Features of gamification component introduction during the development of constructive strategies for overcoming youth life crises

Hanna B. Varina[1 [0000−0002−0087−4264]],
Viacheslav V. Osadchyi[1 [0000−0001−5659−4774]],
Olga A. Goncharova[1 [0000−0002−1084−7112]], and
Serhii M. Sankov[2 [0000−0001−9668−0167]]

[1] Bogdan Khmelnitsky Melitopol State Pedagogical University,
20 Hetmanska Str., Melitopol, 72300, Ukraine
{anyavarina22, poliform55, goncharoo82}@gmail.com
http://irbis-nbuv.gov.ua/ASUA/1468211/
http://inf.mdpu.org.ua/2017/10/25/osadchij-vjacheslav-volodimirovich-2/
https://cutt.ly/3J7JQiX
[2] Tavria State Agrotechnological University,
18 Bohdan Khmelnytsky Ave., Melitopol, 72312, Ukraine
sanserg@i.ua
https://scholar.google.com.ua/citations?user=isc34nsAAAAJ

Abstract. Information technology is becoming an increasingly important part of the lives of today's youth, opening up numerous opportunities for its application in various fields of public practice. The statistics presented in the article on the increasing demand for gaming IT industry products update the search for ways to incorporate gamification components in the educational space in order to optimize the process of professional development of a competitive specialist. The article considers the incorporation of gamification into the educational process of higher education institutions in order to develop stress resistance in individuals as a factor in selecting constructive strategies for overcoming life crises in young people. The concept of gamification is investigated using scientific research analysis. The benefits of gamification in the educational and psychocorrectional processes are established. The use of simulator games with augmented and virtual reality elements in the process of developing constructive coping strategies of individual behavior in uncertain situations and overcoming life crises is supported. The article describes the experience of interdisciplinary research at Bogdan Khmelnytsky Melitopol State Pedagogical University's STEAM-laboratory, Laboratory of Psychophysiological Research, and Laboratory of Health Psychology. The paper describes in detail the step-by-step empirical study on the incorporation of gamification components as well as augmented and virtual reality technologies into a comprehensive training program aimed at developing resilience, emotional stability, and as a predictor of constructive strategies for overcoming life crises in young people. The implementation of the experience is described in the stages of ascertaining and

shaping the study. According to the findings, implementing a psychocorrectional program with gamification elements aided in increasing the individual's emotional stability and stress resistance. Representatives of the experimental group, who received active training using gamification elements and AR/VR technologies, demonstrated significant differences in the choice of constructive strategies for overcoming life crises when compared to the control group, which did not receive training.

Keywords: gamification · stress resistance · life crises · coping strategies for overcoming life crises · simulation games · augmented reality technology · virtual reality technology

1 Introduction

Trends in the development of modern society, enhancement of computer technologies, globalization and informatization affect all spheres of social life, including higher education. The significance, aim and mission of modern education is not just the acquisition of basic knowledge and development of necessary competencies, it is the also a development of a cultural code, an independent approach to the acquisition of new knowledge, cultural values, new forms and activities. Information culture and awareness of the use of innovative augmented reality elements are some of the most important and basic competences in the process of training of future specialists, who are competitive, capable of self-realization, professional and emotional stability in the world of unstable socio-economic conditions of society. The use of the opportunities of augmented reality and simulation games in education and psychological practice can regenerate the process of visual perception of necessary information, simultaneously involving person's cognitive and sensory systems in this process. Reproduction of some processes for visual representation in real dimensions gives an opportunity for complex perception and holistic immersion into the phenomenon under study [18].

The key characteristics of the modern educational process in education are: digitalization of the educational environment with a focus on the individualization of the educational process; development of adaptive technologies, technologies of electronic and mobile learning, means of identification and personalized access. All these characteristics contribute to the design of educational process models based on the development of the individual educational route of a student [12]. Change of processes and protocols for the formation and dissemination of new knowledge contributes to the design of open architecture of the educational environment, construction of the model of open education. Open access to modern information technologies changes people's lives for the better, contributes to the transformation of the education system, increases productivity and competitiveness of any country in the world market.

At the current stage of the development of informative society there are main educational trends, including remote and mobile learning, MOOC, augmented reality, cloud LMS, personalization, Big Data, gamification, which can change

not only the content of education, but also affect its quality undoubtedly. Gamification or gaming is expanding to all spheres of life. The modern system of education in the conditions of transformational changes is at the top of implementing acquisition of the scientific and technological progress. Five educational trends that are reported by Forbes magazine: remote education, personalization, gamification, interactive textbooks, video game learning – four of them are gamification. Recently, global IT companies are working on gamification actively to improve existing educational platforms and to create new game training programs for use in open information and educational environment.

Nowadays, the most famous are Classcraft, Minecraft: Education Edition, Power Point Quick Starter, Paint 3D, LinguaLeo, Lego Education WeDo 2.0, SimCity, etc. These products have become an integral tool for educators in the context of digitalization and blended learning [2]. According to the statictics for 2020 fiscal year, the video game industry's total revenue forecast is $ 159.3 billion and the number of players is $ 2.7 billion. Regarding Ukraine, there is the latest data for 2018 from Newzoo. According to their information, video game profits in Ukraine was $ 161 million. According to the survey, the most active users of the gaming industry are young people under the age of 25, that is 72% of all respondents of different age. The relevance of the implementing of gamification's elements in to the higher education system is proved by the international project "GameHub-collaboration of universities and gaming industry enterprises in Ukraine" that is aimed to form GameHub infrastructure in Higher Educational Establishments in Ukraine (project partners). It will give an opportunity to involve interested people in learning and to improve required skills and competencies in the gaming industry.

But the issue of the research of impact of innovative components of gamification, AR technologies on the mental characteristics and adaptive abilities of the individual remains quite extensive and uncovered. A number of issues related to the identification of the features of the use of modern simulation games for the development or stimulation of certain mental functions raises the need to create a continuum of multidisciplinary research programs. The urgent issues are to determine the features of the impact of simulation games on the future specialist's psychological features, in order to improve the capacity and construction of a new paradigm for future professionals' training, taking into account changing conditions of existence of modern society.

2 Literature review

The term, methods and basic principles of gamification came to us from foreign research and they were related to the business sphere, although not limited to it. Kapp's studies were particular fundamental, who changed the approaches and methods of the learning process thanks to gamification [10]. The significant potential of using game mechanisms in a non-game context and particularly educational has become a common practice and an extremely effective learning tool, which has attracted the attention of domestic researchers. The theory and

practice of gamification are presented by Werbach who confirm that "entertainment is an extremely valuable tool for solving serious business problems related to marketing, efficiency, innovation, customer engagement, staffing and stable development" [26]. Deterding explored general concepts of human-computer interaction to find out where the term "gamification" came from [7]. Chou and Chen studied the motivational component of gamification [5]. The stages of creating a gamified system are considered in detail by Janaki et al. [13]. The experience of using video games during learning is viewed in a series of articles by Cong et al. The authors are supporter of the use of game methods in the educational process, but they emphasizes that "it is always necessary to explain to students how and why the game fits into the general learning context [6].

On the other hand, Koster et al. sees learning as an integral part of the game [11]. Domestic scientists attach special importance to updating the process of implementing into the higher education system. As part of optimizing the implementation of the competency approach in the process of professional training of the future professionals in the context of digitalization of education, scientists suggest the implementation of game stimulators to develop soft skills competencies. Vakaliuk et al. present the possibilities of using the game simulator Software Inc for the development of professional soft skills in future software engineers in higher education, describe in detail how students can develop professional soft skills in the process of using game simulators [23]. Kalashnikova et al. considers the use of game tools in non-game educational process and emphasizes the positive impact of gamification in higher education that increases the competitiveness of future professionals [9]. Our theoretical review lets us say that the scope of researches related to serious video games at the international level is quite wide. One of the priority areas of the gaming industry is the introduction of elements of AR/VR technologies, which allows to bring game markers closer to reality, promotes better visualization and perception of virtual images. Analyzing the latest innovative approaches and models of the use of augmented reality components in education, we should pay attention to research by Binytska et al., identifies the implicit potential of immersive technologies implementation in in the educational space of universities around the world [4]. It is worth mentioning Pinchuk et al. research, which is aimed at comparative analysis of the use of mobile applications as elements of creating cognitive tasks for students in the process of natural and mathematical disciplines learning [19]. In the framework of interdisciplinary research we have to take into account scientific analysis of the effectiveness of the use of search algorithms of learning based on cognitive visualization (Bilousova et al. [3]) and the experience of implementing an innovative approach while providing a support for pedagogical interventions in information technologies for education based on Bayesian networks (Martínez Bastida et al. [15]). Theoretical analysis of the research results on the impact of integrative combination of game technologies and AR/VR technologies on psychological features and human conditions is presented in table 1.

The analysis of scientific sources and personal experience have revealed the main benefits of using gamification, which affect the effectiveness of professional

Table 1. Analysis of modern research on the impact of game technology, augmented reality on emotional states and physiological characteristics of the individual in the process of overcoming life crises and stressful situations.

Authors	Study	Concept of study
Róbert Sabo, Jakub Rajčáni, Marian Ritomský	Designing database of speech under stress using a simulation in virtual reality	The aim of this study was to provide a methodological foundation for creating language database under pressure that could be used in future experiments focused on the research of speech under stress. To trigger stress-related language changes, speakers participate in a virtual reality simulation of roller coaster riding. Heart rate and skin resistance are monitored as body features, whereas subjective experience is monitored using the Stress and Excitation List (SACL) [20].
Chelsea Dobbins, Stephen Fairclough, Paulo Lisboa, Félix Fernando González Navarro	A Lifelogging Platform Towards Detecting Negative Emotions in Everyday Life using Wearable Devices	The development of sensory technology helps to raise awareness of physiological states associated with negative emotions and this technology is aimed at the development of effective strategies for overcoming stressors. Smartphones and other devices use several built-in sensors that are able to capture everyday behavior on an ongoing basis that can provide a basis for self-reflection and understanding. The authors describe a mobile life-logging platform that uses augmented reality technologies which monitor and classify stress levels [8].
Anna Ståhl, Kristina Höök, Martin Svensson, Alex S. Taylor, Marco Combetto	Experiencing the Affective Diary	The authors demonstrate the experience of developing and implementing a digital diary called "Affective Diary", which provides users with an opportunity to write down their notes, but it also allows the users to record data from body sensors and mobile devices regarding certain physiological and emotional states of the users [22].
Diana MacLean, Asta Roseway and Mary Czerwinski	MoodWings: A Wearable Biofeedback Device for Real-Time Stress Intervention	Despite the increasing availability of sensors and methods for detecting stress, little attention has been paid to automated stress interventions and their actions. The authors introduced MoodWings: a wearable butterfly that displays the user's tense state in real time by means of activated wing movement. Researchers have developed MoodWings as a stress alert system and there is also a physical interface that allows users to manipulate their affective state. Accordingly, they have found out that MoodWings helps users to calm down and work better while fulfilling stressful tasks [14].
Daniel McDuff, Amy Karlson, Ashish Kapoor, Asta Roseway, Mary Czerwinski	AffectAura: An Intelligent System for Emotional Memory	AffectAura allows users to reflect on their emotional states for an extended period of time. Researchers have developed a multimodal sensor setup for continuous recording of audio, visual, physiological and contextual data, a classification scheme for predicting the affective state of the user, and an interface for displaying the user. The system constantly predicts the valence, excitement and activation of the user and associates it with event information, communication and data interaction [16].
Pablo Paredes, Matthew Chan	CalmMeNow: Exploratory Research and Design of Stress Mitigating Mobile Interventions	The researchers have created four prototypes to study the usability and effectiveness of mobile interventions for stress management: – Social networks: a text interface using SMS to deliver alarm messages is created. – Playing games: commercially available mobile games with simple tasks such as mazes and basic interaction games (slopes, moves, rotations) as stimulation of the distraction factor are used. – Managed acupressure: uses two vibration tactile motors in the bracelet, which stimulate acupressure points in the wrists and chest; these points are known to reduce stress. The researchers used the Wizard of Oz technique to monitor the time of this stimulus. – Controlled Breathing: using the same bracelet, participants are trained to breathe according to known methods of deep breathing; proper breathing rhythm is one of the key elements of achieving a calming effect. Authors researched the effectiveness of this comprehensive approach [17].
Akane Sano, Andrew J. Phillips, Amy Z. Yu, Andrew W. McHill, Sara Taylor, Natasha Jaques, Charles A. Czeisler, Elizabeth B. Klerman, Rosalind W. Picard	Recognizing Academic Performance, Sleep Quality, Stress Level, and Mental Health using Personality Traits, Wearable Sensors and Mobile Phones	The researchers have collected extensive subjective and objective data through mobile phones, surveys and sensors. The authors have analyzed daily and monthly behavioral and physiological patterns and identified factors that affect performance (GPA), Pittsburgh Sleep Index (PSQI), stress scale (PSS), and overall mental health score (MCS) with SF-12, using the data obtained [21].

development and development of professionally important qualities of future professionals, namely:

- in contrast to traditional technologies, gamification has an entertaining aspect that helps to have high involvement in the educational process;
- gamification is a helpful tool that increases cognitive activity and motivation;
- gamification allows students to develop flexibility of mind in solving practice-oriented tasks;
- gamification allows students to cooperate not only with each other but also with the teacher, to feel equal with him, which helps to remove psychological interaction barriers;
- gamification creates a sense of competition, causes positive emotions;
- gamification provides feedback – there is a feeling of excitement, curiosity is aroused;
- gamification creates a spirit of competition, which provides an opportunity to form constructive coping strategies of behavior in stressful situations and overcoming life crises [27].

However, despite the deep analysis of the information given above, the mechanisms of using augmented reality gamification in educational and psychocorrectional practice, taking into account the individual characteristics of young people, remain insufficiently studied, which led us to write this article.

3 Research methods

This research was conducted in the framework of joint research work of teachers and students (future psychologists and programmers) at the Laboratory of Health Psychology, Laboratory of Psychophysiological Research and STEAM-Laboratory of Bogdan Khmelnitsky Melitopol State Pedagogical University (figure 1).

The methods used in the process of research are the following:

1) theoretical – analysis, synthesis, comparison, generalization, systematization of theoretical and research data (identification of the state of the research problem, approaches to self-regulation analysis, general principles and advantages of simulated games based on augmented reality technologies in the development of personality stress as a factor of choice constructive strategies for overcoming life crises by young people, defining the basic concepts of the study);
2) the experiment, which was conducted in three stages:
   (a) *ascertaining stage* – psychological diagnosis by methods using HC-psychotest and Google Forms.
   To identify strategies for overcoming life crises were used:
      i. The Coping Strategy Indicators by Amirkhan [1];
      ii. Questionnaire "How I overcame the crisis of life". The method of projective drawings was used as an auxiliary one. There was a given theme of drawings – "I and the crisis", "I'm coming out of the crisis", "I am after the crisis".

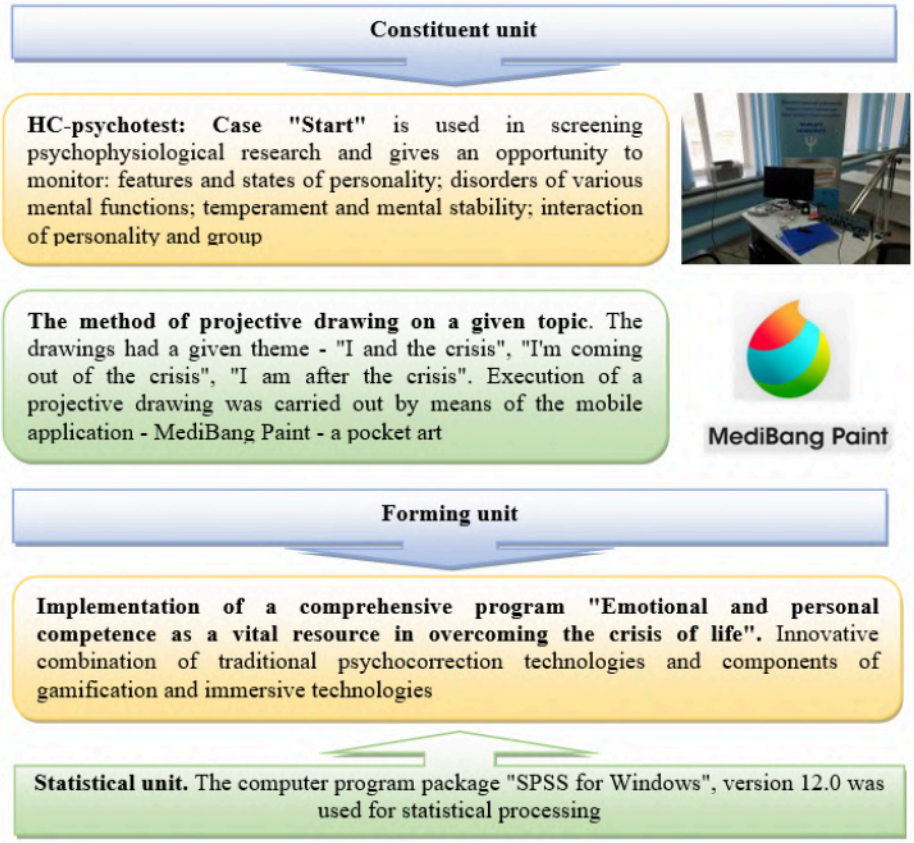


Fig. 1. The structure of the research program.

iii. Reflexive survey (compiled by the authors) using Google Forms, provided an opportunity to summarize the subjective assessment of personal and behavioral changes of respondents after experimental exposure.

In our research, we used both qualitative and quantitative approaches to study the problem, in order to supplement the results of each and cross-validate the obtained data.

(b) at the *formative stage* we integrated traditional psychological training on the use of cognitive-behavioral, relaxation and case-study techniques and the innovative opportunities of gamification components with AR technologies. The formative stage was carried out on the basis of STEAM-Laboratory.

(c) *statistical processing of experimental data* – calculations of measures of variability of results, correlation analysis (Pearson correlation coef-

ficient), Mann-Whitney U test and Student's t-test. SPSS for Windows 12.0 was used for statistical processing.

4 Research results

As a result of a comprehensive analysis of data, technical capabilities and close cooperation of teachers and students (future psychologists and programmers) a comprehensive program for the implementation of gamification components with AR technologies in the development of adaptive coping behavioral strategies in overcoming life crises.

The pilot study consisted of ascertaining and formative stages. Total sample (randomized), made by a stratification method – $n = 92$ people (future programmers and psychologists). According to the research objectives, the respondents were divided into control and experimental groups. No training sessions were conducted with respondents of control group. Specially organized corrective work was carried out with the respondents of the experimental group. Individual and group forms of training work were used within the limits of personality's stress resistance development. The training included elements of traditional psychocorrection work and gamification components with AR technologies. The study was conducted during 2019 – early 2020. Let's consider each research stage in turn.

1. Ascertaining stage. Pilot psycho-diagnostic research was conducted at the Laboratory of Psychophysiological Research with the use of an innovative computer-based complex of HC-psychotest. Respondents were also offered the use of mobile applications for the purpose of reflective interviewing and realization of self-control:

- Psychological tests (http://surl.li/adboq). A set of personality questionnaires, projective tests, aimed at studying the cognitive, personal, emotional, volitional, motivational and behavioral areas.
- Digital Freud: Psychological Tests (http://surl.li/adbpa). The application allows you to get objective knowledge about yourself, see the reflection of your personality in the digital world using innovative algorithms.
- Socionics, psychology, tests (http://surl.li/adbpg). Socionics studies the process of information exchange between a person and the outside world, i.e. how people perceive, process and issueinformation. With the help of the appropriate application, respondents have the opportunity to analyze the features of interaction with other people, their own psychotype and personal ability to overcome the impact of stressors and life crises.

One of the tasks of our psychodiagnostic study, which was conducted using the innovative computer system HC-psychotest [25] and Google Forms, was to study what life situations, events a person in adolescence considers a crisis, what is their content, whether they differ in boys and girls and representatives of different age groups. Let's turn to the results of the study. During the procedure of conducting the questionnaire "How I experienced a life crisis" most students

were responsible for the tasks, joined the work quickly, were interested in the results of the study. Almost all respondents (96.8%) were able to define the term "life crisis" and describe its various characteristics. Moreover, the number of definitions and described meaningful characteristics of the life crisis increases significantly with the age of the participants, ie the largest number of definitions was recorded at the age of 17–18 years. The average indicators of the number of definitions and characteristics of the life crisis, indicated by the respondents ofdifferent age groups are following: to $x = 3.7$ ($\sigma = 0.40$) – in 15–16-year-olds, $x = 5.4$ ($\sigma = 0.28$) – in 20–21 years old. According to the results of calculating the Mann-Whitney discrepancy criterion, for the age groups 18–19 years and 20–21 years, a significant statistical difference was found (the criterion ranges from 146–162, at $p = 0.05$). There is no statistically significant difference on the basis of gender.

Among the recorded characteristics of the studied features of the life crisis is most often noted "lack of resources to overcome the crisis", as well as "having no idea about the ways to solve the problem": "Lack of strength and capabilities", "I do not know much and I am not able to do it", "I do not know how to get out of this situation, what to do when it happens..." etc.

From the qualitative analysis, it is clear that a number of situations are perceived almost equally by both boys and girls. However, girls, unlike boys, more often described in more detail situations related to emotional content – "dissatisfaction with themselves or their appearance", "loneliness", and boys – those who have a rational character - "deductions from higher education institution", "financial problems".

As for the "emotional" situations, boys experience "public humiliation" and "betrayal" more difficult than girls. There are differences among the studied groups of different age. In that way, older respondents (aged 20–21 years) more specifically and described in more detail the various events and situations in life that caused the crisis.

According to the results of the survey, a certain typicality in response to a crisis and stressful situation was revealed, with its subjective uniqueness for each subject. If we combine the respondents' answers on the emotional principle and psychophysical response, they can be reduced to the following: short-term loss of reality and pain, sleep disturbances (or its loss), muscle tension, loss of appetite, indigestion, somatic diseases, anxiety and depression, self-doubt, increased excitability and irritability or vice versa apathy and indifference, impaired thinking and concentration, avoidance of difficulties (mentally and in real action), mental absorption of the problem, subjective feeling of burden of responsibility, sense of loss of meaning life, anger, shame and guilt, a sense of uncontrollability of what is happening, an understanding of the need to do something to change the situation. The typicality of the response was confirmed by the fact that the differences were not found between participants of different ages. However, there are statistically significant differences in reactions to such situations among the girls and boys.

The results show that girls experienced heart failure and difficulty breathing more often than boys (103, at $p = 0.002$), they could not perceive reality correctly (158, at $p = 0.005$), felt bad (criterion is 167, $p = 0.002$), were too excited and irritating (166, $p = 0.005$). Boys, on the contrary, more often felt a state of apathy and indifference (168, at $p = 0.005$).

According to table 2 it is seen that the number of choices of each of the studied participants as a whole in the sample is 3–4 such methods and they do not differ statistically in different age groups. No gender differences were recorded. Such data indicate that subjects of different sexes and ages are equally likely to note one or another way of overcoming life crises. They actualized them in their descriptions as those that are recorded in individual experience and implemented in life. About 30 different ways of overcoming difficult life situations were named from the sample. The list of overcoming ways is mentioned in the amount of at least 1% of all these. This includes ways that can be related to the 3 main areas of personality – or the emotional sphere ("I try to keep myself in hand", "I despair", "I got into a dead end", etc.), or to the cognitive sphere ("I'm trying to understand how this could have happened", "I'm looking for a logical explanation for what happened", etc.), or to the behavioral sphere of personality ("I pretend that nothing happened, that I'm fine", "I'm trying to move on to another case", etc.)

Table 2. The average indicator of ways of overcoming life crises.

	Total	18–19 years	20–21 years	Girls	Boys
arithmetic mean (X)	3.65	3.76	3.38	3.85	3.59
standard deviation (σ)	0.36	0.31	0.34	0.40	0.43

So, young people prefer search activity, the use of self-control and logic to find reasons, etc.; girls prefer emotional reactions, imagination, seeking support and communication, transmission of anxiety and problems of another person, that is, among the girls' ways of reactions emotional ones are dominated. According to the Mann-Whitney test, there are also some statistically significant differences between participants of different ages (range from 141 to 159, $p = 0.05$).

In order to help young people, conceptualize their ideas about how to overcome crises, they were asked to draw pictures on topics – "I and the crisis", "I overcame the crisis", "I am after the crisis". We assumed that with the help of a drawing it is possible to actualize unconscious symbolism and imagery. It should be noted that some complications were caused by this technique while performing and trying to "protective" avoid reflection ("I can't draw"). However, all those who participated in the study completed this task. Due to the nature of the symbols and the peculiarities of the image, we conditionally called these types "fighter", "infantile" and "seeking support" (table 3).

As can be seen from table 3, among the studied the most filled are 2 types – "Fighter" and "Infantile". Moreover, 20–21-year-old participants and young men

Table 3. Types of symbolic representation of the process of overcoming life crisis for the individual, (in %).

	Total	18–19 years	20–21 years	Girls	Boys
"Fighter"	55.4	47.5	64.6	66.5	43.2
"Infantile"	35.5	42.8	29.3	28.3	41.5
"Seeking support"	9.1	9.7	6.1	5.2	15.3

are the majority in the type of "Fighter". The Mann-Whitney test is 148 and 143, respectively, at $p = 0.002$.

The "Fighter" type is characterized by images of complex abstract symbols – various elements (e.g., water, sky, volcano, flood, fire, etc.), cosmic bodies (planets, sun, stars, space, constellations, etc.), complex geometric shapes (spirals, inscribed and described circles and rectangles, spheres, etc.). It is usually a metaphorical image in the form of a complex image that gives a complex meaning.

In addition, for all drawings referred to this type, the individual active position is characterized by the image of his struggle with the circumstances. In some drawings (8.3%) there are contradictions – for example, the simultaneous depiction of the desire for leadership and the need for care, patronage.

The "Infantile" type is characterized by the image of plot drawings with a clear and quite detailed image of yourself or self-portrait. Sometimes (5.2%) there were abstract, rather schematic images. However, the symbol "I" is more often (68.3%) depicted separately, as if "along the plot line", is outside the overall plot, or not depicted at all (26.5%), which indicates that the individual's non-involvement in overcoming life crisis and in feelings about it.

The "Seeking support" type is distinguished by a set of different images that show the direct expression of the feelings and sensations associated with a seeking support and a help. As a rule, plants, landscapes, animals, people and specific plots that show the search for and receiving a help from others were depicted.

Identified types of symbolic representation of the life crisis for the individual show insignificant differences between the samples of boys and girls and 18–19-year-olds and 20–21-year-olds according to Student's t-criteria. It is 2.36 at the significance level $p < 0.05$. This means that the subjects that we have classified into separate types belong to one population. This is also confirmed by the strong association between the sample of boys and girls and 18–19-year-old and 20–21-year-old subjects according to Pearson's agreement, which is 0.756 and 0.62, respectively, at a significance level of $p < 0.001$.

That is, these samples coincide in the symbolic representation of the life crisis for the individual. To clarify and differentiate the priority and significance for the studied participants of separate ways of overcoming life crises, as well as to better systematize them in self-awareness, the method of ranking was used in our research.

To do this, the participants were asked to read the list and main characteristics of coping methods, which they had named, and evaluate the methods

of overcoming their priority for themselves during a difficult life situation by assigning each of them the appropriate rank. The participants were given the task to determine their attitude to each method of overcoming by the criterion "I used it" or "I did not use it".

Then participants had to find the place of each method in their lives, determining their rank on the scale "It's important to me" and "I'll use it in the future". This technique makes it possible, on the one hand, to diagnose the level of identification with the peculiarities of ways to overcome life crises, and on the other hand it gives a chance to activate the independence of thinking in choosing different ways.

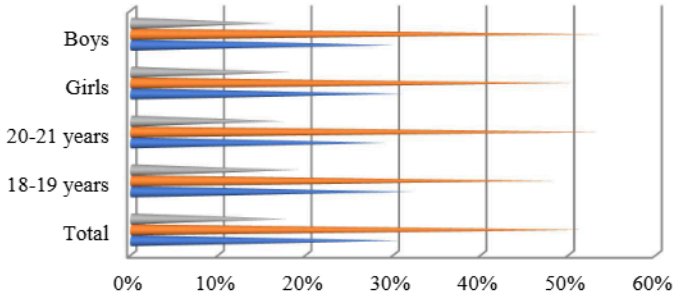
The ranking results show that there are age differences in the use of ways to overcome life crises. The Mann-Whitney discrepancy criterion for the age groups 18–19 and 20–21 years varies between 144–160, at $p = 0.05$.

For participants of older age (20–21 years), in contrast to younger ones, more significant and priority for the future use are ways to overcome life crises, which are connected with the activation of social connections and communication, including with professionals, as well as stress resistance, emotional stability, resilience, low anxiety, self-control, self-regulation, self-belief, self-esteem and the use of creative activities and hobbies. In addition, younger students are more likely to choose crisis management mechanisms such as search activity and imagery in the future, and 20–21-year-olds are more likely to choose physical activity. Analysis of the results of ranking the ways of overcoming by girls and boys showed that in general there is no statistically significant difference between girls and boys. However, there are differences in the use of certain methods in the future. Girls are more often than boys tend to choose in the future such ways of overcoming crises as the use of imagery, emotional reactions, as well as relaxation, meditation, breathing exercises, etc., and boys – a logical search for causes and increase self-esteem. The Mann-Whitney discrepancy criterion for these indicators varies between 142–154, $p = 0.05$. Based on the obtained data after the ranking, the participants were joined into 3 groups based on the level of acceptance of ways to overcome life crises. A small assignment of ways to overcome the criterion of "This I will use in the future" is characterized for those who showed a "low level of acceptance of ways to overcome".

Participants from this group are selected and included in the list "It is important to me" all the proposed methods, but due to ignorance of the possible use of selected methods they cannot choose them for the future use in a difficult life situation or crisis. As a rule, for further use, they chose a small number of ways to overcome.

The "high level of acceptance of coping methods" is characterized by the coincidence and strong connection with Spearman's rank correlation between the lists of coping techniques according to the criteria "It is important for me" and "I will use it in the future". The rank correlation index is in the range from $+0.56$ to $+0.835$ (significance level $p < 0.001$). The level of "confusion" is characteristic of those young people who have demonstrated differences between the ways of overcoming that are important to them and those that they will use

later in their life. That is, such participants who chose one list of methods as important for the individual and another one - that might be used in the future. Comparative data are given in figure 2. Significant difference in age and gender statistically was not found.



	Total	18-19 years	20-21 years	Girls	Boys
Perplexity	17.80%	19.20%	17.50%	18.10%	16.40%
High level of acceptance of ways to overcome	51.60%	48.50%	53.50%	50.70%	53.50%
Low level of acceptance of ways to overcome	30.60%	32.30%	29%	31.20%	30.10%

Fig. 2. Levels of acceptance of overcoming life crises ways.

A comparison of the results of the representatives of different types symbolic representation of life crisis for the individual in the drawings showed that the group "Low level of acceptance of overcoming ways" represents the types "Infantile" (68.5%), "Seeking support" (27.9%) and "Fighter". (3.6%). The group "High level of acceptance of overcoming ways" consists of 84.2% of representatives of the type "Fighter" and 15.8% "Seeking support". And the third group "Confusion" includes 56.3% of students, who are of the type "Seeking support", 30.7% – "Infantile" and 13% – "Fighter".

Thus, the majority of young people (51.6%) were able to accept, understand the suggested ways of overcoming difficult life situations and include them in the arsenal of potential ways that can be used in the future. In general, it should be noted that adolescence is characterized by the desire to seek a help and a support from the close environment, that the young person trusts more both parents, loved ones, friends and so on. Boys and girls show a desire to keep away from strangers, including professionals. Relevant empirical data are the basis for the implementation of the formative stage of the research.

2. Formative stage. At the formative stage we integrated traditional psychological training on the use of cognitive-behavioral, relaxation and case-study techniques and the innovative opportunities of gamification components with AR/VR technologies. The formative stage was carried out on the basis of STEAM-

Laboratory. Traditional training, presented at the formative stage, included the psycho-corrective program "Emotional and personal competence as a vital resource in overcoming the crisis of life". The purpose of the program is for participants to acquire knowledge about psychological support and the use of elements of gamification in the process of psychological support of young people in crisis situations and to acquire practical skills for its application in everyday life. Particular attention is paid to the formation of a positive image of a stressful situation, learning how to analyze the situation in a cognitive way, updating the skills of arbitrary relaxation and gaining the experience of applying techniques and formulas of constructive response in stressful situations. In the process of implementing the comprehensive program, the following psycho-correctional methods were implemented: resource exercises, interactive mini-lectures, discussions, facilitation, brainstorming, clustering, moderation, role play, "aquarium", reflection, sharing. The corresponding program consists of three blocks: development of cognitive sphere, formation of constructive coping strategies of behavior of youth in the course of overcoming of life crises (behavioral sphere), development of sanogenic potential and stress resistance (emotional and volitional sphere). An innovative trend in the implementation of a comprehensive program "Emotional and personal competence as a vital resource in overcoming the crisis of life" is the introduction of gamification components and augmented and virtual reality technologies.

The program is created in accordance with the principles of the concept of Accelerated Learning Theory and uses all the latest developments in the field of methodology of adult learning. Note that smartphones, tablets, laptops have become an integral part of youth's lives, and the versatility of these powerful high-tech devices remains largely unclaimed. Active attempts to use these devices in the educational process are characterized in the literature as a trend BYOD (Bring Your Own Device). From the point of view of reorganization of educational process and psychological support of youth implementing of BYOD brings many useful opportunities.

Using the concept of BYOD as a universal tool for psychological support of youth provides a unique opportunity to combine traditional training technologies with components of gamification and AR/VR technologies in the development of stress resistance and the formation of constructive strategies for overcoming life crises by future professionals. This provides an opportunity to implement at a higher level such principles of psychological influence as clarity, accessibility, awareness, connection with life, and most importantly – to develop the desire for self-change and introspection, promote cognitive activity, initiative, develop the ability to define problems and find ways for their solution.

Psychological technologies of the complex program were implemented on the basis of the Laboratory of Health Psychology, components of gamification and elements of augmented and virtual reality in the corresponding program were implemented on the basis of STEAM-Laboratory of Bogdan Khmelnitsky Melitopol State Pedagogical University (figure 3).

Fig. 3. Practical implementation of a comprehensive program "Emotional and personal competence as a vital resource in overcoming the crisis of life" with a combination of traditional psychocorrectional technologies and elements of gamification with augmented and virtual reality.

In order to implement the constructs of virtual and augmented reality we have used special technical equipment of STEAM-Laboratory. The minimum set of equipment, which is required to implement such an integrative approach is the following: required number of smartphones and VR helmets; tablet; computers; Wi-Fi router, Internet access; system of remote update; educational videos and software; touch pad. The XRcase system gives the opportunity to deliver classes on 10, 16 or 30 virtual reality devices. In the process of traditional training delivering, the elements of AR technologies were actively used, namely [24]:

1. While implementing the elements of cognitive-behavioral therapy, desensibilization techniques, aimed at reducing anxiety (fear) to scary objects or situations (such as fear of flying, heights, fear of spiders, mice, snakes), the following Google Play applications were used:
   - *VR Thrills: Roller Coaster 360 (Cardboard Game)* – an amazing roller coaster adventure in virtual reality mode. This game provides the users with the opportunity to see many different types of roller coaster in virtual reality mode. It gives the chance to feel and reflect on various mental and emotional fears, maybe even frustration.

- *VR Heights Phobia* – a virtual reality game with a challenge: while completing the mission, participants cope with their phobias in the VR world. They use their own body to navigate the three- dimensional world, bounce their heads up and down, and the avatar moves as well. Each movement is monitored by a telephone gyroscope, giving participants a realistic, enjoyable experience, and the participants focus on and deal with their emotions.
- *VR – Spider Phobia Horror*. Through this program, participants try to overcome their arachnophobia. Students explore the world of spiders at 2 different levels and their environment. This virtual, but very close to reality case, develops the skills of self-control and emotional stability in extreme stressful environments.
- *Ball Maze VR* for cardboard and daydream virtual reality glasses – participants need to roll the ball across the maze from start to exit. The ball always moves straight. The movement of the ball is controlled by the rotation of the head. This game is aimed at the development of concentration and stability of attention, emotional intelligence, and internal analysis of psychophysical states.
- *VR Mission Leviathan – underwater expedition* – virtual reality attraction is a 360 VR adventure. A VR helmet, goggles, or card-board allow participants to fully experience the depth of field explorer. Mission Leviathan's VR attraction is an underwater mission simulator. Surrealistic virtual reality with carefully crafted sound and detailed 3D graphics, clear, vivid and colorful models and characters, is aimed at a comprehensive impact on all sensory features of the person, at the same time arouses a variety of emotions, feelings and experiences, shapes cognitive-reflective skills of information processing and making decisions in difficult conditions.

2. In order to implement relaxation techniques using AR technologies, the following applications have been used:
   - In *Graffiti Paint VR* participants spray graffiti in virtual reality – they just choose a can or create their own one with a certain color and start to spray it. This application provides the possibility of psycho-emotional relief, overcoming neuropsychic tension.
   - *Art Therapy* is an application for adults that helps users concentrate on positive emotions, create their own art masterpiece, relieve emotional tension and relax.
   - *Thisissand – Art, Creativity & Relaxation* is a creative space for designing objects from colored sand; it is focused on reducing psycho-emotional stress, situational and personal anxiety, as well as on the promotion of personality's creative potential.
   - *Relax River VR* – participants can achieve emotional and psychological comfort while having a virtual reality boat tour, sailing on a beautiful river, with picturesque scenery of mountainous area and incredible creatures. It is a fully automatic tour, without any settings.

3. The use of augmented reality components while implementing cognitive-behavioral therapy and self-reflection:
   - *Moodpath – Depression & Anxiety Test* is focused on assessing mental health, monitoring and reflecting one's own mood, as well as taking a break from negative thoughts and negative emotions. Moodpath is used as an intelligent mood tracker. Through it, participants are provided with a chance to have a quick overview of their emotional states throughout the day, master cognitive-behavioral therapy (CBT) activities, understand the cause-and-effect relationship between events and emotional states, integrate mindfulness into their daily lives, develop empathy and skills of self-observation.
   - *CBT Companion: (Cognitive Behavioral Therapy app)* is the most comprehensive cognitive-behavioral therapy application available today. It is equipped with easy-to-use visual tools. The application presents the scheme of formation of certain skills through cognitive-behavioral therapy. A block of video lessons is also given.
   - *ACT iCoach: Acceptance Commitment Therapy App* is a comprehensive application that covers all aspects of acceptance and commitment therapy. Participants learn and practice ACT skills using video tutorials and fun animation that help them learn more. The application provides participants with convenient tools for tracking their mood, emotions.
   - *CBT Thought Diary – Mood Tracker, Journal & Record.* A central element of cognitive behavioral therapy (CBT) is training to identify negative and distorted patterns of thinking in order to change one's own emotions and behavior for the better. In cognitive-behavioral therapy, "record of thought" leads participants through the stages of detection, denial and rethinking of negative models of thinking. With the Thought Diary, participants can record their negative emotions, analyze the drawbacks in their thinking, and re-evaluate their negative thoughts into more balanced ones.

The following game technologies were recommended for the purpose of introduction of games-simulators within each corresponding training block:

1. Development of cognitive sphere of personality:
   - *Mind Games* is a collection of amazing educational games based on the principles of cognitive psychology and aimed to develop mental abilities. The application includes more than 24 educational games. All games keep track of successes, with numbers and graphs. Personal best results for all time and for the current day are given on the page of the list of games. All indicators are evaluated on a common scale, and the participant can easily see exactly what skills you need to work on. This game trains concentration, reaction speed, memory, flexibility of thinking.
   - *Left vs Right: Brain Games for Brain Training* is a game designed to check awareness, adaptability, reflection, prudence, accuracy and patience, stimulates the development of interspheric interaction of the brain.

- *NeuroNation* is a set of 27 interesting games, exercises and personalized courses that stimulate the development of intelligence, memory and logical thinking, increase volume and concentration of attention.
- *Lumosity* is a set of 25 cognitive games that stimulate development cognitive and motivational sphere of personality.
- *Brain Games* is an interesting brain simulator which consists of various games: games for memory development, thinking, cognitive games, intelligence games, attentiveness games. An application with simulator games develops the mind, abilities, strengthens cognitive connections, expands consciousness, increases, attentiveness, trains memory, adjusts the mental process.

2. Development of emotional and volitional sphere:
   - *Emoji Puzzle* is an imagination game in which you need to match pairs of emotions with associations, it stimulates the development of emotional competence;
   - *Harmony* is a puzzle game that combines art therapy technology, music therapy and an exciting gameplay in which you need to click on the squares and create good symmetry. When you press each square, music plays, which stimulates the harmonization of psycho-emotional state.
   - *Antistress Relaxing Games* is the collection of simulation games which helps to relax or switch attention temporarily. In this game you can listen to a bamboo bell, play with wooden cubes, move your finger on the water, press buttons, draw with chalk and so on.
3. Development of the behavioral sphere:
   - *Easy Game* are the games-simulators presented in the application and provide an opportunity to make decisions based on the cognitive abilities of the individual in difficult life situations and situations that require quick choices.
   - *Virtual High School Teacher 3D* is a simulator game, which stimulates the development of constructive behavioral strategies in professional activities.
   - *Homescapes* is a simulator game focused on the development of constructive behavioral strategies in overcoming stressful life situations.

We used re-diagnostic data as a criterion for assessing the effectiveness of the training and the changes that occurred with the respondents, using the Coping Strategy Indicator, the procedure for ranking ways to overcome life crises and a questionnaire on changes that occurred after training. Indicators of the experimental and control groups were compared with each other. Statistically significant differences between them were analyzed by the criterion of Mann-Whitney differences.

Representatives of the experimental group, who underwent active training with the use of gamification elements and AR/VR technologies, in contrast to the control group, which did not undergo training, showed significant changes in the choice of strategies to overcome everyday difficulties. Only 3 people from the experimental group chose, as before the training, an avoidance strategy, and the

vast majority implement new active methods of overcoming. The vast majority of the control group did not change their strategies for solving daily problems. The Mann-Whitney test shows statistically significant differences between the results of the experimental and control groups (164 at $p = 0.05$).

As a result of the re-ranking of coping techniques according to the criteria "It is important for me" and "I will use it in the future", out of 25 representatives of the experimental group 17 showed a coincidence of sets of coping methods that are important to them and that they will use in the future (table 4). This is an indicator of a high level of awareness of these methods and their acceptance (the value of Spearman's rank correlation coefficient varies in the range from +0.46 to +0.71 at the significance level $p < 0.001$). That is, these subjects significantly improved their results and were assigned by us to the group with a "high level of acceptance of ways to overcome life crises", which also includes representatives of the control group (figure 4). This is confirmed by Student's t-test, which shows insignificant differences between the two samples (2.34 at the level of significance $p < 0.05$).

Table 4. Comparative data of the researchers using the Coping Strategy Indicator.

Strategies	Experimental group				Control group			
	Before training		After training		Before training		After training	
	Persons	%	Persons	%	Persons	%	Persons	%
Problem solving	–	–	11	47.8	–	–	2	8.7
Search for social support	5	21.7	9	39.1	4	17.4	5	21.7
Avoidance	18	78.3	3	13.1	19	82.6	16	69.6

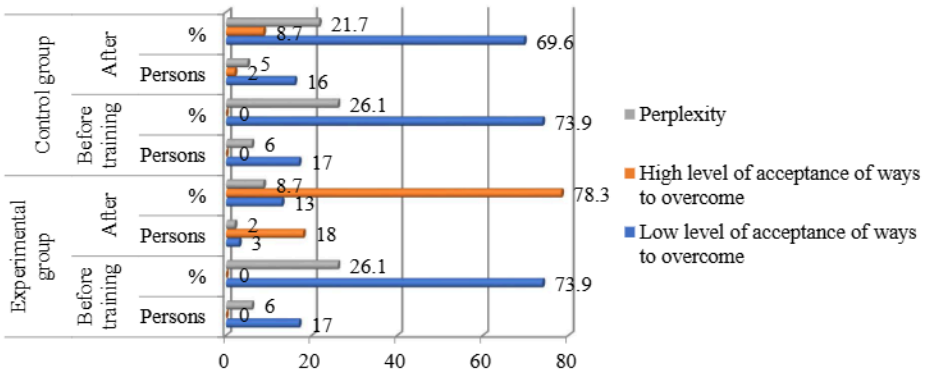


Fig. 4. Comparative data of the studied by the method of ranking ways to overcome life crises.

5 young people from the experimental group, according to the ranking, showed a result identical to the one they demonstrated before the training, i.e. 2 people remained in the group "confused" and 3 – "low level of acceptance of ways to overcome". Perhaps, the positive changes in these subjects would be more pronounced if they had the opportunity to receive additional training in the formation of practical skills of choice and application of possible ways to overcome life crises. In contrast to the experimental group, most of the control group (21 people) did not change their level of acceptance of crisis management techniques, only 2 people were able to improve their previous result and showed a high level. The differences between the control and experimental groups are statistically significant. The Mann-Whitney test is equal to 161 at the significance level $p = 0.05$.

According to the results of the survey, the vast majority of respondents noted and named specific changes that they were able to notice in themselves, their own behavior, etc. (table 5).

Table 5. The results of self-assessment of changes in the experimental group.

The nature of the changes	Persons
Convinced of their ability to cope with life's difficulties	21
Learned to control their emotions	19
Learned different ways and techniques to deal with problems	18
Understood the value of supporting relatives and friends in a difficult situations	17
Self-confidence has increased	17
Learned to analyze problem situations	17
Became more positive about themselves	15
Anxiety decreased	13
Self-esteem has increased	12
Understood the need for more flexible behavior in a problematic life situation	11
Became calmer	10
They found that there is a way out of any situation	9
We were convinced that it is possible to change oneself	8
We understand that if the situation cannot be resolved, it is possible to change the attitude to it	8
Learned to perceive problems philosophically	6
Learned to plan their actions	5
Gained new life experience	3
Gained new life experience	3

The results presented in table 5 show that the vast majority of the experimental group named the changes that took place in themselves, the experience and skills of self-regulation of emotions, which, in our opinion, also indicates the effectiveness of the training program with elements of gamification.

5 Conclusions and recommendations for future research

The key features of the education system are the results of globalization and technologization, which can be observed at the present stage of society development. Under the conditions of globalization, a network model of knowledge dissemination is being formed. It is characterized by the rapid dissemination of a new information product through the Internet. In the context of the society technological development, new approaches and formats for the presentation and transfer of knowledge are being formed. They provide available, high quality and personalized access; new conditions of professional activity realization due to the development of modern technologies (artificial intelligence, robotics, 3D modeling and prototyping, virtual reality, etc.). Analyzing the works of foreign authors on this topic, it should be noted that the increasing popularity of the augmented reality technology and interest to it, at the present moment, is driven by the research works that provide the rational for the prospects of using augmented reality technology through the expansion of production sphere and creation of completely new spheres and service markets in the near future. Due to such a global introduction of gamification components and augmented reality elements into education, our research, aimed at the implementation of an integrative approach in the development of youth's stress-resistance, choosing constructive strategies for overcoming life crises has turned out to be a very vital and important one. This research shows an innovative combination of traditional psychodiagnostic and corrective influences with of gamification components and AR/VR technologies. This research was conducted within the framework of the cooperation of laboratories – Laboratory of Psycho Physiological Research, Laboratory of Health Psychology and STEAM-Laboratory. At the methodological level of the research we have analyzed and substantiated the ways of combining traditional methods with gamification components and AR/VR technologies, and the model of development of constructive strategies for overcoming life crises in adolescence. At the empirical level, the effectiveness of implementing gamification components and AR/VR technologies into the process of stress resistance development, as an integrative feature of future specialist, that directly influences productivity and efficiency of the future activity, has been proved. The perspectives for further research are the following: development of the concept of the purposeful use of gamification components and AR/VR technologies while constructing an effective personality-oriented vector of higher education; research of the impact of augmented reality elements on a person's mental characteristics.

Acknowledgements A comprehensive interdisciplinary study was conducted in the framework of scientific cooperation between STEAM-laboratory, Laboratory of Psychophysiological Research and Laboratory of Health Psychology of Bogdan Khmelnitsky Melitopol State Pedagogical University. The interdisciplinary approach was implemented in the doing of the research work at the expense of the general fund of the state budget: "Adaptive system for individualization and personalization of professional training of future professionals in blended learning", number of state registration is 0120U101970.

References

1. Amirkhan, J.: A Factor Analytically Derived Measure of Coping: The Coping Strategy Indicator. Journal of Personality and Social Psychology **59**(5), 1066–1074 (11 1990). https://doi.org/10.1037/0022-3514.59.5.1066
2. Avsar, E.K.: Analysis of gamification of education. The Online Journal of New Horizons in Education **7**(1), 20–23 (2017), https://www.tojned.net/journals/tojned/articles/v07i01/v07i01-04.pdf
3. Bilousova, L., Gryzun, L., Zhytienova, N., Pikalova, V.: Search algorithms learning based on cognitive visualization. In: Ermolayev, V., Mallet, F., Yakovyna, V., Mayr, H.C., Spivakovsky, A. (eds.) Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. Volume I: Main Conference, Kherson, Ukraine, June 12-15, 2019. CEUR Workshop Proceedings, vol. 2387, pp. 472–478. CEUR-WS.org (2019), http://ceur-ws.org/Vol-2387/20190472.pdf
4. Binytska, K., Bilyakovska, O., Yankovych, O., Buchkivska, G., Binytska, O., Greskova, V., Ocheretna, I., Burov, O., Lytvynova, S.: Implicit potential of immersive technologies implementation in the educational process at the universities: World experience. In: Proceedings of the 1st Symposium on Advances in Educational Technology - Volume 2: AET. pp. 264–274. INSTICC, SciTePress (2022). https://doi.org/10.5220/0010930700003364
5. Chou, Y.K., Chen, T.L.: The implementation of digital creative teaching in design. In: 2018 1st IEEE International Conference on Knowledge Innovation and Invention (ICKII). pp. 274–277 (2018). https://doi.org/10.1109/ICKII.2018.8569196
6. Cong, G., Domeniconi, G., Shapiro, J., Yang, C.C., Chen, B.: Video action recognition with an additional end-to-end trained temporal stream. In: 2019 IEEE Winter Conference on Applications of Computer Vision (WACV). pp. 51–60 (2019). https://doi.org/10.1109/WACV.2019.00013
7. Deterding, S.: Interaction tension: A sociological model of attention and emotion demands in video gaming. Media and Communication **7**(4), 226–236 (2019). https://doi.org/10.17645/mac.v7i4.2366
8. Dobbins, C., Fairclough, S., Lisboa, P., Navarro, F.F.G.: A lifelogging platform towards detecting negative emotions in everyday life using wearable devices. In: 2018 IEEE International Conference on Pervasive Computing and Communications Workshops (PerCom Workshops). pp. 306–311 (2018). https://doi.org/10.1109/PERCOMW.2018.8480180
9. Kalashnikova, L., Hrabovets, I., Chernous, L., Chorna, V., Kiv, A.: Gamification as a trend in organizing professional education of sociologists in the context of distance learning: analysis of practices. Educational Technology Quarterly (Feb 2022). https://doi.org/10.55056/etq.2, https://acnsci.org/journal/index.php/etq/article/view/2
10. Kapp, K.M.: Gamification designs for instruction. In: Reigeluth, C.M., Beatty, B.J., Myers, R.D. (eds.) Instructional-Design Theories and Models, vol. IV. The Learner-Centered Paradigm of Education, pp. 351–383. Routledge, New York (2016), https://www.taylorfrancis.com/chapters/edit/10.4324/9781315795478-16/gamification-designs-instruction-karl-kapp
11. Koster, P., Kamperman, F., Lenoir, P., Vrielink, K.: Identity-based DRM: Personal entertainment domain. In: Shi, Y.Q. (ed.) Transactions on Data Hiding and Multimedia Security I. pp. 104–122. Springer Berlin Heidelberg, Berlin, Heidelberg (2006). https://doi.org/10.1007/11926214_4

12. Kruglyk, V.S., Osadchyi, V.V.: Developing competency in programming among future software engineers. Integratsiya obrazovaniya = Integration of Education **23**(4), 587–606 (2019). https://doi.org/10.15507/1991-9468.097.023.201904.587-606
13. Kumar, J., Herger, M., Deterding, S., Schnaars, S., Landes, M., Webb, E.: Gamification @ work. In: CHI '13 Extended Abstracts on Human Factors in Computing Systems. p. 2427–2432. CHI EA '13, Association for Computing Machinery, New York, NY, USA (2013). https://doi.org/10.1145/2468356.2468793
14. MacLean, D., Roseway, A., Czerwinski, M.: Moodwings: A wearable biofeedback device for real-time stress intervention. In: Proceedings of the 6th International Conference on PErvasive Technologies Related to Assistive Environments. PETRA '13, Association for Computing Machinery, New York, NY, USA (2013). https://doi.org/10.1145/2504335.2504406
15. Martínez Bastida, J.P., Gavrilenko, E., Chukhray, A.: Developing a pedagogical intervention support based on bayesian networks. In: Ermolayev, V., Bassiliades, N., Fill, H., Yakovyna, V., Mayr, H.C., Kharchenko, V.S., Peschanenko, V.S., Shyshkina, M., Nikitchenko, M.S., Spivakovsky, A. (eds.) Proceedings of the 13th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer, ICTERI 2017, Kyiv, Ukraine, May 15-18, 2017. CEUR Workshop Proceedings, vol. 1844, pp. 265–272. CEUR-WS.org (2017), http://ceur-ws.org/Vol-1844/10000265.pdf
16. McDuff, D., Karlson, A., Kapoor, A., Roseway, A., Czerwinski, M.: Affectaura: An intelligent system for emotional memory. In: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. p. 849–858. CHI '12, Association for Computing Machinery, New York, NY, USA (2012). https://doi.org/10.1145/2207676.2208525
17. Paredes, P., Chan, M.: Calmmenow: Exploratory research and design of stress mitigating mobile interventions. In: CHI '11 Extended Abstracts on Human Factors in Computing Systems. p. 1699–1704. CHI EA '11, Association for Computing Machinery, New York, NY, USA (2011). https://doi.org/10.1145/1979742.1979831
18. Parsons, T.D., Iyer, A., Cosand, L., Courtney, C., Rizzo, A.A.: Neurocognitive and psychophysiological analysis of human performance within virtual reality environments. Stud Health Technol Inform **142**, 247–252 (2009)
19. Pinchuk, O., Tkachenko, V., Burov, O.: AR and VR as gamification of cognitive tasks. In: Ermolayev, V., Mallet, F., Yakovyna, V., Mayr, H.C., Spivakovsky, A. (eds.) Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer. Volume I: Main Conference, Kherson, Ukraine, June 12-15, 2019. CEUR Workshop Proceedings, vol. 2387, pp. 437–442. CEUR-WS.org (2019), http://ceur-ws.org/Vol-2387/20190437.pdf
20. Sabo, R., Rajčáni, J., Ritomský, M.: Designing database of speech under stress using a simulation in virtual reality. In: 2018 World Symposium on Digital Intelligence for Systems and Machines (DISA). pp. 321–326 (2018). https://doi.org/10.1109/DISA.2018.8490641
21. Sano, A., Phillips, A.J., Yu, A.Z., McHill, A.W., Taylor, S., Jaques, N., Czeisler, C.A., Klerman, E.B., Picard, R.W.: Recognizing academic performance, sleep quality, stress level, and mental health using personality traits, wearable sensors and mobile phones. In: 2015 IEEE 12th International Conference on Wearable and Implantable Body Sensor Networks (BSN). pp. 1–6 (2015). https://doi.org/10.1109/BSN.2015.7299420

22. Ståhl, A., Höök, K., Svensson, M., Taylor, A.S., Combetto, M.: Experiencing the affective diary. Personal and Ubiquitous Computing **13**(5), 365–378 (Jun 2009). https://doi.org/10.1007/s00779-008-0202-7, https://doi.org/10.1007/s00779-008-0202-7
23. Vakaliuk, T., Kontsedailo, V., Antoniuk, D., Korotun, O., Semerikov, S., Mintii, I., Kalinichenko, O.: Possibilities of using the Game Simulator Software Inc in the Training of Future Software Engineers. In: Proceedings of the 1st Symposium on Advances in Educational Technology - Volume 1: AET. pp. 665–675. INSTICC, SciTePress (2022). https://doi.org/10.5220/0010927200003364
24. Varina, H., Osadcha, K., Shevchenko, S., Glazunova, O.: Features of implementation of augmented and virtual reality technologies in the psycho-correctional process of development of emotional intelligence of high school students in terms of professional self-determination. In: Proceedings of the 1st Symposium on Advances in Educational Technology - Volume 2: AET. pp. 85–100. INSTICC, SciTePress (2022). https://doi.org/10.5220/0010928700003364
25. Varina, H., Shevchenko, S.: The peculiarities of using the computer complex HC-psychotests in the process of psychodiagnosis of the level of development of future specialists´ mental capacity. E3S Web Conf. **166**, 10025 (2020). https://doi.org/10.1051/e3sconf/202016610025
26. Werbach, K.: (re)defining gamification: A process approach. In: Spagnolli, A., Chittaro, L., Gamberini, L. (eds.) Persuasive Technology. pp. 266–272. Springer International Publishing, Cham (2014). https://doi.org/10.1007/978-3-319-07127-5_23, https://works.bepress.com/kevin_werbach/3/
27. Wood, L.C., Reiners, T.: Gamification. In: Khosrow-Pour, M. (ed.) Encyclopedia of Information Science and Technology, pp. 3039–3047. IGI Global, 3 edn. (01 2015). https://doi.org/10.4018/978-1-4666-5888-2.ch297