mirrors contributed to developing decision-making skills and out-of-the-box thinking, as some clues were visible only through the mirror surface.

In the escape room, artificial lighting was used to reveal hidden symbols (ultraviolet lighting), increase tension, or create an atmosphere of fear by limiting visibility (dim or flickering light). Notably, a significant number of players (32.8%) associate red room lighting with danger and fear. They emphasised that it accelerated decision-making and allowed them to focus on solving the problem. In the context of teamwork, the red light helped to intensify communication between participants. 31.1% of the players said that the level and type of lighting affected their visual adaptation, and 26.5% of the participants had difficulty concentrating in the dark. At the same time, 44.2% of people said that the lighting effects made the team work together and communicate effectively. Wall decoration and floor temperature control enhanced the feeling of isolation and increased the realism of the escape room scenario. The cold floor and the simulation of "wet zones" enhanced the sensory experience and had a significant emotional impact on the players. 39.6% of the players said these elements

contributed to quick adaptation and teamwork. Thus, participants had to quickly assign roles, and the discomfort caused by the cold floor enhanced the sense of unity as participants supported each other mentally and physically.

Special attention was paid to the impact of sound effects during the game. The experiment revealed that sound affects the formation of players' sensory perception and determines the speed of their adaptation to a new environment. 42.1% of participants claimed that unpredictable sounds, such as sudden whispers, mechanical noises, or footsteps, can cause psychological stress and make it difficult to concentrate. At the same time, most players (50.9%) indicated that sound cues positively impacted the outcome of the game. Notably, 34.7% of people believe that loud sounds helped strengthen team cohesion, and moments of lower sound intensity created an opportunity for players to actively listen to each other and make collective decisions. Using smells as escape room elements helped regulate players' emotions and cognitive reactions. 32.8% of participants acknowledged that familiar or pleasant smells helped players adapt to the environment faster and encouraged cooperation. In contrast, unfamiliar or intense smells caused increased vigilance and disorientation, making it difficult for players to concentrate. At the same time, 29.9% of people said unpleasant smells distracted them from the game and caused stress.

Thus, the experiment proves that the design of an escape room to enhance adaptation and teamwork depends on the effective integration of several elements, including sound, smell, temperature, lighting, and room decoration, which form the atmosphere, influence the player's perception, and create a sense of reality in the game environment. Combining several sensory stimuli makes it possible to evoke emotions, direct attention to a specific object or task, and make players quickly adapt to the environment. In addition, the interaction of these factors affects decision-making and teamwork, turning the game into a more dynamic and psychologically stimulating activity.

Conclusions. The study proved that escape-the-room quests use architectural solutions and sensory environments to increase the realism of the game space and regulate the complexity of tasks. Audiovisual effects create an emotionally charged atmosphere in the escape room format during the game. Types of spatial design of escape rooms include thematic design, interactive design, immersive design, and technological space. Game design is the process of conceptualizing, planning, and structuring an interactive game space. The game design of an escape room focuses on creating interactive games with puzzles that force players to solve tasks within a limited time. The experiment proved that the skillful use of escape room design elements (darkness, mirrors, artificial lighting, wall decoration, floor temperature, sound effects, and smells) has a positive effect on enhancing adaptation and team interaction of players. The game participants demonstrated increased adaptation skills, medium and high levels of team interaction, and skill level. The analysis of the influence of escape room design elements on players' emotional state and behaviour showed that enhancing adaptation and teamwork depends on the effective integration of these elements into the game environment, which affects the perception of game participants and creates a sense of reality.

In the future, we consider it necessary to explore the prospects of using innovative technologies (artificial intelligence, virtual and augmented reality) to create an interactive environment and expand the capabilities of game scenarios. An important aspect of future research is enhancing the game's emotional perception and activating cognitive processes using innovative technologies.

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