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ЦИФРОВАЯ СОЦИАЛИЗАЦИЯ И ОБУЧЕНИЕ В ЦИФРОВОЙ ОБРАЗОВАТЕЛЬНОЙ СРЕДЕ

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Тематические редакторы: М.Г. Сорокова, О.В. Рубцова

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PSYCHOLOGICAL SCIENCE AND EDUCATION

DIGITAL SOCIALIZATION AND TEACHING IN A DIGITAL LEARNING ENVIRONMENT

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Introduction from the editors of the thematic issue

The digital transformation of the economy, education, and everyday life has become a reality. Digital technologies are actively used in the educational process, where teachers' and students work at different levels of education. In psychological and pedagogical research, the concept of a digital learning environment (DLE) is becoming more popular. There are a lot of studies about its influence on the interaction between teachers and students and their academic achievements. There are a lot of discussions about the perception of DLE by participants of the educational process. In this issue authors reveal predictors of DLE adoption and the "barriers of the first and second order". The first "shock" from the sudden and massive transition of the education system "to digital rails" during the COVID-19 pandemic had been replaced with an understanding of the new possibilities of digital technologies and their partial application in modern professional and everyday life. As a result, recently appeared some constructive studies on that, and we selected them for this thematic issue.

The professional community is beginning to understand that the DLE is not only online learning; it s the whole set of modern digital platforms, LMS, tools, and services for managing the learning and self-learning process and implementing new opportunities for interaction between a teacher and students or schoolchildren. In one of the articles in our new issue, the digital learning environment of a university is understood as a set of digital technologies, methods, and tools designed to support the educational process and the implementation of scientific activities by students and teachers to promote learning, self-learning, and the development of general cultural, professional, and digital competencies that students will need to find their place in the labor market [Sorokova M.G., Odintsovo M.A., Radchikova N.P., Evaluation of digital educational technologies by university teachers].

The DLE consists of various components in different combinations, including: online courses on the educational platforms (Moodle, Coursera, Stepik, etc.); webinar software for distance education (Mirapolis, Zoom, Cisco Webex, Google Meet, etc.); university platforms for independent testing of students' academic achievements (HT-Line, etc.); an electronic library of the universities; digital tools and programs for quantitative analysis of empirical research data (SPSS, Statistica, Mathcad, etc.); tools for checking the uniqueness of texts (Anti-Plagiarism, etc.); and others. There is also an increasing interest in the use of gamification in education.

The indicated trends are discussed in the articles of this thematic issue "Digital socialization and teaching in a digital learning environment". There are three sections: "The role of digital games in the development of children and adolescents", "Digital tools for assessing development, competencies, and behavior" and "Digital learning environment in the modern process of education and upbringing". The first section contains articles that analyze the correlationship between the personal characteristics of adolescent gamers and their behavior in the virtual space, the role of social intelligence in successful task solving in computer games, and the study of the correlation between preferred digital games and the regulatory functions of children 6—7 years old. The second section combines articles that analyze assessments of creativity, digital literacy, cognitive control while using digital tools, as well as cyberloafing among schoolchildren and students. The third section covers the analysis of the readiness of students and teachers to use digital technologies in education and the study of the mechanisms of "virtual education" in the Virtual College of Medical Education and Management of the University of Medical Sciences of Tehran. There is an interesting analysis of the phenomenon of "technostress" and the features of interaction between teachers and students in the DLE provided by scientists from Indonesia. Other subjects are the formation of methodological readiness for mediation in the hybrid model of education and digital storytelling as an educational tool for the formation of spiritual and moral values among adolescents.

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The Role of Digital Games in the Development of Children and Adolescents

Роль цифровых игр в развитии детей и подростков

Network Analysis of the Relationship between Personality Traits and Online Behavior in Adolescents and Young Adults: Research on Dota 2 Players

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The article presents the results of a correlation analysis of the influence of Dota-2 players' personal characteristics on their behavior in the virtual space. The analysis is based on the data, received in the course of a series of experiments conducted by the Center for Interdisciplinary Research on Contemporary Childhood in Moscow State University of Psychology and Education in 2015-2023. Research methods include the Q-Sort technique by W. Stephenson, the Butler-Haigh "Real and Ideal Test", the Role Conflict Questionnaire developed by O.V. Rubtsova, and Adolescent Egocentrism Scale (AES) by R. Enright. The sample includes 103 active players of MOBA Dota-2 aged 14—25. The paper discusses statistical correlations, in particular, those identified on the basis of a network analysis of partial correlations. The analysis suggests that such factors as role incompatibility and the need for role-playing experience may be manifested in virtual play activity and partly determine the specifics of its implementation by adolescents and young adults.

Keywords: computer games, play activity, virtual reality, adolescence, role conflict, partial correlations, network analysis.

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Сетевой анализ взаимосвязи личностных особенностей игроков подросткового и юношеского возраста с их поведением в виртуальном пространстве (на примере групповой компьютерной игры «Dota 2»)

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В статье представлены результаты корреляционного анализа влияния личностных особенностей игроков видеоигры «Dota 2» на их поведение в виртуальном игровом пространстве. Анализ выполнен на основе данных, полученных в ходе серии исследований, проведенных в Центре междисциплинарных исследований современного детства МГППУ в 2015—2023 гг. В качестве методик исследования применялись: тестовая методика «Q-сортировка» Б. Стефансона, «Тест различий между «Я»-реальным» и «Я»-идеальным» G.M. Butler и G.V. Haigh, авторский «Опросник ролевого конфликта» О.В. Рубцовой, а также Опросник «Подростковый эгоцентризм-социоцентризм» (AES) Р. Энрайта. Выборку исследования составили 103 активных пользователя компьютерной игры «Dota 2» в возрасте от 14 до 25 лет. В статье обсуждаются корреляционные зависимости, которые были выявлены в том числе на основе сетевого анализа частных корреляций. Показано, что такие факторы как ролевая несовместимость и потребность в ролевом опыте могут проявляться в виртуальной игровой деятельности и отчасти определять специфику ее реализации игроками подросткового и юношеского возраста.

Ключевые слова: компьютерная игра, игровая деятельность, виртуальное пространство, подростковый возраст, ролевой конфликт, частные корреляции, сетевой анализ.

Финансирование. Исследование выполнено в рамках государственного задания Министерства просвещения Российской Федерации от 02.06.2023 № 073-00038-23-05 «Взаимосвязь когнитивных и коммуникативных способностей подростков и юношей с эффективностью решения ими игровых задач в цифровой среде».

Для цитаты: *Рубцова О.В., Артеменков С.Л., Панфилова А.С., Токарчук А.М.* Сетевой анализ взаимосвязи личностных особенностей игроков подросткового и юношеского возраста с их поведением в виртуальном пространстве (на примере групповой компьютерной игры «Dota 2») // Психологическая наука и образование. 2023. Том 28. № 4. С. 5—19. DOI: https://doi.org/10.17759/pse.2023280401

Introduction

Video games and research

Development of the video game industry has resulted in a rapid transformation of video games, that have evolved from quite simple, allowing for only a limited array of actions, to complex virtual worlds providing multiple choices and paths [29]. As a result, in the past few decades video games have turned into a mass medium.

Entertainment Software Association estimates that in the USA more than 227 million people play video games, and 60% of Americans play video games daily. The average age of a video game player is 31. In total, players are roughly half female (45%) and half male (55%). Players agree that video games can bring different people together (89%) and create an accessible experience for people of different abilities (89%) [18].

Given the growing popularity of video games, recently there has been a significant increase in the number of research works studying the effects of video games on various aspects of physical and mental development — particularly, in children and adolescents, who represent more than one fourth (around 27%) of the world's gamers [11, c. 25]. Research in this field includes such issues as video game addiction, association between video games and aggression, the influence of video games on higher mental functions (e.g. attention, thinking and memory) as well as on creativity and academic achievement[1].

Russian research in this area often indicates that Internet addicts and gamers often demonstrate signs of negative psychological characteristics [4; 10; 12; 13]. Interestingly enough, the results of the research are quite controversial. On the one hand, there are scholars who argue that playing video games excessively may result in problems with attention, self-control, aggression and anxiety in children [20]. On the other hand, certain scholars report on the potential positive impact of video games, their mental health benefits [22], including various specific positive effects [25], in particular: decreased reaction times [35] as well as improved performance on visual attention tasks [22] and spatial ability [24]. Other reported benefits include improved academic achievement — particularly in maths, reading and science [27; 31]. Finally, there is even research to suggest that playing violent video games can help improve social skills by reducing violent behavior among certain populations [19].

An interesting area of research is represented by scholars studying the connection between personality and behavior in video games [32]. As Borders argues [15], playing video games should be perceived as a conscious activity, which requires a sizeable commitment. According to Hartmann T. and Klimmt C. [26], the conscious effort to partake in any kind of behavior is influenced not only by situational constructs, but also by consistent

constructs, such as personality. Thus, there are strong grounds to believe that decisions made about video games represent a reflection of personality and its traits. In this regard, contemporary research aimed at studying the possibility of using video games to diagnose cognitive abilities is of great interest [28].

Studying the association between personality and behaviors in video games is rather challenging both theoretically and methodologically. From the theoretical perspective, one could assume that behaviors in video games resemble very much the player's real-world behaviors. This implies that users with particular psychological characteristics are more likely to demonstrate in video games certain behavioral patterns than others (e.g. communicative individuals would communicate more than those who are less communicative in real life etc.). However, many video games allow players to emerge into a totally different reality and experience events that are impossible, illegal, or unlikely in the real world [35]. In addition, players' behaviors in video games are generally free of real-world consequences, which may result in individuals breaking free of habitual behavioral constraints and demonstrating absolutely unexpected patterns of behavior and interaction. Another challenge is connected with giving an interpretation to actions and behaviors that have no direct equivalent in the real life.

From the methodological perspective, research in this area requires adequate tools for examining video game behavior and, more specifically, for revealing the criteria that could be associated with certain traits of personality. It should be taken into account, that given the variety of the existing video games and the diversity of behavioral patterns, which they offer, it may be difficult to generalize the results of research.

It is probably due to this theoretical and methodological complexity that research in this field has been rather limited. There have been several studies examining the association of personality traits and video game behavior in a number of popular video games: "Second Life" — an online virtual world, in which a variety of activities are available [14], the Massively Multiplayer Online Role-playing Game (MMORPG) "World of Warcraft" — a fantasy-type world that allows players to control an avatar [21; 35]. These studies have revealed that in-game behaviors and motivations for play are related to personality traits in predictable ways. A few studies of the connections between personality and motivation for playing also suggest that personality-behavior correlations may be found in other video games [30], including mobile games [34]. The study by Worth & Book [35] provides a more general overview to the connections between personality and dimensions of behavior in video games.

However, more research is needed to explain why and how people are deeply immersed in certain types of play and what are the factors that influence, predict, and help clarify video game play. The relationship between personality traits and behavior in virtual gaming reality is particularly interesting to investigate.

The current study

The article presents the results of a correlation analysis of the influence of Dota-2 players' personal characteristics on their behavior in the virtual space. The analysis is based on the data, received in the course of a series of experiments conducted by the Center for Interdisciplinary Research on Contemporary Childhood in Moscow State University of Psychology and Education in 2015-2023 [7]. The aim of the research was to reveal the existing connections between personality traits and behavior in the video game «Dota 2» («Defense of the Ancients 2»). The game was chosen for the empirical research due to a number of circumstances. First, for a certain period of time «Dota 2» was one of the most popular video games among teenagers and young adults (approximately 12,5 million of users around the world.) Second, the

game provides access to the history of the sessions, which makes it possible to analyze the gamers' behavior in a longitudinal perspective. Third, the game offers a big variety of roles with different playing functions and capacities. The results presented below refer to the network correlation analysis [2; 3] of the data obtained in the studies.

Methods

Video game "Dota 2" and indicators of play efficiency

"Dota 2" is a multiplayer online battle arena (MOBA) video game. The game was developed as a sequel to the game "Defense of the Ancients" by Valve Corporation. "Dota 2" is played in matches between two teams of five players with each team occupying and defending their own separate basis on the map. Each of the ten players controls a powerful character — a "hero", having unique abilities and a particular style of play. During a match players collect experience points and items for their heroes in order to defeat the other team's heroes in player-versus-player combat. A team wins by being the first to destroy a large structure located on the competing team's basis, called the "Ancient".

The game offers a big variety of roles with different playing functions and capacities (e.g., players can cooperate with each other to defeat difficult game-generated opponents in raids, or attack and kill others' avatars in player-versus-player activities like battlegrounds).

Valve Corporation provides access to the history of all "Dota 2" matches. Each match is recorded and made available on the website Dotabuff [16]. Dotabuff is an open-access service collecting raw statistical data of each "Dota 2" match using Steam Web API (application programming interface).

Play behaviors are reflected in numerous indicators that may be used for objective analysis, including:

- frequency of playing and time spent in game (match date and time);
- results of the match (match result: win; lost);
- number of matches abandoned (abandoned match: yes; no);
- number of bot matches played by the player (bot match: yes; no);
- number of playing kills, deaths and assists performed by the player (KDA);
- the hero chosen by the player (hero name; hero role);
- the level of the "skill" developed by the player (normal skill; high skill; very high skill).

An important part of the analysis consisted in considering the choice of heroes by the players throughout the history of matches. For this the following classification of heroes was used [17]: Carry, Support, Nuker, Disabler, Jungler, Durable, Escape, Pusher, Initiator. In the framework of the research all of the indicators listed above were downloaded and analyzed for 70649 matches.

Procedure and ethics of the study

Participants were recruited through a posting on the site of the Russian social network "VKontakte". In order to be eligible for the study participants were required to have played "Dota 2" at least several times and to be not younger than 14 years of age. A link to the research webpage was provided in the study posting; individuals who were interested in participation could click on the link to enter the project website, where they viewed a consent and information form that explained the purpose and nature of the study. Participants who chose to partake clicked on a link at the bottom of the consent form in order to indicate agreement to start the study.

Taking part in the study required that participants share their profile on Dotabuff webpage [16]. Each participant who chose to partake inserted the link to their profile on Dotabuff (including Steam ID) into the registration form on the webpage of the research project. Participants then completed the tests. All participants completed the questionnaires in the same order.

Sample characteristics

The participants for the current study were 203 Dota-2 players from Russia, of which 100 participants were excluded because they had failed to fill in all the questionnaires offered in the study. Of the 103 participants included in the analysis, 98 (95.1%) were male.

Participants ranged in age from 14 to 25, with a mean age of 18.3 (SD = 2.9). The majority of participants (79; 76.7%) were under the age of 21.

Frequency of playing video games among participants in the current sample ranged from less than once a month 6 (5.8%) to seven days a week 32 (31.1%). Among 103 participants 34% (35 participants) did not report their frequency, 29.1% (30 participants) reported playing once a week, three times a week or more than 3 times a week. The number of games played by the participants of the study varied from 8 to 8451 matches (M = 1710; SD = 1476) for gaming experience through 1 to 10 years (M = 7.1; SD = 2.8).

Measures

Q-sort technique of W. Stephenson ("Test Q-Sort")

This technique was developed at the Humboldt University in Berlin and published in 1958. The technique was adapted on the basis of the Research Institute named after V.M. Bekhterev. The stimulus material includes 60 statements, with each of those the subject is asked to agree or disagree. The technique is designed to study a person's ideas about themself and determines tendencies towards dependence and independence, towards sociability and lack of sociability, towards "fight" and avoidance of "fight". The technique also makes it possible to identify the presence of intrapersonal conflicts [5].

Self-Ideal Discrepancy Test ("Test Self-ideal")

The method of Self-Discrepancy Testing was developed in 1954 by G.M. Butler and G.V. Haigh and makes it possible to determine the features of the modalities of the "I-concept" of the individual. The subjects are asked to evaluate 50 statements with characteristics of the self-image in the range from 1 to 5. The assessment is carried out on the basis of how the subjects see themselves in reality, and then — how they would like to see themselves "ideally". The diagnostic indicator is the discrepancy between the indicators of "I-real" and "I-ideal" [5].

Inner-Role Conflict Test («Test Roles»)

The questionnaire was developed by O.V. Rubtsova and allows to identify contradictions in the structure of role identity, manifested in such indicators as: rejection of one's own role behavior; rejection of the role behavior of other people; level of need for role-playing experience. The questionnaire consists of 30 statements, with each of those it is proposed to express agreement or disagreement [5].

Adolescent Egocentrism Scale (AES), R. Enright ("Test Enright")

The AES questionnaire is a classic method for measuring the level of egocentrism. The original questionnaire included 45 questions. A variant containing 60 questions was used (variant of Ryabova T.V., 1997) [9].

Additional variables

In addition to the test variables, the age and playing experience of the players in years were also taken into account:

- personal age;
- personal gaming experience (in years).

Results of network correlation analysis

Sample characteristics

The main results of the study, related to the description of the sample and standard statistical analysis, are published in the ar-

ticle [7]. The number of matches played by players has been shown to increase with a player's age, which is due to the increase in gaming experience with age. Similarly, gaming experience increases with age (Fig. 1):

Correlation analysis

Designations of personal, psychological and game factors are shown in Table 1.

Correlation analysis of 101 measured factors, including personal qualities and "Dota 2" game ratings, was carried out using Spearman's rank correlation and network analysis of partial correlations using the glasso method [2;3]. Mathematical processing was carried out in R with the help of "qgraph" package. Glasso network model of 101 correlated factors is shown in Fig. 2.

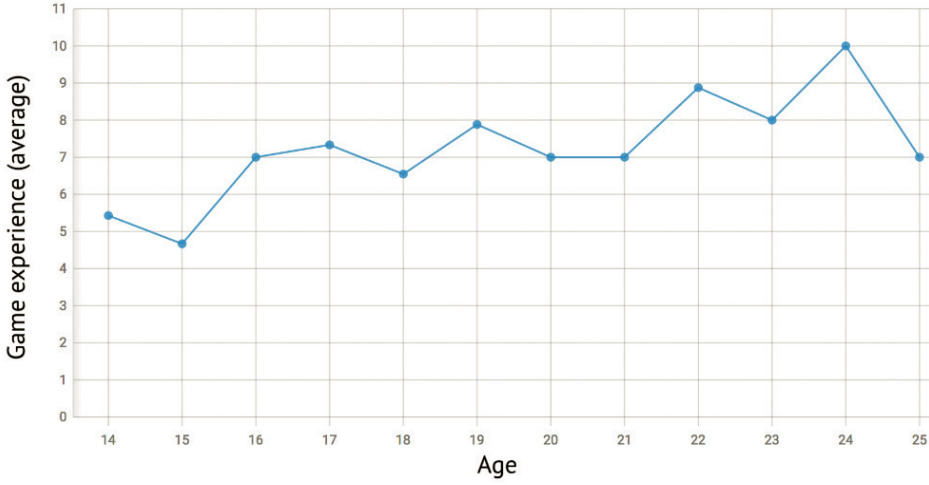

Fig. 1. Average player game experience for each age scale

Table 1

Designations of personal, psychological and game factors

#	Symbols	Factors' names	Comments
1	AG	"Player Age"	Personal age
2	GE	"Player Experience"	Personal game experience in years
3	R1-R5	Inner-role Conflict Test ("Test Roles")	R1 — rejection of their own role behavior, R2 — rejection of other people's role behavior, R3 — role incompatibility, R4 — role overload, R5 — the need for role experience.
4	Q1-Q6	Q-sort technique ("Test Q-Sort")	Q1 — dependence, Q2 — independence, Q3 — sociability, Q4 — unsociability, Q5 — acceptance of conflict, Q5 — conflict avoidance.
5	YA	Self-ideal discrepancy Test ("Test Self-ideal")	The magnitude of the difference between "I-real" and "I-ideal".
6	E1-E6	AES, R. Enright ("Test Enright")	E1 — personal myth, E2 — imaginary audience, E3 — self focus, E4 — personal interests, E5 — social and political interests, E6 — social and political activity.

#	Symbols	Factors' names	Comments
7	TM	"Matches Total"	Number of Total Matches played.
8	AK	"Kill", "Average Kill"	The Average number of kills.
9	AD	"Death", "Average Assist"	The Average number of deaths.
10	AA	"Assist"	The Average number of assists.
11	AW	"Win Total"	Total number of games won.
12	AL	"Lost Total"	Total number of losing games.
13	TA	"All Total"	Total number of games played.
14	TN	"Abandon No"	Total number of not abandoned games.
15	TY	"Abandon Yes"	Total number of abandoned games.
16	T1-T9	"Class Total"	9 game factors of "Total_classificator".
17	1W-9W	"Class-Wins"	9 game factors "Wins_classificator".
18	1N-9N	"Class-Normal-Skill"	9 game factors "Classificator_normal_skill".
19	1H-9H	"Class-High-Skill"	9 game factors "Classificator_high_skill".
20	1V-9V	"Class-Very-High"	9 game factors "Classificator_very_high_skill".
21	1U-9U	"Class-Unknown"	9 game factors "Classificator_unknown_skill".
22	1B-9B	"Class-Bot"	9 game factors "Classificator_bot_match".
23	1S-9S	"Class-no-Stats"	9 game factors "Classificator_no_stats".

As Figure 2 shows, factors of different types are grouped and form certain clusters in the network. Clustering is more related to game factors dedicated to game classes and total coefficients. The characteristics of personal psychological testing are also more or less grouped. Meanwhile it is clear that they are not strongly connected with all game rates. Moreover, not all of the links presented in Figure 2 are truly meaningful. A detailed check of the relationship between test factors and game factors showed that only some game indicators have more or less significant correlations with personal and test psychological factors.

Figure 3 shows a network of partial correlations of 28 factors, showing the relationship of all personal and psychological factors with individual game factors 6S, 1H, 9H, 1N, 3N, 8N, AK, AA. It can be seen that the psychological factors of the tests are associated with a relatively small number of game factors, and these relationships are generally not very strong.

Spearman's significant correlations between game, player, and test factors are shown in Table 2 below. The value of the presented correlations lies in the range: $0.19 < \rho < 0.40$.

The age factor AG positively correlates (ρ=0.30**, Table 2) with the psychological factor R5 (role experience). Players with a greater need for role-playing experience tend to be older. The test factor R5 positively correlates with the game factor 8N — class 8 of ordinary abilities (ρ=0.20*, Table 2).

The gaming experience factor GE positively correlates (ρ=0.23*, Table 2) with the psychological factor Q4 (non-sociability). Players with more gaming experience are less sociable (apparently, excessive communication distracts from the game). GE gaming experience also contributes to an increase in the average number of players helping other players in the game AA (ρ=0.19*, Table 2). The game is difficult to win without the mutual help of the players in the team.

Factors AG and GE with a high degree of significance ($p<0.001$) correlate ($0.34<\rho<0.44$) with the entire group of gaming factors 1N, 1H-9H (the last 9 factors correspond to a high level of gaming skills). The 1N factor is located in the network separately from other medium N-type

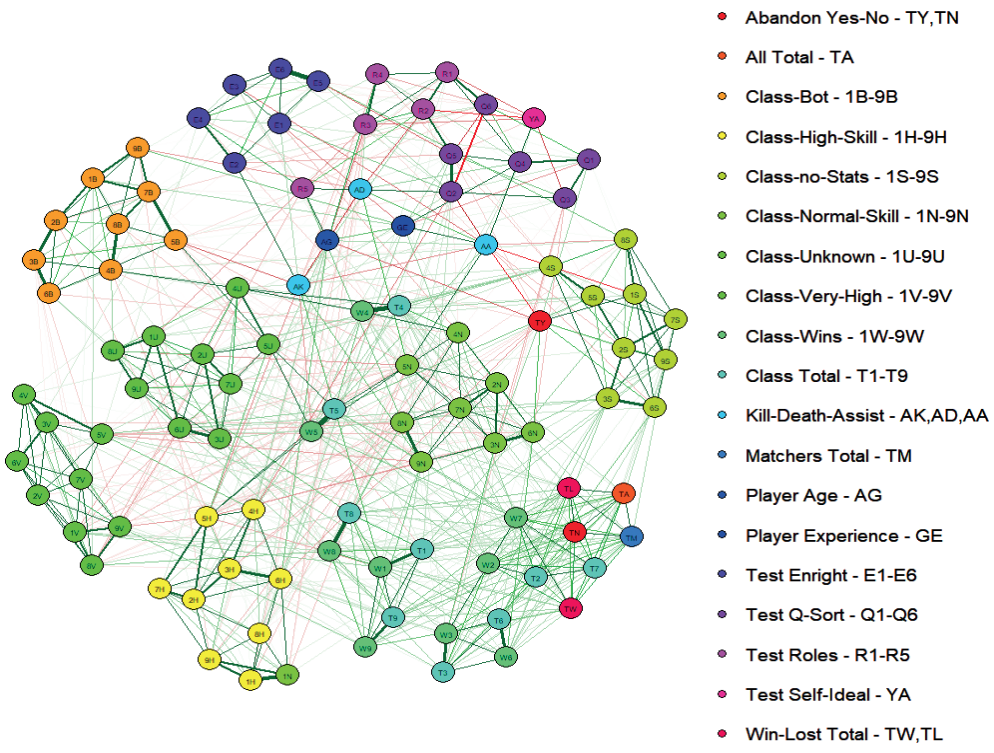

Fig. 2. A network of partial correlations reflecting the relationships between the studied factors: the age of players AG and game experience GE, personal test characteristics E1-E9, YA, Q1-Q6, R1-R5, and game ratings TY, TN, 1B-9B, 1H-9H, 1S-9S, 1N-9N, 1U-9U, 1V-9V, 1W-9W, AK, AD, AA, TA, T1-T9, TW, TL, TM (parameter $\lambda = 0.1$, hyperparameter $\gamma = 0.5$)

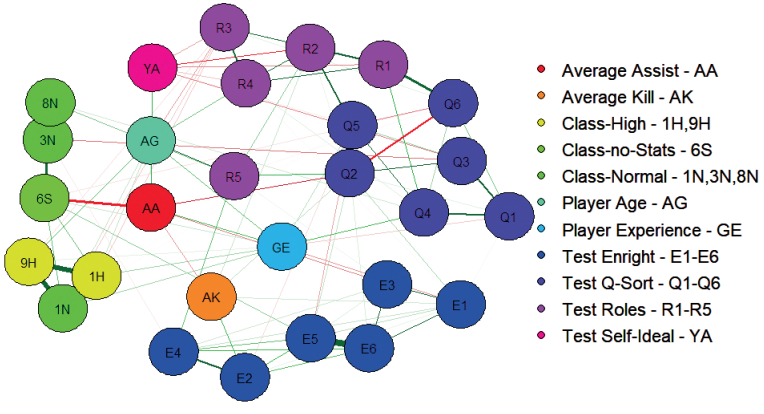

Fig. 3. A network of partial correlations reflecting relationships between 28 studied factors: age of players AG and game experience GE, personal test characteristics E1-E9, YA, Q1-Q6, R1-R5 and game ratings 6S, 1H, 9H, 1N, 3N, 8N, AK, AA (parameter $\lambda = 0.1$, hyperparameter $\gamma = 0.01$)

Table 2

Spearman's correlations between testing and player factors and gaming factors

#	Correlated factors	Spearman's correlation	The rate of significance
1	R3-1N	–0.24	$p < 0.05$
2	R3-1H	–0.24	$p < 0.05$
3	R3-2H	–0.19	$p < 0.05$
4	R3-6H	–0.21	$p < 0.05$
5	R3-7H	–0.20	$p < 0.05$
6	R3-9H	–0.23	$p < 0.05$
7	R5-8N	0.20	$p < 0.05$
8	R5-AG	0.30	$p < 0.01$
9	Q2-AA	–0.26	$p < 0.01$
10	Q3-3N	–0.21	$p < 0.05$
11	YA-AA	0.25	$p < 0.01$
12	E2-AK	0.24	$p < 0.05$
13	E3-AA	–0.20	$p < 0.05$
14	E5-6S	0.21	$p < 0.05$
15	AG-AA	0.19	$p < 0.05$
16	AG-1N	0.40	$p < 0.001$
17	GE-AA	0.19	$p < 0.05$
18	GE-1N	0.35	$p < 0.001$
19	GE-6S	0.21	$p < 0.05$
20	GE-Q4	0.23	$p < 0.05$

factors and closer to the group of high H-type factors (Fig. 2) — see the light green node, which is located next to the cluster of yellow nodes. That is why in Fig. 3 factor 1N is located next to the factors 1H and 9H. Almost all of these game factors (1N, 1H, 2H, 6H, 7H, 9H) are significantly ($p<0.05$) negatively correlated with the R3 factor ($0.19<\rho<0.24$, Table 2). The 1N factor corresponds to players with normal skills, and the H-type factors correspond to players with high skills. An increase in the values of these factors is associated with a decrease in R3, which means a decrease in the difficulty of combining roles in a group of high skilled players. It should be noted that such dependence is not observed in the group of very high skilled players.

Players who, on average, help more in games, are significantly positively correlated with the YA factor ($\rho = 0.25^{**}$) and negatively with the Q2 ($\rho = –0.26^{**}$) and E3 ($\rho = –0.20^{*}$) factors (Table 2). On the one hand, this suggests that these players are more dependent on other players, and on the other hand, they are less focused on themselves. The psychological factor Q3, which determines sociability, negatively correlates with the gaming factor 3N ($\rho = –0.21^{*}$).

Players who, on average, kill more during the game, as a rule, have relatively higher E2 scores ($\rho=0.24^{*}$, Table 2). Appar-

ently, they are more focused on an imaginary rather than a real audience.

The gaming factor 6S has a significant positive correlation with the psychological factor E5, which determines social and political interests, and the gaming experience GE (ρ=0.21*), and at the same time, it negatively correlates with the gaming helping factor AA (ρ = –0.40 ***, Table 2).

It is important to note that the abovementioned correlations of game factors 1H, 3H, 8H, 1H, 2H, 6H, 7H, 9H, 6S with indicators of psychological tests have a relatively low level of significance.

Conclusion

On the basis of correlation analysis, small statistically significant relationships between personal psychological and game factors were revealed. In order to identify other and possibly more significant relationships between gaming and psychological indicators, it seems necessary to increase the sample of subjects.

The possible relationships identified on the basis of correlation analysis show that the need for role-playing experience generally increases with the age of the players. At the same time, players with more gaming experience are less sociable psychologically, but they are more politically interested and ready to help other players in the game. On the one hand, this suggests that these players are more dependent, and on the other hand, that they are less focused on themselves. It is clear that players who help less are more independent and self-centered. Willingness to help is also associated with a greater difference between “I-real” and “I-ideal”.

It can also be argued that players with more kills during the game tend to be more focused on an imaginary rather than on a real audience.

The factors of normal and highly skilled players seem to be related to the poor compatibility of these players with the roles that they have to try on in the game. As a result, the difficulty of combining roles is negatively correlated with the level of skill required from the player. In the group of very experienced players, this dependence is not observed.

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Efficiency of Collaborative Computer Problem Solving by the Students of the Young Adolescence: The Contribution of Social and Emotional Intelligence

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The present study is focused on the measurement of the game efficiency by the younger adolescences in the individual and collaborative game problem solving conditions. The previously elaborated computer game system "PL-modified" was used. Social and emotional intelligence as well as gender factor were additionally controlled. 189 middle-school students from the 5—6th grades participated in this study. The results showed that game efficiency was higher in collaborative problem solving conditions (in comparison with the individual game) no matter which additional factor was controlled. Furthermore, the whole sample was divided in two groups by the criterion of the level of social intelligence of those participants who played in each pair. Thus, the group 1 included players with the equal level of social intelligence whereas the group 2 was presented by the gamers with the different levels of social intelligence. The pairs form the group 1 outperformed those participants from the group 2 in their game efficiency. Another independent result concerns significant impact of social intelligence on the game performance in the pairs of boys. Emotional intelligence demonstrated only one significant positive correlation with the one parameter of game efficiency in the individual conditions. The present results are discussed in terms of the prospects of the usage of 'PL-modified' computer game system in the psychological studies conducted on the sample of young adolescents and taking their cognitive abilities into account.

Keywords: efficiency of game problem solving; computer game system "PL-modified"; social intelligence; emotional intelligence; mental actions of analysis and planning; collaborative problem solving.

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Успешность совместного решения игровых компьютерных задач учащимися младшего подросткового возраста: вклад социального и эмоционального интеллекта

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Исследование направлено на оценку успешности решения игровой компьютерной задачи на примере разработанной компьютерной системы «PL-modified» учащимися младшего подросткового возраста в условиях их индивидуальной и совместной (в паре с партнером) работы. Отдельно оценивались и контролировались такие переменные, как: индивидуальные различия в уровне социального и эмоционального интеллекта, гендерный фактор. Для реализации поставленной задачи было проведено исследование на выборке учеников 5—6-х классов (189 человек). Игровая результативность оказалась выше в условиях совместного решения задач независимо от других контролируемых факторов. Кроме того, выборка учащихся была разделена на две группы с учетом уровня социального интеллекта, который демонстрировали играющие в парах партнеры. Так, группу 1 составили испытуемые с одинаковым уровнем интеллекта, а группу 2 — с разным уровнем социального интеллекта. Результаты сравнительного анализа показали, что игровая результативность в парах выше, когда когнитивные возможности игроков равны. Отдельным результатом можно считать вклад социального интеллекта в показатели игровой результативности в парах у мальчиков. В свою очередь, данные эмоционального интеллекта показали положительную связь с одним по-

казателем игровой результативности только в индивидуальных условиях игры. Представленные результаты обсуждаются с позиции дальнейших перспектив использования компьютерной системы «PL-modified» в психологических исследованиях, а также с точки зрения роли изначальных когнитивных возможностей самих игроков.

Ключевые слова: успешность решения игровых задач; компьютерная игровая система «PL-modified»; социальный интеллект; эмоциональный интеллект; абстрактный интеллект; умственные действия анализа и планирования; рефлексия; совместное решение задач.

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Introduction to the scientific problem

In recent years, the enthusiasm of teenagers and youth to play video games increase. According to Russian Public Opinion Research Center , the number young people 18-24 years old playing video games, increased from 40% in 2019 [3] to 56% in 2022, with 20% of them playing daily. Most often used for games mobile phone and landline available computer [9]. Even more common passion for video games among children and teenagers sprouts. Thus, according to JSC Laboratories Kaspersky", 83% of Russian children are old over 7 years old play video games [4]. Similar data are also provided by foreign studies — 81% of adolescents and young adults young people from 10 to 24 years old play video games, and friendships are formed and maintained have been online since school age [15]. As the researchers note, under conditions global digitalization children's game also inevitably undergoes a digital transformation and becomes specific type of age-related play activity, in which largely occurs socialization of modern children [2; 6; 7]. In this regard, psychologists are interested in possibilities of video games for the development of social skills, especially among teenagers, who often experience difficulties in communication with peers. The first similar studies were conducted on samples children with autism and showed good performance results. In 2006 it was presented at digital board game SIDES, developed by aimed at helping teenagers with the syndrome Aspergers acquire skills to effectively group work. Six-month results activities have demonstrated that co-seating board computer games are motivating and supportive tool to facilitate effective active group work among the target audience [17]. Subsequently it was carried out many similar studies that showed that the use of information but-communication technologies in therapy opens up new prospects for treatment many areas in people with disorders autism spectrum. K. Grossard with colleagues provide data on 31 "serious game", 16 of which are aimed at recognizing formation or production of emotions, and 15 — on social skills [13].

Despite the fact that such games looked promising for developing many different skills, they have some restrictions: most of them designed for high-functioning of people; their clinical validation is rare meets evidentiary standards medicine; game design is usually not descriptive varies; in many cases clinical validation and playability/game design incompatible. According to the authors, about future research plans should be more reliable from a methodological point of view, including including stability assessment social and emotional changes skills [13]. It is also necessary to take into account the possible negative influence of certain elements video games — for example, with the help of a specially developed video game based on Minecraft it was shown that modeled in game situation social competition, increasing cognitive load, has a negative effect — reduces concentration, learning efficiency and situational interest. The authors note that although competition is one of basic elements of video games, you need. It is possible to strike a delicate balance between increasing the mental load on players and motivational benefits in the process of achieving game results [16]. New ones are currently being developed "serious games" aimed at development social competencies, and not only for children with symptoms of ASD, but also for normotypical adolescents. One of these games became LINA, a smartphone-based augmented reality game designed for children from 10 years old and their teachers. This game can be played by the whole class to facilitate and improve class interaction and reduce stress factors. The authors believe that use of augmented reality, sharing an exciting story and shared gameplay in a common classroom space makes it possible to use teenagers' passion for digital technologies to improve social connections in the real world [15].

The effectiveness of communication processes in video games can be assessed in different ways, for this it is used as post-interviews of participants and evaluation team gaming productivity. There is a large number of studies which use psychophysiological diagnostic methods, for example, recording eye movements during social interaction [1]. Social intelligence adolescents playing video games is a significant predictor of positive relationships with parents and peers, and its level is negatively associated with negative emotions, and these effects manifest themselves over time [14].

Thus, the development of "serious games" aimed at developing communication among adolescents and young adults and their cognitive capabilities is a current direction of modern practical psychology. Moreover, as the studies described above show, individual psychological characteristics players, including differences in social skills (social intelligence) and emotional responses (emotional intelligence) can make a significant contribution in the efficiency of solving game problems. The presented research is aimed to study the contribution of individual psychological differences in younger adolescents — namely, the level of their social and emotional intelligence — on indicators of their success in solving computer game problems in different game conditions: individually and in interaction (in pare) with a partner.

General design and research methods

The study used a modified version of the "PL-modified" computer gaming system developed by the authors to implement the tasks in previous studies [5]. A sample computer game is shown in Fig. 1: on a field of size 9x9 cells according to certain rules ("patterns") colored colors appear balloons. The player's task is to line up balls of the same color to score points. Understanding the rules for the appearance of balls should help more effective game, manifested in particular, in more points. Specific parameters

of the game — understanding rules and their use in the game are diagnostic markers of specific mental actions — analysis (understanding rules) and planning (game results).

The procedure for research and evaluation of the parameters of the effectiveness of solving game problems. The study was conducted at school for three academic hours (lessons). At the first lesson, participants were introduced to the "PL-modified" system, for two minutes they played the training version games with random appearance of balls. Next, the participants played individual version of the game consisting of three 10-minute sessions in which the balls appeared according to certain patterns, different in every session. After each of three sessions ended, each participant had to answer questions about what the rules were used in the game. By answers the actors' understanding of the elements of the pattern was assessed. It was also recorded the number collected by each participant points. Thus, to assess the effectiveness of solving game problems, we carried out calculation of the following parameters: 1) general number of correctly named rules (patterns of the appearance of balls), which characterized the formation mental action (hereinafter referred to as UD) analysis, 2) game performance, which characterized the formation of the mental action of planning and was calculated according to the following formula: X1/X2, where X1 is the general number of points scored in each game, X2 is the number of game moves. This calculation was made in order to equalize the capabilities of players

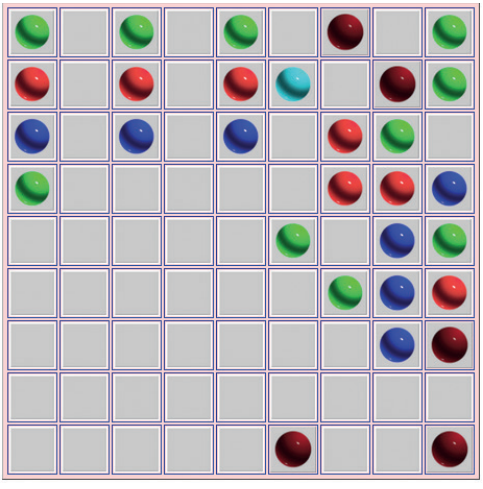

Fig.1. The playing field of the "PL-modified'" system

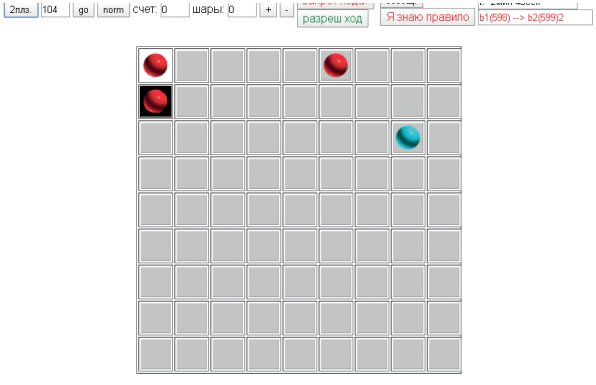

Fig.2. An example of a playing field with options, with examples of the presentation of balls, permission / prohibition of a move

in different game conditions (so how obvious it is that individually a person will obviously score more points, than working in pairs)[1].

In the second lesson, the participants played the game in pairs with a partner, for which they were randomly assigned to pairs. The participants took turns making moves, but each of them had the opportunity to forbid or allow each move of the partner (see Fig. 2). It is assumed that the proposed format of the game in the form of a dialogue initiates the mental activity of students, activating the use of mental actions to successfully complete the task. During the game, the participants had the opportunity to communicate with each other. In this version of the game, the participants also first played the training version with a random presentation of the marbles, then moved on to the main version with the regular presentation of the marbles. In it, as well as in the individual version, there were three sessions of 10 minutes each with different patterns in each session. Participants answered questions about the elements of regularities one by one, and the number of points scored was recorded for the pair.

Thus, in total, for each respondent, 4 indicators of game performance were recorded: 1. the number of named elements of regularities in an individual game (LE of analysis); 2. performance indicator in an individual game (planning UD); 3. the number of named patterns in the game paired with a partner (UD analysis — separately for each player); 4. performance indicator in the game paired with a partner (planning UD for each player).

In the third lesson, participants filled out tests of abstract, social and emotional intelligence in paper format. Assessment of general (abstract) intelligence was carried out using the J. Raven Standard Progressive Matrices test[2]. The level of social and emotional intelligence was assessed using two tests decision-making designed specifically for adolescents 10—15 years old [8].

Data analysis was carried out using the methods of mathematical statistics — correlation analysis and comparison of averages, and was carried out in the IBM SPSS Statistics 23 program.

Sample. The study involved 189 Russian-speaking students of a secondary school in Moscow (46% girls and 54% boys), age range: 10—12 years.

Results

The results of the study provide data on: 1) game performance indicators in two game conditions: in an individual format and in the form of an active dialogue between the participants; 2) game performance indicators in two game conditions, taking into account the individual psychological differences of the actors; 3) game performance indicators in two game conditions, taking into account the gender differences of the actors.

Average indicators for two variables — LGD analysis and planning — are presented in Table. 1.

The Wilcoxon non-parametric statistical t-test was used to compare the average values of the indicators in the two game conditions. The results of both tables indicate the following. First, there are obvious significant differences in the severity of game indicators between the two game conditions. This applies to both the plan-

[1] Indicators of success in solving a game problem (game performance) were calculated in accordance with criteria developed and described in previous studies by the authors [5]. This article focuses attention is focused on another subject of research, therefore the indicators of UD analysis and planning will not be disclosed in detail, they appear as the main parameters for solving game problems.

[2] The study used a shortened version of the test consisting of 12 tasks, which was previously tested in several studies, including on students of the Faculty of Software Engineering at Moscow State University of Psychology and Education [12].

Table 1

Average values of game performance indicators (standard deviations are given in parentheses)

Name of indicator	Game type			
	UD Analysis		UD Planning	
	Ind. a game	Pairs game	Ind. a game	Pairs game
1st game	0,91	0,75*	1,31	1,48*
2nd game	0,87	0,9	1,64	2,08**
3rd game	0,9	0,61**	1,14	2,72**
General game indicator	3,33 (2)	2,56 (1,61)**	4,1 (1,31)	6,31 (3,38)**

** differences are significant at the level p ≤ 0.006; ** differences are significant at the level p ≤ 0.000.*

ning indicator and the analysis indicator. Secondly, despite the higher indicators of analysis in individual conditions, it is the game performance (planning indicator) in the conditions of joint solution of game problems that gradually increases with each new game set and, in general, turns out to be higher in the conditions of two players working in pairs.

Next, a correlation analysis of intelligence indicators (abstract, social and emotional) was carried out with the main indicators of game performance. The Spearman coefficient was applied to calculate the values. No significant differences were found, except for a positive relationship between the level of social intelligence and the indicator of planning in a game in pairs, however, the resulting indicator slightly exceeds the required significance level threshold (r = 0.2; p = 0.07). These data allow us to conclude that general intelligence does not affect the gaming performance of the test takers. However, individual differences in social intelligence can be significant. To confirm this assumption, the conditions of the game in a pair with a partner were analyzed from a different angle, namely: the entire sample of subjects was divided into two groups: group 1 (54 people) consisted of actors playing in a pair with the same level of social intelligence, group 2 (48 people)consisted of actors who worked in pairs and whose level of social intelligence differed (by one or more standard deviations). In table. 2 shows the average values of the studied variables[3].

The data in the table also show significant differences in game performance

Table 2

Mean values for the tested variables (standard deviations are given in parentheses)

Name of indicator		Group 1	Group 2
Analysis	Ind. a game	3,52 (2)	3,45 (2)
	Pairs game	2,67 (1,71)	2,66 (1,4)
Planning	Ind. a game	4,03 (1)	4,4 (1,73)
	Pairs game	6,27 (3,6)**	5,2 (2,18)*

** differences are significant at the level p ≤ 0.06; ** differences are significant at the level p ≤ 0.001.*

[3] The results of each actor were marked as follows: as higher than 66.7% of the sample (high level), in the range from 33.3 to 66.7% of the sample (medium level), or lower than 33.3% of the sample (low level).

between the conditions of work individually and in pairs with a partner — these patterns are observed regardless of the division into group type and, despite the fact that the understanding of the rules for constructing patterns is slightly (but still insignificant) higher in individual game conditions. In addition, the results of the table show that if in an individual game the indicators of gaming performance are almost equal in both groups of actors, then in the case of playing in pairs with a partner, this indicator is higher in group 1,when the players have equal opportunities in the manifestation of the level of social intelligence. Thus, despite the absence of significant correlations of game results with cognitive abilities, nevertheless, the contribution of cognitive variables, in particular, in this case, social intelligence matters when it comes to the interaction of two players.

Next, a correlation analysis was carried out between cognitive abilities and game performance indicators, taking into account the division of the sample by gender. Given that differences in the manifestation of levels of social and emotional intelligence in boys and girls have been studied for a long time [11], we assume the possibility of obtaining different effects. Table below. 3, which contains the main results of the correlation analysis between the studied variables on the sample of boys.

The results of the table show that the level of social intelligence of boys is associated with such variables as LE of analysis (i.e., understanding the rules in an individual game), as well as LE of planning (game performance in a game paired with a partner). With an understanding of the rules in an individual game, it reveals significant positive correlations and the level of emotional intelligence. No such associations were found in girls. Emotional intelligence also turned out to be the only one of the studied indicators, the level of which differed in boys and girls — in girls it was significantly higher when analyzed by Student's t-test (9.31 and 6.68, respectively, $p \leq .01$). The indicators of analysis and planning themselves do not differ between boys and girls, but they turn out to be higher when paired with a partner, regardless of the gender of the actors.

Study Findings

The study was devoted to assessing the degree of formation of mental actions of analysis and planning of schoolchildren of younger adolescence through game indicators, namely: using a specially designed computer game system "PL-modified" in two game conditions,individually and with a partner. In addition, game performance indicators were compared taking into account the cognitive capabilities (level of social intelligence) of the players in a pair, as well as taking into account the gender factor. The results obtained allow us to formulate several fundamental conclusions.

TaTable 3

The results of the correlation analysis of the level of abstract intelligence, social and emotional intelligence and gaming performance in individual and group play among boys (paired correlations)

	Abstract intelligence	Social intelligence	Emotional intellect
Analysis *(ind. a game)*	0,19	**0,28***	**0,33***
Analysis *(pair game)*	-0,03	0,14	0,02
Planning *(ind. a game)*	0,16	–0,12	0,16
Planning *(pair game)*	0,04	**0,34***	0,25

** differences are significant at the level $p \leq 0,05$.*

First, game performance indicators as diagnostic markers of mental actions of analysis and planning, as well as patterns of relationships between them, are mediated by several factors: game conditions (individually / in pairs) and intellectual resources (equal / unequal abilities). The empirical facts obtained indicate that the game conditions in pairs are more productive, which is manifested, first of all, in higher indicators of game performance (SP planning) both for the entire game and for each new stage. These effects allow us to conclude that there are favorable opportunities for using individual computer games as a modern tool for diagnosing mental actions with the possibility of organizing joint problem solving, where a productive dialogue is needed to get the most out of the game task being solved. This conclusion is confirmed by both the recurring general effects of previous studies [5] and the same data on the greater productivity of the playing conditions in a pair with a partner at each game stage, taking into account additional psychological factors.

A separate issue is related to the mental action of analysis, the indicators of which are higher in individual conditions of the game, which contradicts the previously obtained data of previous studies by the authors. Such effects may be partly due to the limitations of the process of interpreting the results, when knowledge of the rules of the game (by which the LEV of analysis was understood) in the conditions of working in pairs was also assessed individually for each player (for certain technical reasons). It seems that a deeper procedure for evaluating game indicators will also make it possible to obtain more differentiated results in relation to game indicators, and, consequently, the mental actions of players. In any case, it should be taken into account that a joint game is a complex structural phenomenon, “sensitive” both to external dimensions (organization of diagnostics) and to internal differences associated with the individual psychological characteristics of the players themselves.

Secondly, the (indirect) contribution of social intelligence to game outcomes is found. Although significant correlations were not obtained on the general sample of players, nevertheless, the analysis of the gaming performance of couples, taking into account their level of social intelligence, revealed a significant superiority in favor of partners with equal opportunities. In addition, an important result is the contribution of the boys’ social intelligence to the indicators of LE of analysis (when playing individually) and LE of planning (in pairs with a partner). This phenomenon can be commented on taking into account the specifics of the sample itself — it was made up of students of younger adolescence. Communication is the leading activity of younger adolescents [10], in this regard, the individual psychological characteristics of players in this age category are the prism through which the results of any activity are refracted. Previous research has also shown the importance of abstract intelligence for adolescent couples at play. Thus, the cognitive capabilities of the players are an important factor to be taken into account when developing diagnostic computer games. As for gender differences, it is obvious that it is boys who need the same (in terms of level) partner to a greater extent in order to demonstrate effective play. Taking into account the fact that mental actions of planning are behind the indicators of game performance, the contribution of social intelligence to the formation of specific mental actions in the game is indicative in boys. The game interaction of girls in this regard depends to a lesser extent on their cognitive level.

The results obtained, of course, are an intermediate stage on a long journey of studying computer games as a diagnostic tool and the influence of their conditions on the manifestation of the mental capabilities of the players. At the same time, it is already

important to understand how important it is precisely an integrated approach to the studied psychological variables, which is realized with the subtle, competent use of computer games to assess the potential of students.

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The Relationship of the Preferred Types of Digital Games and Executive Functions in 6—7-Year-Old Children

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This study aimed to examine the relationship of the types of digital games preferred by preschoolers and their executive functions. For a more detailed study we created a classification of the games in question based on the content analysis of the participants' interview, game mechanism, and the required cognitive functions. 6 types of digital games were developed: quick reaction games, logic games, educational games, strategic games, drawing games, and simulators. The overall sample comprised 335 children (48,6% girls) aged 6—7 (M=74,6 months, SD=6,06 months). The study included assessment of the executive functions and an interview about digital games. We used the NEPSY-II subtests to measure the examinees' executive functions level: visual and verbal working memory, and inhibition. We also used "The Dimensional Change Card Sort" to assess cognitive flexibility. Data analysis revealed that quick reaction games were the most popular at this age. The next favourite were logic games, strategic games, and simulators'. The study demonstrated quick reaction game players' visual working memory was better developed than in the non-players. Logic game players processed information at a higher speed than the non-players. Simulation game players obtained higher score in cognitive inhibition, than the children who didn't like this type of games.

Keywords: early childhood; digital games; executive functions; quick reaction games; working memory; inhibition; cognitive flexibility; information processing speed.

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Взаимосвязь предпочитаемых типов цифровых игр и регуляторных функций у детей 6—7 лет

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Работа направлена на изучение взаимосвязи типов цифровых игр, которые предпочитают дошкольники, с развитием у них регуляторных функций. На основе анализа интервью дошкольников, а также с учетом игровых механизмов и задействуемых в играх когнитивных функций была разработана классификация цифровых игр. Было выделено 6 типов цифровых игр: игры на быструю реакцию, логические игры, обучающие игры, стратегические игры, игры-рисование и игры-симуляторы. Общая выборка включала 335 детей (48,6% девочек) в возрасте 6—7 лет (M=74,6 месяца, SD=6,06 месяца). Исследование состояло из оценки регуляторных функций и беседы о предпочитаемых цифровых играх индивидуально с каждым ребенком. Были использованы субтесты NEPSY-II для измерения уровня регуляторных функций испытуемых: зрительной и вербальной рабочей памяти, а также когнитивного и поведенческого сдерживающего контроля. Также была использована методика «Сортировка карточек по изменяемым параметрам» для оценки когнитивной гибкости. Результаты показали, что игры на быструю реакцию были самыми популярными среди дошкольников 6—7 лет. Далее по популярности следовали логические игры, стратегические игры и игры-симуляторы. Исследование показало, что зрительная рабочая память лучше развита у тех, кто играет в игры на быструю реакцию, чем у тех, кто не играет в такие игры. Дети, играющие в логические игры, обрабатывали информацию с большей скоростью, чем те, кто не играет в данный вид игр. Респонденты, которые играют в игры-симуляторы, получили более высокий балл по когнитивному сдерживающему контролю, чем дети, которые не играли в этот тип игр.

Ключевые слова: дошкольный возраст; регуляторные функции; цифровые игры; игры на быструю реакцию; рабочая память; сдерживающий контроль; когнитивная гибкость; скорость обработки информации.

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Introduction

Executive functions (EF) belong to the family of top-down mental processes that provide purposeful problem-solving and adaptive behavior in new situations [28] In the research literature, EF are discussed in the context of self-regulation [24; 44]. The most common assessment model applicable to the children's EF skills [4] is proposed by Miyake. Following Miyake's approach, basic EF skills include working memory, cognitive flexibility, and inhibition [45]. Working memory allows us to retain the memory target items during the performance of the task. Cognitive flexibility enables us to switch the attention from one task to another, and to adapt to changing conditions. Inhibition is understood as the ability to regulate dominant but inappropriate impulses. EF skills are most rapidly developed in childhood [21; 30; 69]. EF are important predictors for child's social, cognitive, and psychological development at school and later. Thus, children with better EF skills show higher results in mastering math [26; 67], and speech development [41; 47]. Their transition to school [20] goes easier, they have higher academic achievements [46; 64], and behave more appropriately in the classroom [52].

Both genetic [34] and environmental factors [29; 59] influence the EF development. Therefore, the search for conditions and factors that surround children on a daily basis and affect the development of the EF skills is of topical interest for psychology. For example, digital devices are an important constituent part of modern childhood [10; 11; 37]. Relevant studies revealed that screen time among children has increased significantly through the recent years [11; 58]. Children spend more than 3 hours every day using digital devices [12; 39; 60]. Playing digital games in everyday life affects children's cognitive development including EF [43; 60]. Thus, the prevalence of digital games among preschoolers and the "sensitivity" of this period to the development of the EF skills emphasize the importance of studying the correlations between playing digital games in everyday life and the development of EF in children. Identifying optimal conditions for the use of digital games can facilitate parental support of a child's digital activity. This, in turn, can reduce the negative effects of digital games, and contribute to its developmental and educational potential [6].

Digital games as a tool for training EF skills

According to research, play activity is of the utmost importance for the cognitive, emotional, and personal development of preschoolers [14, 29]. It was demonstrated that play has a high developmental potential also, in case of the EF [22; 30; 59]. In comparison to other activities, the biggest advantage of play in the context of the development of the EF skills is its naturality and spontaneity. Moreover, play is enjoyable [14: 5]. Since recently, digital game occupied a solid position among traditional types of play [38, 61]. Let us emphasize, though, that digital games are not a complete alternative for traditional games. From the perspective of the cultural-historical approach, these are the key characteristics of children's play: 1) a child creates an imaginary situation and acts within it, and 2) play develops through the changes in the relationship between the roles, rules, and play

actions [61; 63]. Digital games don't always meet these requirements. Nevertheless, the interest of the scientific community to this type of games is constantly growing due to the fact that children spend more and more time using digital devices for playing [39; 58]. The potential of using digital games for the development of the EF skills is under active consideration and study in the expert community. A number of research works revealed that digital games can affect the development of the working memory [17; 51; 56] and inhibitory [27] in a positive way. The results of certain training experiments also confirmed that the effect of digital games on the EF skills' development is more noticeable than the one of traditional games and other developmental means such as sports education, drawing, etc. [42; 48; 59; 65].

For example, in the study by Xiong and colleagues (2019), 60 4—6-year-old preschoolers attended 20-minute intervention sessions for 8 weeks. The participants were divided into groups randomly: the first group played specially selected exergames (a new generation of digital games that provide a more active, whole-body play experience), and the second followed a traditional teacher-led physical activity program. Apparently, the children who played exergames, demonstrated much more significant dynamics in the development of skills и social acceptance, if compared to those who participated in the physical activity program. This outcome can be also explained by the fact that exergames are an innovative physical activity combining traditional physical exercises and an engaging video-game, which results in additional developmental effect.

Similar results were obtained in the study by Rafiei Milajerdi and colleagues (2021). It explored the influence of the "Sports, Play and Active Recreation for Kids" program and exergaming on EF in 6—10-year-old children with ASDs. The results revealed that the use of digital games for the development of the EF skills was more efficient than the conventional sports and play programs, due to a higher motivational involvement of children.

The development of the EF skills by means of digital games proved its efficiency both for girls and boys [59; 65]. However, certain gender differences were registered in the digital game preferences. Boys chose competitive games more often, for example, "military games", action-games, or racing games, while girls rather opted for puzzle games [13; 35; 55]. Both genders were equally interested in the creative and construction games [23]. Nevertheless, at the moment, there is still a serious lack of research aimed at the gender-based digital game preferences and the development of the EF skills.

Thus, digital games can be used not only for entertainment but as a tool of correction, training, and development at preschool age [60]. Because of the deep engagement [16] and the direct skill training by means of digital simulators, the EF skills' development in children becomes possible. It is essential to note that the active involvement of adults into the organization, selection and discussion of digital games considerably enhances their developmental potential [8, 60]. The reason is that it is the adult who transmits to children the ways of use of digital devices and digital games as psychological and cultural means, as well as demonstrates all the range of options of interacting with them [54]. So, if digital games are played by children on a regular basis, and are an efficient developmental tool in the preschool age, it provides the grounds for the following questions. Are all types of digital games equally efficient for the EF development? How is the content and the mechanism of a digital game related to the development of the EF skills?

Different types of digital games and the EF development

Cognitive psychology mostly relates the development of the EF skills to action video

games that require an active use of voluntary attention and a well-developed perception from the player [15; 18]. Digital action-games are complex 3D games with fast-moving goals that quickly appear and leave the range of the player's vision. Digital action-games include such genres as fighting games, beat 'em ups (hand-to-hand fighting against multiple opponents), shooter games, and platform games. All of them require an agile reaction to multiple quickly-moving visual and audial stimuli, a flexible adjustment of behaviour to the constantly evolving conditions of the play situation, and the development of control strategies for one's actions.

However, other research results contradict the theory of action video games as the most efficient for the development of the EF skills [33; 66]. For example, 119 3—6-year-old children participated in the study by Yang and colleagues (2020), and it revealed no connection between action video games with the total EF skills score. Moreover, action content of digital games was correlated with the inhibition development negatively. The lack or even a complete absence of positive effect of action video games is related to the fact that this genre requires a very quick reaction almost at every moment of playing process which leaves no room for strategic planning.

At the moment, it is the efficiency of a new generation of digital games, the exergames, is of immediate research interest. This genre combines exercises and play, i.e., physical activity and cognitive involvement. This is why many authors believe them to be the most effective type of digital games in regard to development of the EF skills [32; 34; 65]. For example, Gashaj and colleagues (2021) undertook a study that included 97 preschoolers and their parents in order to explore the relationship of classical digital games, exergames, non-digital board games, and EF. Parents evaluated their children's play behaviour by the criteria of frequency, duration, and type of game. It was revealed that in comparison to other digital games (3-dimensional, balance-objects games, etc.), exergames, non-digital board games, and puzzle digital games positively correlated with the development of the EF skills. Let us indicate the fundamental difference between exergames and other types of digital games, it is the criterion of physical involvement. Other than that, in their mechanism, rules, engagement of psychological functions, and content, exergames can be identical to other digital games, such as fast-paced arcade games, first-person shooter games, puzzle games, and others. Therefore, the analysis of the specifics of digital games promoting the EF skills' development needs more explicitation.

Currently, the research of digital games is contradictory and not sufficiently systemic. Comparative studies distinguish different game types at the author's will, because already existing popular classifications of digital games are mostly based on genres and the criteria of the plot, design, and tasks [3]. This approach is not sufficient for the definition of a potential correlation between games and cognitive development. Another categorization of digital games in comparative studies is based on the analysis of parent surveys [7]. The parents describe the games their children prefer in interviews or surveys, and the categories are drawn according to these responses. However, this data may not reflect the real interests of the preschoolers, since parents are not always aware of the digital content their children are dealing with [54]. Moreover, there is almost no research that would include the data obtained directly from the preschoolers. All the above-mentioned complicates the definition of the specifics of digital games contributing to the development of the EF skills. Still, it is essential to underline that the exploration of spontaneous use of digital games by children in real life together with children's preferences is of the urgent interest for us.

The present study

This study was aimed at the correlation between the types of digital games preferred by preschoolers and their EF skills. We wanted to find out what types of games were popular at the moment among present-day preschoolers in general, and the preferences of boys and girls, in particular. Secondly, we aimed to examine the relationship between those preferred types of digital games and the EF skills in children. For a more detailed study of the connection of types of digital games and the specification of their key features defining their efficiency, we created a classification of the games in question. It was based on the children's responses about the digital games they preferred and the current vision of their genres and mechanism [1; 3]. We selected two parameters as the classification criteria: the game mechanism, and the required cognitive functions. We pointed out 6 types of digital games: quick reaction games, logic games, educational games, strategic games, drawing games, and simulators.

The first category included action-games, platform games, and racing games. They require an active processing of visual information in the conditions of fast appearance and disappearance of multiple objects in the player's range of vision. It is also crucial to retain multiple objects in focus. These specifics activate visual working memory. Quick reaction games also imply that the player makes very quick but precise decisions which requires an inhibition of impulsive reactions.

Logic games included arcades, puzzles, and causal games. This category is characterized by relatively simple control mechanism, and simple rules. Logic games don't require an active voluntary attention, but do need strategic thinking and use of logic. Creating their own strategy requires the skills of control of spontaneous actions in favour of the ones that are strategically necessary.

Educational games are basically adjusted educational programs, for example, for English, ABC, maths, and other disciplines. Normally, they have an attractive multicoloured interface, include virtual rewards, video instructions to perform the tasks, and the actual tasks. Educational games are aimed at the training of a particular skill.

Strategic games include sandbox mode (configuration and moving of objects, mapping), Battleship, chequers, and chess. Games that belong to this category have a more complex mechanism than the logic ones. This genre requires planning of the player's activity, coordination, and control of the sequence of actions, and remembering a certain volume of visual information to be able to use it later. Strategic games activate planning skills and visual working memory. It is important to note, that often, preschoolers don't use the benefits of all the potential of strategic games.

We assigned a separate category to the drawing games. In order to draw an object, a visual analysis is required, along with the examination of the details and features of the object. It is also necessary to remember its physical properties. Therefore, drawing activates the mental functions related to the retaining and transformation of images. Besides, the games of this type imply active use of motor skills.

The last but not least category comprises simulation games, or simulators. They create an image imitating real conditions, they reflect a certain part of reality in the virtual environment. A child gets a chance to try to imitate handling some objects. Simulators offer trying out "adult" roles to children: taking care of an animal, decorating a house, doing grocery shopping, and so on. This characteristic is common for simulation and plot role play.

Deriving from this classification of the digital games preferred by preschoolers and the analysis of corresponding re-

search literature we assumed the following: 1) boys would prefer quick reaction games to the others, and 2) girls would rather choose logic games over other genres. We also proposed four specific hypotheses regarding the preferred game types and the EF skills:

Quick reaction game players and strategic game players will demonstrate higher visual working memory scores than the non-players.

Quick reaction game players and strategic game players will demonstrate higher scores in verbal and auditive working memory than the non-players.

Quick reaction game players will demonstrate higher cognitive flexibility scores than the non-players.

Quick reaction game players, strategic game players, and simulation game players will demonstrate higher inhibition scores than the non-players.

Methods

Participants

335 children (48.6% girls) aged 6—7 (M=74.6 months, SD=6.06 months) were recruited for this study. All children were attending public kindergartens in the districts characterized by the same infrastructure level, and designed to accommodate primarily medium-income families.

Procedure

The study included two stages: EF skills assessment and an interview. Both were conducted individually with each child using electronic versions of the tests and questions on a tablet. This made the testing procedure identical for all participants. Three meetings with each child were held to complete all tests and the interview. During the interview about digital devices, the children were asked: “What games do you like to play?”. Participants could name several favorite games. These answers formed the basis of the proposed classification. The assessment took place in a secluded quiet place, familiar for the child in one of the kindergarten rooms.

Parents of all the participants gave written consent for their child to participate in the study. The study was approved by the Ethics Committee of the Faculty of Psychology of Lomonosov Moscow State University.

EF assessment

We used the NEPSY-II subtests [4; 40] to measure the examinees’ EF level: visual (“Memory for Designs”) and verbal working memory (“Sentence Repetition”), and inhibition (“Naming and Inhibition”, “Statue”). We also used “The Dimensional Change Card Sort” [68] to assess cognitive flexibility. It allowed us to measure various components of the preschoolers’ EF.

The NEPSY-II “Memory for Designs” (MD) subtest was used to assess visual working memory. This test reflects the correct memorization of image details and their spatial location

The NEPSY-II “Sentence Repetition” (SR) subtest was used to assess verbal working memory**.** This test consists of 17 sentences that gradually become more difficult to remember due to their length and grammatical structure.

The “The Dimensional Change Card Sort” (DCCS) test was used to assess cognitive flexibility. This technique consists of three tasks for sorting cards. First, the child must sort the cards by color, then by shape, and eventually, to follow a complex rule: if a card has a frame, it must be sorted by color, and if there is no frame, by shape.

To assess the cognitive component of inhibitory control, we used the NEPSY-II “Naming and Inhibition” (Inhibition) subtest in order to measure the information processing speed and inhibition of impulsive reactions. This technique consists of two blocks: a series of white and black circles and squares, and a series of white

and black arrows pointing in different directions (up and down). Two tasks were performed with each series of pictures: first, to identify the form (in this case, the child simply had to quickly name the forms that he/she saw), and an inhibition task. In the latter case, the child had to do everything contrariwise: for example, if a square was demonstrated, he/she was supposed to say "circle" and so on. For each task, the researchers recorded the number of mistakes the child made and corrected or could not correct, as well as the time it took to complete the task.

The "Statue" subtest was used to evaluate behavioral inhibitory control. In this test, the child needs to maintain a stationary body position with his/her eyes closed for 75 seconds, restraining impulsive reactions in response to distracting sounds.

Data analyses

A frequency analysis of participants' responses was conducted to determine the types of digital games children preferred. Then Pearson's chi-squared test was used to reveal gender-based differences in the preferences of digital game types. The Mann-Whitney test was performed to compare the EF in children playing different types of digital games. Significance was set at a p-value of 0.05 throughout the analysis.

Results

Preliminary analyses

A frequency analysis of children's responses to the question "What games do you like to play?" was carried out. First, the answers were categorized according to the proposed classification of digital games (quick reaction games, logic games, educational games, strategy games, drawing games, simulators). Second, a percentage distribution of preferences was calculated. In 55.2% of the responses quick reaction games were mentioned. Children were the least likely to name games involving drawing (10.4%). Table 1 provides an overview of the frequency statistics for the six preferred types of digital games for the entire sample, and separately for each gender. The descriptive statistics for the measures of the executive functions are presented in Table 2. The Shapiro-Wilk test demonstrated that the distribution was abnormal (see Table 2). Thus, nonparametric criteria were used in further analysis.

Analysis of gender preferences of digital game types

Pearson's chi-squared test was applied to display the differences in the preferences of digital game types between boys and girls. The results confirmed that the boys played quick reaction games (Chi-square test, $x = 26.6$, $p < 0.001$) and strategic games (Chi-square test, $x = 9.55$, $p = 0.002$) significantly more frequently than the girls (*see Table 1*). The girls preferred logic games (Chi-square test, $x = 4.65$, $p = 0.031$), educational games (Chi-square test, $x = 7.81$, $p = 0.005$), drawing games (Chi-square test, $x = 10.4$, $p = 0.001$), and simulators (Chi-square test, $x = 38.7$, $p < 0.001$) significantly more often than the boys (*see Table 1*).

The mean scores (mean values, the median, and standard deviation) in the EF tests meet the normal values for the 6—6.5-year-old preschoolers, both for girls and boys (Veraksa et al., 2020).

The analysis of the correlation between preferred digital game types and the EF skills

An intergroup comparison of the EF in children playing different types of digital games was carried out to reveal the correlation between the preferred type of digital game and the EF skills. The Mann-Whitney test was used to analyze the following six pairs: 1) quick reaction game players (n=185, 35% girls) and quick reaction game non-players (n=150, 63% girls); 2) logic

Table 1

Frequency distribution of preferred digital game types

Digital game type	Sample	Boys	Girls
	N=335	N=173	N=163
Quick reaction games	55.2%	[a]68.8%	40.7%
Logic games	28.1%	23.0%	[b]33.5%
Educational games	11.6%	6.9%	[b]16.7%
Strategic games	27.2%	[a]34.5%	19.5%
Drawing games	10.4%	5.2%	[b]15.9%
Simulators	29.5%	14.5%	[b]45.4%

Note: [a]Boys play this type of digital game significantly more frequently than girls; [b]Girls play this type of digital game significantly more frequently than boys

Table 2

Descriptive statistics for the executive functions measures

		N	Mean	Median	Standard deviation	Minimum	Maximum	Shapiro-Wilk W	Shapiro-Wilk p
MD_Content	boys	161	40.9	41	5.21	22	48	0.950	<.001
	girls	152	40.9	41.5	5.10	22	48	0.954	<.001
MD_Spatial	boys	161	20.6	21	3.55	9	24	0.856	<.001
	girls	152	20.0	21.0	3.58	7	24	0.893	<.001
MD_Bonus	boys	161	26.5	28	13.3	0	48	0.959	<.001
	girls	152	22.9	20.0	13.0	0	48	0.949	<.001
MD_Total	boys	161	88.0	89	20.3	38	120	0.966	<.001
	girls	152	83.7	81.5	19.7	42	120	0.970	0.002
SR_Sum	boys	161	19.3	19	3.39	12	31	0.967	<.001
	girls	152	19.7	20.0	3.54	11	30	0.979	0.022
DCCS_Sum	boys	163	19.9	20	2.68	13	24	0.948	<.001
	girls	173	19.7	19	2.81	12	24	0.941	<.001
Naming comb. score	boys	163	11.0	11	3.14	1	17	0.959	<.001
	girls	173	11.1	11	3.15	3	18	0.950	<.001
Inhibition comb.score	boys	163	11.1	11	3.10	4	19	0.982	0.023
	girls	173	11.2	11	2.98	4	19	0.981	0.026
Statue	boys	163	26.6	28	4.60	4	30	0.708	<.001
	girls	173	27.3	29	3.70	10	30	0.682	<.001

game players (n=95, 57% girls) and logic game non-players (n=93, 51% girls); 3) educational game players (n=39, 69% girls) and educational game non-players (n=39, 72% girls); 4) strategic game players (n=92, 34% girls) and strategic game non-players (n=93, 38% girls); 5) drawing game players (n=35, 77% girls) and drawing game non-players (n=35, 77% girls); 6) simulation game players (n=98, 74% girls) and simulation game non-players (n=97, 78% girls). The compared groups (except quick reaction game players and quick reaction game non-players) did not differ by gen-

der, age, and the number of digital game types that children played. The quick reaction game players and non-players differed by gender. All pairs, except quick reaction game players and non-players were formed purposefully, so that for each child playing each type of digital game, a child of the same age and gender was selected from those who did not play that type of games. For quick reaction games, this procedure omitted because there were more players than the non-players.

Significant differences in visual working memory were registered for the quick reaction game players and non-players. Children who played quick reaction games showed better results in memorizing image details in the visual working memory task than children who did not play such games (Mann-Whitney test, U = 10686.500, p = 0.039; M = 23.42, SD = 12.9 for non-players; M=26.56, SD = 13.7 for players). The quick reaction game players also obtained higher total scores in visual working memory tasks than those who did not play this type of games (Mann-Whitney test, U = 10557.500 at p = 0.033; M = 83.44, SD =19.17 for non-players; M=88.32, SD =20.75 for players).

Significant differences in information processing speed were revealed for the logical game players and non-players (Naming combined score in the Inhibition test) (Mann-Whitney test, U =3453.000, p = 0.009; M = 10.5, SD = 3.16 for non-players; M=11.7, SD = 2.78 for players).

For simulation game players and simulation game non-players, significant differences were revealed as well. Children who played simulators showed significantly higher results in cognitive inhibition than those who did not play simulators (Manna-Whitney test, U = 3727.500, p = 0.009; M = 10.58, SD = 2.80 for non-players; M=11.66, SD = 2.94 for players). No significant differences were registered for other game types.

Discussion

The main goal of this work was to examine the preschoolers' preferences in digital games, and their correlation to the EF skills. Our data analysis revealed that quick reaction games were the most popular at this age. The next favourite were logic games, strategic games, and simulators. Educational games and drawing games were mentioned by the examinees much less frequently. Moreover, boys preferred quick reaction games and strategic games more often than girls, while the latter chose four other types of digital games, compared to the boys: logic games, educational games, drawing games, and simulators. The study also demonstrated quick reaction game players' visual working memory was better developed than in the non-players. We also discovered that logic game players processed information at a higher speed than the non-players. Simulation game players obtained higher score in cognitive inhibition, than the children who didn't like this type of games.

The obtained data confirms the popularity of quick reaction games (action-games, shooter games, racing games, and platform games) among present-day preschoolers. This type of games is the most widespread, and this is why its influence might be both the most noticeable and the most accessible for studying. This fact partially explains the high interest of the scientific psychological community for the analysis of action video games in the context of the EF skills' development [2]. These results coincide with the previous research data that it was the genre of action video games that was mostly related to the EF development in cognitive psychology [15; 18]. On the other hand, the obtained data complements and specifies already existing ideas about contemporary children's interests.

The gender differences discovered in the digital game preferences match our

first hypothesis that boys would play quick reaction games more eagerly than the girls. This data also coincides with previously obtained information that boys tend to prefer competitive and sport games [13; 35; 55]. However, our second hypothesis assuming that girls would choose logic games above others, remained unconfirmed. Same as with the boys, of all digital game types, the girls preferred quick reaction games which may be explained by their dynamism and intensity. Yet, girls still preferred logic games more often than the boys, and in general, demonstrated more diverse play interests. These gender differences match the research data revealing that girls tend to prefer more intellectually challenging digital games [35; 55]. A higher diversity of girls' interests in regard to digital games can be related to their broader non-digital play repertoire than the one of the boys. For example, at preschool age, boys usually play with construction blocks and all kind of cars, while girls prefer puzzle games and crafts, play with stuffed toys and dolls, and enjoy "family" role play [57; 58]. Girls' more miscellaneous interests in toys ad plots in conventional play activity can be transferred to digital games as well. Besides, the revealed gender differences can be also explained by the influence of marketing. The manufacturers and the sellers of games tend to orientate boys and their parents on the games related to explorations, victories, and aggression [9]. Meanwhile, girls are offered the games based on consumer behaviour (shopping, beauty parlour, clothes, etc.), communication, demonstration of care, and intellectual development [42]. Thus, all these factors together can indeed, form the ground for the gender differences in digital game preferences.

Quick reaction game players demonstrated a higher level of visual working memory, than the non-players. The cause of these differences can derive from the very mechanism of quick reaction games and the most required and active mental functions of the players. This genre requires immediate reaction to multiple quickly moving visual stimuli [15; 18]. The child needs to quickly perceive and focus on many objects at the same time, as well as make decisions based on this information. Therefore, quick reaction games imply active engagement of visual working memory. Moreover, the differences in visual working memory scores can be related to gender differences in digital game preferences. Among children who played quick reaction games, boys prevailed (65%), while among the non-players, there were more girls (65%). However, some studies revealed that at the age of 5—7 years boys generally have a better developed visual working memory [2; 49]. The combination of these two factors can potentially explain the higher scores for visual working memory in children who played quick reaction games, compared to the non-players. Yet, more recent meta-analyses didn't reveal any gender differences in visual working memory at preschool age [62], which is why the explanation suggested above may be not sufficiently valid. Let us also note that the comparison of other groups of players didn't evidentiate any significant differences in visual working memory. Therefore, the hypothesis that higher score in visual working memory is related to the preference of quick reaction games, drawing games, and strategic games, is only partially confirmed.

The obtained results demonstrated that logic game players processed information at a higher speed than the non-players. This difference can be related to the specifics of the mechanism of logic games. They don't activate voluntary attention directly, but often imply making the decisions based on the logical analysis of the situation in the limited time conditions. Therefore, the child

playing a logic game has to process a significant volume of information at the same time. For example, he/she has to analyse all possible outcomes of a certain event, and choose the most favourable. The obtained results match earlier research data that revealed that digital games could positively affect the perception speed and the speed of activation of executive attention network in children [49; 53].

Stimulation game players demonstrated a higher level of cognitive inhibition control than the non-players. This difference can also be caused by the mechanisms of this genre of games. Simulators imply taking up a play role (a pet-owner or a hairdresser) that requires performing certain role functions. This is a common feature for simulators and plot role play. In other words, in a simulation game, the child has to follow the rules and requirements of a virtual role, for example, to feed a virtual cat at the established time, and take proper care of it. Same as in plot role play, in a simulator, the child has to play up the role correctly to receive bonuses and rewards. He/she should comply with the rules and control his/her impulsive reactions. A constant obligation to follow the role pattern activates inhibitory control in children. Besides, at the age of 5—7 years, this mental function is developing most dynamically [19]. This EF component is the most sensitive to the external influence such as digital games. Another possible reason for a higher level of inhibitory control in simulator players, compared to the non-players, is related to the parental control. Simulators don't have a logical end, nor levels to complete, or any other limits, like other games featuring an end of playing session. There, you complete a mission, perform an educational task, draw something, etc. Apparently, one can play a simulation game endlessly, which means, the parents of the children preferring this genre would more probably have to be strict about their screen time. This, in turn, would contribute to the inhibitory control development. In other groups, no differences in the level of inhibitory control were registered. Therefore, the hypothesis that a higher inhibition level is related to the preference of quick reaction games, strategic games, and simulators, was only partially confirmed.

This study didn't reveal any differences in the indicators of the EF skills between the children that played strategic, educational, and drawing games, and the non-players. This was an unexpected result. However, the absence of correlation might be caused by the fact that in these games, the activation of other cognitive processes was required, rather than the classic EF components. For instance, strategic games imply an active but not an on-stream planning of the players' activity. Despite that planning is closely related to the EF development, the most popular theories see the function of planning and the EF as separate phenomena [28; 45]. Moreover, preschoolers usually use the most primitive features of strategic games that are comprehensible at their age. This relatively low level of cognitive complexity does not foment EF development. Drawing games, in turn, activate the functions related to the analysis and the transformation of images together with motor skills. Thus, visual working memory per se, is not often required for such tasks, since drawing games normally provide the sample that is accessible at any moment of time. Or, children draw freely. Educational games are aimed at the development of particular skills that are not necessarily related to the EF. Besides, the absence of connections between the digital game type and the EF development could be also caused by the insufficient number of children in some groups. In fact, there were just a few educational and drawing game players and non-players. This fact

could explain the absence of the statistical differences between the groups. Thus, the obtained results reflect the need in the search for the most favourable conditions and ways of the EF skills' development in preschoolers by means of various digital games, including those normally used for mere entertainment. The question of the correlation between game preferences and other cognitive processes also arises in this context.

The lack of control of the screen time the children spent playing this or that type of the digital game appeared to be an important limitation for this study. However, it is necessary to emphasize that the homogeneity of the environment the sample came from, allows assuming of an approximately equal time the examinees spent playing games [59]. Secondly, a recent meta-analysis [25] demonstrated the absence of any significant correlation between the total screen time and the EF skills. This fact also speaks in favour of a bigger impact of the type of the game than the screen time, on the development of the EF skills. Another limitation is related to the insufficient control of the characteristics of the compared groups. When the pairs of groups were selected for the analysis, the following factors were taken in to consideration: if they played a certain type of digital game, or not; gender and age composition, and the number of other types of digital games the children played. However, other types of the games played by the participants were not controlled. Furthermore, there weren't enough preschoolers playing one particular type of game to perform a reliable statistical analysis. The sample didn't include the children who didn't play any digital games, either. The analysis of the interviews revealed that some games were not easy to categorize definitively, since they possessed the features of two or more types. Last but not least, this study was also limited in the sense that its results only allow the conclusion about the correlation between the preferred digital game and the EF development, but not about any cause-and-effect connections. On the one hand, playing a certain type of digital games can indeed determine a higher level of EF development. On the other hand, a certain level of development of different EF components can also determine children's game preferences.

Further research could be potentially focused on the sample extension to provide the data for a more reliable statistical analysis of the players and non-players of certain games. More research parameters should be controlled, too. Besides, the amplification of the diagnostic toolkit will allow gathering more complete and systemic date about the digital preferences of present-day preschoolers.

Conclusion

This study suggested a classification of digital games based on the children's reports about their preferences. This classification was designed considering the mechanism and the most actively engaged mental functions of the players. Digital game preferences of present-day preschoolers were defined, as well as their correlation to the EF skills. The suggested classification and the obtained data can be of avail to the end of further research aimed at the definition of the most favourable conditions of digital devises' use. It can also benefit to the preschoolers' parents and kindergarten educators, since the adult's participation is fundamental for the EF skills' development by means of digital games. Adults should choose the game together with children, take part in it, and discuss it. The results obtained in this study can be also applied by adults to purposefully select the most efficient games for children's development and preparation for school.

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Digital Tools for Assessing Development, Competencies, and Behavior

Цифровые инструменты оценки развития, компетенций, поведения

Smartphone on the Desk: a Study of the Features of Cyberloafing in Schoolchildren and Students

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This study aims to research a new form of students' deviation: cyberloafing. This term refers to the use of Internet technologies during classes for non-educational purposes. Children get distracted during lessons by online or off-line activities. A sample of the study consists of students and schoolchildren from Chelyabinsk city. The study involved 233 people aged 13 to 20 years. 146 schoolchildren aged 13—15 years (42% boys and 58% girls) and 87 students aged 17—20 (40% male and 60% female) were recruited for this study. We use the cyberloafing scale proposed by Y. Akbulut (in the Russian version by N.V. Sivrikova). The results of the research demonstrate that the level of cyberloafing is quite low and correlates with participants' gender and educational level. Differences between schoolchildren and students correspond to the structure of cyberloafing behavior.

***Keywords*:** Internet deviations; Internet abuse; digital technologies in education; gadgets.

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Смартфон на парте: исследование особенностей киберлафинга у школьников и студентов

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Работа посвящена изучению новой формы девиации среди учащихся — киберлафингу. Данный термин обозначает использование интернет-технологий во время учебных занятий для не связанных с учебными задачами целей. Фактически это отвлечение детей во время уроков на действия в Сети или офлайн. Авторы представили материалы эмпирического исследования, полученные на выборке студентов и школьников, обучающихся в г. Челябинске. В исследовании приняли участие 233 человека в возрасте от 13 до 20 лет. Выборка школьников: 146 человек в возрасте 13—15 лет (42% — мальчики и 58% — девочки). Выборка студентов: 87 человек в возрасте 17—20 лет (40% — юноши и 60% — девушки). Для сбора эмпирических данных использовалась шкала киберлафинга, предложенная Y. Akbulut (в русскоязычной версии Н.В. Сиврикова). Полученные результаты дают возможность говорить о том, что уровень киберлафинга у участников исследования низкий и связан с полом и ступенью обучения. Различия между школьниками и студентами касаются структуры киберлафинга.

Ключевые слова: киберлафинг; медиапотребление; интернет-девиации; интернет-злоупотребления; цифровые технологии в образовании; гаджеты.

Финансирование. Исследование выполнено при финансовой поддержке Мордовского государственного педагогического института в рамках научного проекта «Исследование девиантного поведения, связанного с использованием цифровых технологий и гаджетов», заявка от 04.05.2023 № МК-42-2023/2.

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Introduction

Why do students hold a smartphone on their desk? This issue is becoming increasingly relevant as the widespread use of digital technologies leads to the blurring of the boundaries between virtual and real

space, between study and entertainment. Students, having access to the Internet through their gadgets, can surf the web during lessons and not always for study purposes.

Researchers use the special term "cyberloafing" to refer to the use of technical devices (most often with access to the Internet) for personal purposes while studying or working. This is a special form of avoiding boring work or a variant of procrastination, carried out through the use of information technologies [9]. Researchers see cyberloafing as a type of counterproductive workplace behavior [29]. However, cyberloafing can be seen not only in the workplace. It is observed in the academic environment too.

Scientists note that cyberloafing is a problem that has intensified due to the need to switch to a remote format of work or study, as well as the digitalization of education [18].

The intensive development of digital technologies, their special role in the life of a modern person, and their widespread introduction into the learning system explain the growing interest of children in the use of digital technologies and the interest of teachers in assessing the advantages and risks of their use in education. Researchers from different countries conclude that information and communication technologies have become a natural part of education and learning [3; 4] and contribute to significant changes in the habitat and development of children [20]. Digital games are increasingly included in classroom education in different countries around the world [2]. For example, in 2019, 47% of teachers in grades 3—8 in the United States reported using digital games in their classrooms several times a week [6]. Research in other countries also shows the use of digital tools in training as tools to transfer or strengthen academic skills [10]. The use of digital educational resources is now possible on a wide variety of media, including tablets, mobile phones, game consoles, portable game controllers, and computers [6; 17]. Many of them have access to the Internet. Such innovations lead to the emergence of new forms of behavior in lessons, require a revision of the norms of "correct" childhood declared by psychology, and require the development of new methods for monitoring the behavior of children in the digital environment. However, solving such global problems requires a preliminary empirical study of the problem of media consumption among children. Firstly, new forms of deviant behavior, such as cyberloafing, deserve attention.

The request from society encourages researchers around the world to analyze the identified problem. Scientists analyze changes in the use of gadgets by children [20], risks to the health, development, and education of children associated with the use of digital technologies [6; 17], factors affecting academic performance and personal development [12; 13; 16], and teachers' willingness to digitally transform learning [10].

The reasons for the use of digital devices in the lesson are one of the central aspects of cyberloafing research. E. Ergun and A. Altun [5] highlight the following causes of cyberloafing in the lesson: motivation, teacher personality, environment, and time. Other authors add to this list the content of the course, the student's identity, and their knowledge of information technology [25, 28]. When studying the personal predictors of student cyberloafing, the researchers found that this type of behavior in the lesson is influenced by psycho-social ideas, attitudes, and learning strategies [26; 27]. Among the environmental factors associated with the level of cyberloafing of students are: level of study, family income, and place of residence [7; 24].

Researchers consider the positive and negative results of the digitalization of education. Data on the effects that are found

with regard to academic performance are ambiguous, but in most studies, they are negative [8]. Teachers admit that it is naive to expect schoolchildren to use digital devices exclusively for educational purposes during class. Moreover, this can negatively affect the emotional sphere of the child [6; 17]. On the other hand, the researchers emphasize that interaction with digital technologies can displace educational content and other types of communication [19].

A recognized fact is that the use of digital interactive technologies in the lesson leads to improvements in student motivation [15], metacognition [17], stress reduction, mood improvement, self-development, and multitasking ability [9; 6].

The ability to multitask is higher in representatives of those generations who were born in the era of intensive development of Internet technologies, and cyberloafing does not negatively affect the cognitive activity of generation Z [11]. Researchers recognize the possibilities of cyberloafing as a means of restoring effort [27; 24].

It should be noted that all the empirical data obtained on the prevalence of cyberloafing among students was obtained by foreign researchers. In Russia, such studies have not yet been carried out. In this regard, the issue of studying the level of cyberloafing among Russian students and schoolchildren is relevant.

Methodology

Study flow chart. Students and schoolchildren took a voluntary, anonymous part in the study of the peculiarities of media consumption. To do this, they filled out specially prepared forms with a cyber buffer scale and brief information about them (age and gender).

Study sample. The study involved 233 respondents (ages 13 to 20). 146 schoolchildren aged 13—15 years (42% boys and 58% girls) and 87 students aged 17—20 (40% male and 60% female). The survey took place in classrooms during extracurricular hours. Participation was voluntary.

Research methods

We used the cyberloafing scale proposed by Y. Akbulut et al., adapted by N.V. Sivrikova [15], to collect empirical data. The scale contains 24 points (for example, I view my friends' posts). Previously, the study participants were given instructions: Below are a number of statements that relate to the use of the Internet during classes (lessons) for personal purposes (not to solve the tasks set by the teacher). Each of them may be more or less relevant for you. Evaluate the following behaviors: Use a five-point scale for this: 1-never, 2-rarely, 3-sometimes, 4-often, and 5-constantly.

The questionnaire included questions about gender, year of birth, and the digital devices available to the study participants.

The methodology is based on a five-factor cyberloafing model. It allows you to estimate the frequency of five forms of cyberloafing behavior. These are online shopping (6 points), online content usage (7 points), games (3 points), online sharing (9 points), and communication on social networks (5 points). Reliability indicators (Kronbach α value) of individual sub-scales ranged from 0.78 to 0.88.

The analysis of the data assumed an assessment of the distribution parameters of the studied features in the sample (Table 1).

Empirical distribution parameters differ from normal distribution parameters. According to Levene's criterion of Equality of Variances, the application of parametric processing methods to the resulting array of empirical data will be incorrect. Therefore, we used the Mann-Whitney U test to compare the level of cyberloafing in schoolchildren and students (as well as in respondents of different genders). We used Statistical Software Package (SPSS) version 23.0 to perform the calculations.

Table 1

Parameters of distribution of studied cyberloafing features

Cyberloafing behavior	Levene's test		M	SD	Asymmetry	Excess
	F	P				
sharing	10,7	0,001	2,6	1	–0,4	0,2
shopping	6,5	0,011	2	1,1	0,5	–0,5
content usage	11,7	0,001	2,7	1,1	–0,5	–0,1
games	0,5	0,5	1,7	1	1,1	1,7
communication on social networks	3,3	0,1	2,4	1,2	0,1	–0,6

Study results

The survey results showed that the study participants most often own a smartphone (86%). About half of them (58%) own a laptop, about a third (29%) own a stationary computer, and about a quarter (26%) own a mobile phone. Thus, it turned out that smartphones were the most popular among the study participants.

The figure shows the results of the analysis of mean values by sample, which reflect the severity of individual cyberloafing factors among the study participants. The findings say that students and schoolchildren use the Internet during study sessions for non-study purposes, rarely or sometimes. Most often, during lessons, study participants use the Internet to search for information. During training sessions, they play digital games. These features are typical for both schoolchildren and students (Fig.).

We applied the Mann-Whitney U test to analyze differences between study participants at different learning stages (Table 2).

Analysis of the differences between the compared groups showed that the frequency of use of such forms of cyberloafing as exchange, online shopping, and use of social networks is associated with the stage of training. In particular, students more often than schoolchildren make online purchases during study sessions. This may be due to their greater material independence. Perhaps they shop more often than schoolchildren, since some of them live separately from their parents. In addition, shopping via the Internet is not always possible for minors. Schoolchildren are more likely than students during study sessions to communicate on social networks and share information online. This pattern may be related to the differences in tasks and leading activities among schoolchildren and students. The leading activity of the former is communication with peers, which in recent years has become more dependent on digital means of communication. An important task of adolescence is self-expression and self-assertion through the expression of one's opinion. This is probably why teenagers are more dependent on various forms of sharing on the network: likes, comments, etc.

In Table 3, we presented data reflecting the differences in cyberloafing due to the gender of respondents.

Boys are more likely than girls to play digital games during training sessions. Girls are more likely than boys to use social media during training sessions.

Discussion

As a result of comparing the data obtained with the data of other studies, we concluded that among Russian schoolchildren and students, the phenomenon of cyberloafing is less common than among schoolchildren in other countries. The rea-

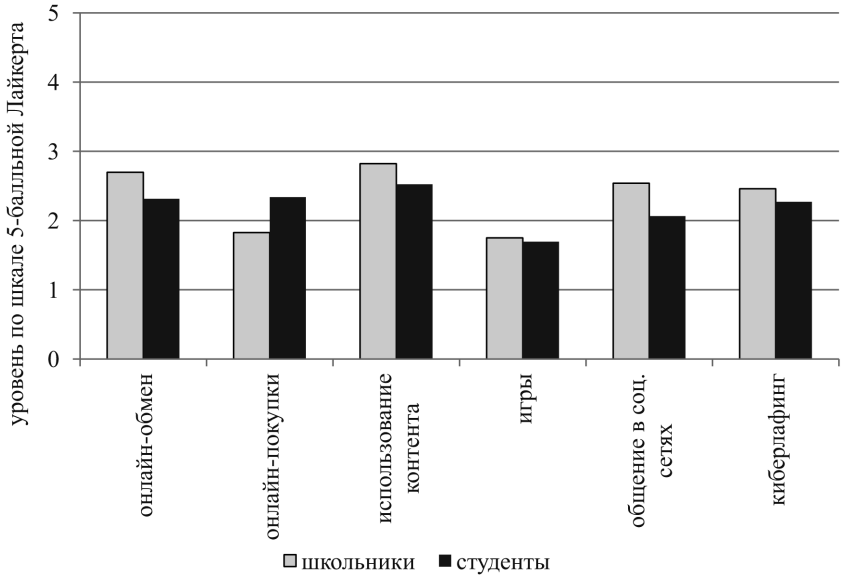

Fig. Features of cyberloafing among schoolchildren and students

TTable 2

Differences in the level of cyberloafing in students and schoolchildren

cyberloafing behavior		N	mean rank	U	p
sharing	schoolchildren	146	125,18	5157,0	0,02
	students	87	103,28		
shopping	schoolchildren	146	103,17	4332,5	0,00005
	students	87	140,20		
content usage	schoolchildren	146	121,93	5631,5	0,15
	students	87	108,73		
games	schoolchildren	146	115,79	6174,0	0,72
	students	87	119,03		
communication on social networks	schoolchildren	146	127,17	4865,5	0,003
	students	87	99,93		
cyberloafing	schoolchildren	146	119,22	6026,5	0,51
	students	87	113,27		

son can be in the policy of banning gadgets in a Russian school (although it should be noted that recently they are increasingly moving away from it). This practice indicates that cyberloafing is seen as a barrier to the successful integration of information and communication technologies into the educational environment.

In the presented study, the level of cyberloafing in schoolchildren indicates that they rarely or sometimes use the Internet during lessons to solve problems unrelated to learning. Similar data on the prevalence of cyberloafing was found in samples of students from Turkey [28] and Turkish students in grades 6—8 [22]. On the other

Table 3

Features of cyberloafing in respondents of different sexes

cyberloafing behavior		N	mean rank	U	p
sharing	male	97	110,94	6008,0	0,25
	female	126	121,32		
shopping	male	97	115,49	6450,0	0,77
	female	126	118,07		
content usage	male	97	125,91	5731,5	0,09
	female	126	110,64		
games	male	97	137,39	4618,0	0,0001
	female	126	102,46		
communication on social networks	male	97	107,75	5698,5	0,05
	female	126	123,60		
cyberloafing	male	97	119,61	6343,0	0,62
	female	126	115,14		

hand, students in the USA [21] and Indonesia [12] demonstrate cyberloafing just sometimes.

As a result of comparing the popularity of certain types of cyberlafing, we found that schoolchildren in classes use access to online content to solve the problems of socialization (self-expression and maintaining significant relationships), students also purchase goods during the lessons. According to other researchers, students communicate more often during classes via the Internet [14]. Such differences may be related to cultural aspects.

There is conflicting data on gender-related differences in cyberloafing studies. In some studies, scientists found no difference in the level of cyberloafing among people of different genders [22, 28] or no association between gender and cyberloafing [13]. In other studies, it was found that gender mediates the relationship between attitude-behavior and goal-behavior [14], which should also manifest itself in the features of cyberloafing. Therefore, it can be assumed that the reason for the inability to detect gender differences in the level of cyberloafing is related to the features of the study sample or to the features of the applied data analysis strategies.

In a number of studies, the authors say that men more often demonstrate cyberloafing than women, both in workplaces and in educational institutions [3; 23]. Researchers attribute this to gender differences in the use of the Internet. For example, the number of male Internet users exceeds the number of female users in Turkey [28]. In Russia, the distribution of Internet users is also shifted towards men (53.5% versus 46.5%) compared to the natural distribution of the population. It is expected that men will transfer the habit of using the Internet to their place of work or study.

Gender differences in the use of the Internet and cyberspace can be controversial. For example, they can vary depending on the type of cyberloafing, which was confirmed in our study. Gender differences in cyberloafing can be influenced by different factors. This is the nature of the study sample and control variables, such as social desirability [14]. Our study found that girls more likely than boys visit social media during lessons, and boys more likely than girls play games. These differences can be explained by the fact that psychological

features related to gender determine the general activity of a person [15].

Conclusion

The study contributes to the study of new forms of deviant interleaving (cyberloafing). Its value is increasing due to the active introduction of remote formats of learning using communication technologies in the educational process. By the results we received we can conclude that in Russia, the phenomenon of cyberloafing is less common than in other countries. But this form of behavior is already observed in schools and institutions of higher levels. An analysis of the experiences of other countries shows, that further monitoring of the level of cyberloafing in Russian educational institutions is necessary. It is also necessary to study this phenomenon and develop measures to prevent its negative effects.

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Using Process Data from Completing a Task in Creative Thinking Assessment

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Creative thinking is an important skill in the modern world, and assessing its efficiency using modern digital tools is an increasingly complex methodological task. Using the information about the process of solving the tasks into the assessment model using the digital testing mechanisms became a promising trend. The use of such data allows us to consider the processes of creative thinking in dynamics, which makes the assessment of the level of creativity more accurate and diverse. The paper presents an analysis of the work of 823 students in the 4th grade who were asked to create images in a closed simulation environment. In this way, we analyzed their creative and critical thinking. Then the sequences of actions of students at different levels of creative thinking were compared, and various strategies they used to complete creative thinking tasks were compared with strategies used for critical thinking tasks. The information on the process helps to understand how these tasks work and to perform validation study. It also enhance the scoring rules and the feedback that can be received after the test.

Keywords: creative thinking; process data; computer testing; N-grams.

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Использование данных о процессе выполнения задания при оценке креативного мышления

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Креативное мышление является важным навыком современного мира, а его оценка с помощью современных цифровых инструментов становится все более сложной методологической задачей. Включение в модель оценки креативного мышления данных о процессе выполнения заданий является перспективным направлением, которое становится возможным в компьютерном тестировании. Применение таких данных позволяет учитывать процессы креативного мышления в динамике, что делает оценку уровня креативности учеников более точной и многогранной. В исследовании представлен анализ работ 823 учеников 4 класса, которые в ходе выполнения задания создавали изображения в закрытой симуляционной среде для оценки креативного и критического мышления. В эмпирической части с помощью критерия хи-квадрат были сравнены последовательности от одного до трех действий учеников с разным уровнем сформированности креативного мышления, а также при выполнении задания на креативное и критическое мышление. В результате было показано, что данные о процессе выполнения задания могут быть использованы при проверке качества заданий и валидизации инструментов измерения, а также расширяют систему подсчета баллов и обратную связь по результатам тестирования.

Ключевые слова: креативное мышление; процессные данные; компьютерное тестирование; N-grams.

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Introduction

The education process identified some important abilities called either “key competences” or “21st century skills” [29], the mastery of which is necessary for successful realization in life. Creativity, or creative thinking, is one of these skills. While computers and various artificial intelligent systems are now replacing workers for many standard tasks [3], the ability to think creatively and solve problems, complex communications, and social skills are becoming increasingly significant skills in the labor market. This requirement forces teachers to consider how to develop these skills and psychometricians to consider how best to assess these skills.

In the field of creativity assessment in the educational sphere, there is a widespread approach representing four main categories of creativity definitions and research areas known as the 4Ps: product, process, person, and press of the environment [20]. In the following, we will review the instruments for measuring cognitive processes related to creativity and creative products or outcomes.

The process approach to measuring creativity focuses on specific cognitive processes that contribute to creativity. Traditional tests developed under this approach involve open-ended or poorly structured tasks that require the production of as many responses as possible, which are then assessed to determine various creativity factors, usually including fluency (number of responses), originality (statistical rarity), flexibility (number of different categories), and elaboration (number of details). The main idea of assessment is not only to consider the quantity of answers, but also their quality.

A major contribution to the assessment of creative abilities was made by Gilford [10], who developed the Structure of the Intelligent (SOI) model and divergent thinking tests, which is considered an important element of creativity. It is also worth noting that the most used creativity tests are the Torrance Tests of Creative Thinking (TTCT) [27], which have been translated into more than 40 languages. Torrance designed 12 tests for different ages, grouped into a verbal, visual, and audio battery. However, Torrens tests are labor-intensive in terms of training experts and administering testing. In addition, the tests do not measure all aspects of creativity, but they do not claim to do so either. In the field of creativity assessment, there is a position that no cognitive test is a predictor of creativity if it does not include affective and motivational factors [26].

The newer creativity tests for schoolchildren are most valuable as indicators of potential creativity assessment (The Evaluation of Potential Creativity, EPoC), which are developed as procedures that assess the "overlap area". The test consists of a series of subtests that were designed to measure both general and specific creative abilities in two areas — verbal/literary and graphic [4]. The EPoC subtests measure two key models of creative cognition — divergent and convergent thinking. Divergent thinking tasks involve creating as many drawings as possible using a simple abstract shape or familiar object. Verbal thinking tasks involve creating several simple story endings in response to a unique story beginning or, conversely, several plot twists in response to a unique denouement. In convergent thinking tasks in the graphic domain, test takers create a completed original drawing using at least four of the eight abstract shapes or familiar objects that serve as the basis for their composition. In the verbal/literary domain of the convergent thinking task, test takers are required to create a completed story based on either a given title or given fictional characters.

However, traditional approaches to creativity testing, such as paper-and-pencil testing, are already outdated and have several disadvantages. First, they require experts for assessment, which creates a high testing workload due to the complexity of administration and introduces the effect of subjectivity of experts into the final scores. In addition, traditional tests have psychometric problems, such as inconsistent evidence of reliability and validity of instruments in different samples, the influence of the test environment on test results, and outdated psychometric analyses [23].

In this regard, the assessment of complex skills requires using not only traditional testing formats, but also more modern formats. One such format is digital tasks containing interactive elements that often resemble games in their form of presentation [15]. Examples include a instrument for assessing convergent thinking — *BuzzWords* [13], divergent thinking — *Immune Defence*

[16], convergent and divergent thinking simultaneously — *Crea.blender* [19]. Often, instruments in digital environments not only have automatic scoring rules without expert involvement, but also collect data about the process of task performance.

Task process data refers to data collected from respondents interacting with the computerized assessment element. This is recorded in computer log files and is often represented as sequences of events (specific actions in the test environment) with time stamps [9]. Such data is collected and analyzed in the assessment of complex skills, such as collaborative problem solving [30], as well as in modern task formats that simulate video games [14].

For example, in the framework of the Programme for International Student Assessment (PISA) in 2012, students' problem-solving skills were assessed using a set of interactive test items [17]. The test is designed to measure individuals' ability to cognitively process information to understand and solve problem situations where the method of solution is not immediately obvious. By exploring the problem situation and interacting with the computer environment, students found pieces of information that would be useful for solving the problem at hand. In addition to the answers to the test questions, students' behavioral data is also recorded to have an insight into their problem-solving strategies. For PISA problem-solving tasks, the learner's explicit answers to each question are product data, and the series of clicks and inputs made during his or her interaction with the questions, as well as the timestamps associated with each action, are process data of the task. Different methods for analyzing process data in relation to one of the 2012 PISA tasks were shown in [18], whose findings suggest that the choice of data analysis methods for analyzing the process of task performance in a saturated digital environment depends on the purpose of the analysis and the structure of the data.

The aim of the study is to determine the possibilities of using data on the task performance process in the framework of evaluating creative thinking using an instrument in a digital environment. Based on the indicators in the instrument, we get information about the level of creativity skill development, so we can compare the processes of solving a task among students with different levels of creativity skill development. In this instrument, described in detail in the next section, not only creativity but also critical thinking is assessed using the same format tasks.

Thus, in the study, we want to answer the following research questions regarding the data on the task process:

1. What actions distinguish the process of performing a creative thinking task for students with a high level of creative thinking from performing it for students with a low level?

2. What actions distinguish the process of performing a creative thinking task from the process of performing a critical thinking task?

Methods

The instrument

This study analyzes one of the tasks of the instrument “4K” for 21st-century skills assessment among fourth-grade schoolchildren, developed by the Centre for Psychometrics and Measurements in Education (Laboratory for New Constructs and Test Design) of Institute of Education of HSE University. The instrument consists of several scenario-type tasks that evaluate four skills: creative and critical thinking, communication, and cooperation. Moreover, most tasks allow to measure several skills.

The instrument is presented to students in computerized form. The task screen is interactive: the test taker clicks on an area of his/her choice and then sees a

pre-prepared specific response from the testing system. This format allows for the demonstration of complex skills, as well as keeps test takers motivated and reduces test anxiety. At the same time, the simulation of a real environment allows for more accurate recording of observed behavior, i.e., evidence that the test taker possesses a specific skill.

This paper considers the task «Monster», which is aimed at assessing creative and critical thinking. The general context of the task is imaginary and consists in the fact that the test taker found himself at a holiday performance in the City of Monsters. The task consists of description screens and a constructor (Figures 1—2) with which the test taker creates images.

In the first part of this task, aimed at assessing creative thinking, each test taker creates three monsters for the performance poster, which should be surprising and unusual and different from the locals. The interface of this part of the task is shown in Fig. 1. The constructor consists of a canvas in the center on which elements from the bottom panel can be placed. All elements are divided into categories (torso, arms, various, etc.) and can be used an unlimited number of times (except for the torso, which must necessarily be one and is fixed in the center of the canvas). On the right side of the screen was a local resident, which was considered a reference for the purpose of originality scoring. Also, on the screen above the reference and on the right side of the bottom panel are instructions for completing the task.

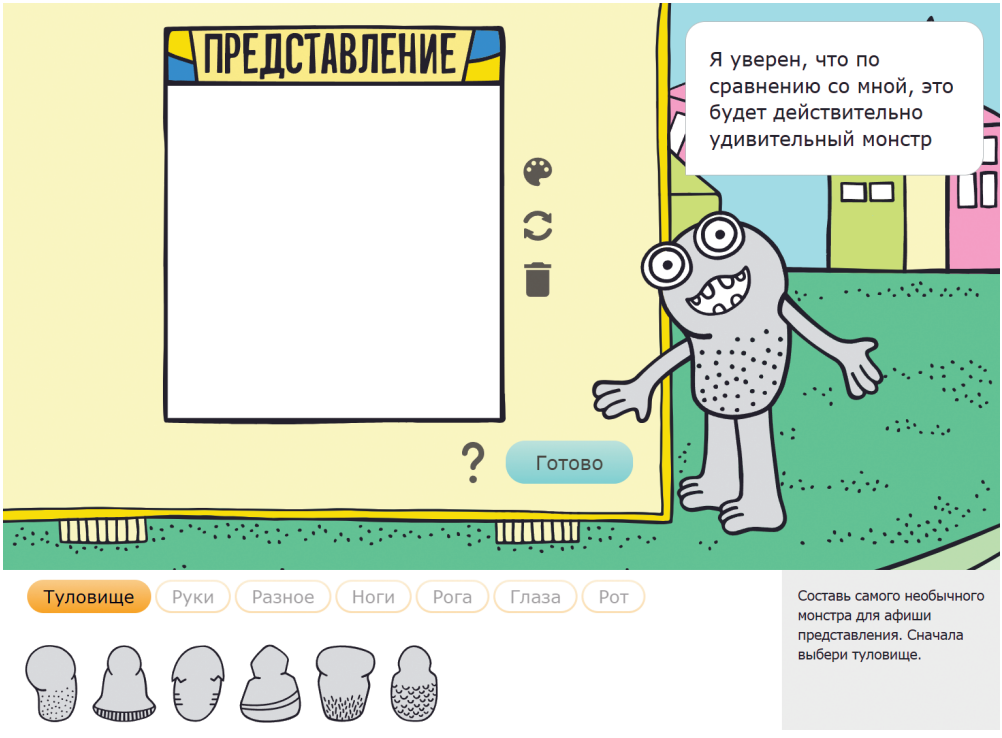

Fig. 1. Interface of the task «Monster» for evaluating creative thinking

In the second part of the task, it turns out that an emergency incident occurred during the performance and the test taker must draw up a sketch of the criminal based on a short description. The interface of this part of the task is not much different from the interface of the previous part and is shown in Fig. 2. The main difference lies in the instructions, according to which the test taker must create a sketch of a criminal monster, and not an unusual monster.

Construct operationalization

To create the measurement instrument, we defined the theoretical framework of the creativity construct [1], which is based on both the cognitive approach [10, 27] and the concept of structured imagination [28]. Creativity within this instrument includes two sub-constructs:

1. *Originality* — the ability to generate new ideas and problems solutions, which can be expressed as new ideas and construct unobvious relations between existing ideas.

To evaluate the originality of the image constructed by the test taker, we compare it with the reference image. A reference is a proxy image that reflects the image that is most frequently found in the sample. When creating a reference for a task, we identify the most typical elements and their number through cognitive interviews and quantitative research at the pilot stage. The focus of the task on creativity is determined by the fact that as part of the task, test takers are asked to create a new image that should differ from the original one.

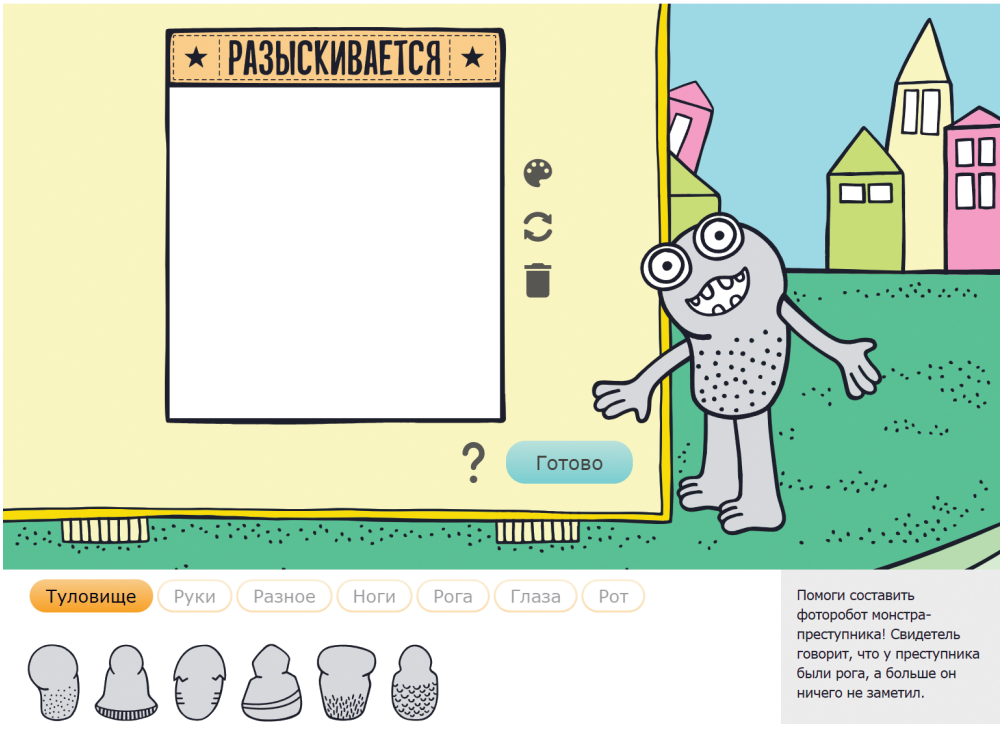

Fig. 2. Interface of the task «Monster» for evaluating critical thinking

2. *Elaboration* — the ability to work out the proposed idea in depth, with a high degree of detail.

Similar to the measurement in the cognitive approach, in our study, elaboration is measured as the number of elements that are used in the solution, and their functional diversity.

Sample and procedure

Testing was conducted in the spring of 2022 in several cities of Russia. From all the samples, students were selected who fully completed the task «Monster» (each image contains at least 2 elements). Thus, the base for the analysis consisted of 823 fourth grade students.

The average task completion time is 15 minutes. Testing took place in schools under the supervision of a teacher with the consent of parents in accordance with research ethics. The results of the students were anonymized for analysis purposes.

Indicators

In scenario tasks of the instrument "4K", skills are evaluated using indicators. Indicators are defined as the behavioral manifestations of a skill that were included in the scenario set by the developer, for example, test taker chosen or did not choose the correct behavior in the situation that arose. Behavioral display of creativity and critical thinking in the task «Monster», we consider the features of images created by test takers. These image features (indicators) have predefined scoring rules, shown in Table 1. The scoring rules were applied to each image separately. Below are the scoring rules based on the indicators of originality and elaboration.

In addition to the indicator, the image creating process was recorded for each

Table 1

Scoring rules for creativity assessment in the task "Monster"

Indicator	Scoring rules
Originality	
origin1	1 — number of elements from the category Legs is different from 2 0 — number of elements from the category Legs is equal to 2
origin2	1 — number of elements from the category Hands is different from 2 0 — number of elements from the category Hands is equal to 2
origin3	1 — number of elements from the category Mouth is different from 1 0 — number of elements from the category Mouth is equal to 1
origin4	1 — number of elements from the category Eyes is different from 2 0 — number of elements from the category Eyes is equal to 2
symmetLegs1	1 — lack of symmetry for elements from the category Legs 0 — there is symmetry for elements from the category Legs
symmetHands1	1 — lack of symmetry for elements from the category Hands 0 — there is symmetry for elements from the category Hands
position1	1 — at least one element from the category Legs is not in the leg's slots 0 — all elements from the category Legs are in the leg's slots NA — elements from the category Legs are not used at all
position2	1 — at least one element from the category Hands is not in the hand's slots 0 — all elements from the category Hands are in the hand's slots NA — elements from the category Hands are not used at all
position3	1 — at least one element from the category Mouth is in the upper part of the torso 0 — all elements from the category Mouth are at the top part of the torso NA — elements from the category Mouth are not used at all

position4	1 — at least one element from the category Eyes is in the upper part of the torso 0 — all elements from the category Eyes are at the top part of the torso NA — elements from the category Eyes are not used at all
Elaboration	
nElements	2 = 9 and more elements 1 = 5 to 8 elements 0 = 0 to 4 elements except elements from the category Various
nVarious	2 = 2 or more elements from the category Various 1 = 1 element from the category Various 0 = elements from the category Eyes are not used at all
color	1 — changed the color of the monster at least once 0 — did not change color
turn	1 — turned any element at least 1 time 0 — did not turn elements

test taker in the form of a comma-separated record of all actions, for example, "Start, Add_Torso, Add_Hands, Add_Hands, Add_Legs, Add_Legs, Add_Mouth, Color, Add_Eyes, Finish". All possible actions are described in Table 2.

Data analysis methodology

To assess the level of creativity, the methodology of confirmatory factor analysis (CFA) on ordinal variables was used [6]. We use the weighted least squares method using the polychoric correlation matrix (WLSMV) for reliable estimation due to the categorical order of the data [7]. The model's fit to data was determined based on the comparative fit index (CFI), Tucker-Lewis index (TLI), and the root mean square error of approximation (RMSEA). The first two indexes show the distance of the constructed model from the

Table 2

Actions in the Action Log

Action log entry	Action
Start	Beginning of the task
Finish	End of the task
Color	Changing the monster color
Add_X, where X can be: Torso Hands Legs Horns Eyes Mouth Various	Adding an element from the corresponding category
Tur_X, where X is same as the case with Add, except Torso, because the torso is always located in the center of the canvas and does not rotate	Rotate an element from the corresponding category
Del_X, where X is same as the case with Add	Delete an element from the corresponding category
Que	Using help by clicking on the question mark

null model, in which no variable is associated with another [5], and the last one is based on the analysis of model residuals [25]. We used the following critical values of the coefficients, following the generally accepted cut-offs (Yu, 2002): CLI>0.95; TLI>0.95; RMSEA≤0.06. To improve the quality of the model, modification indices based on the analysis of model residues were used.

The unit of analysis in models is the indicator. The relationship between the indicator and the factor can be described based on the factor loading of the indicator in the CFA model. A statistically significant and positive factor loading indicates the presence of this relationship, and a higher value of the factor loading indicates a higher relationship of the indicator with the studied factor.

Factor scores from the CFA model calculated using the regression method are used to assess the level of ability formation [for more information, see 8]. Factor scores are a standardized continuous scale with a mean of 0 and a standard deviation equal to the root of the square of the multiple correlation between all indicators and the factor. Thus, the obtained factor scores can be used for further ranking of test takers.

To work with data from the task performance process, the recorded variables were divided into N-grams,small sequences of certain actions, where N is the number of actions in this sequence. The shortest sequences are unigrams, i.e. sequences of one action. Bigrams and trigrams are also used in the work — sequences of two and three actions, respectively. If the test taker performs 16 actions while completing the task, then this sequence contains 16 unigrams, 15 bigrams, and 14 trigrams. N-grams can be repeated both between different test takers and within the process of a task performed by one test taker. Based on the Table 2 we can assume that there will be 24 unique unigrams in the task, and the "Start" and "Finish" unigrams must occur in all tasks. Due to the different frequency of occurrence, certain sequences make a different contribution to distinguishing groups of test takers, so the accepted practice when working with N-grams is to weigh them [12] according to the formula

$$w(i,j) = \begin{cases} \left(1 + \log\left(n_{i,j}\right)\right) * \log\left(\frac{N}{n_i}\right), & \text{если } n_{i,j} > 0 \\ 0, & \text{если } n_{i,j} = 0 \end{cases}$$

where i,j is a certain action i (N-gram) in a certain sequence j,

N is the total number of sequences,

$n_{i,j}$ — frequency of action i in the sequence j,

n_i — frequency of action i in all sequences.

To compare the task performance process, we calculate the weighted frequency of N-grams in different subgroups to determine how much one group differs from another in terms of action frequencies. According to the null hypothesis, two sets are randomly equivalent, so the distribution of their actions is proportional to each other. To assess the deviation from this null hypothesis, the chi-square criterion ($\chi 2$) is calculated [for more information, see 2]. N-grams with higher values of $\chi 2$ are the sequences of actions that distinguish the task performance process in the selected subgroups. At the significance level of 0.05, the critical value of $\chi 2$ is 3.84. That is, if the observed value exceeds it, then we can be 95% sure that the action occurred more often in one of the two subgroups. The higher the value of $\chi 2$, the greater the differences between the subgroups.

All calculations were performed using the programming language for statistical data processing R version 4.3.1 using the lavaan package [21] for evaluating CFA models and the ngram package [24] for calculating N-grams.

Results

Assessment the level of creativity

First, models of confirmatory factor analysis were constructed to determine the level of creativity according to the indicators included in the task. Two separate models

were constructed for the Originality and Elaboration. The fit indexes of both models are presented in Table 3 and indicate that both models fit well to the data.

Table 3

Indicators of compliance данным with the CFA model dataей КФА

Index	Originality	Elaboration
CFI	0.980	0.973
TLI	0.979	0.961
RMSEA	0.039	0.045

Figure 3 shows the factor structure of the model for the Originality. For all three images of monsters, correlations between indicators of symmetry and hand position, symmetry and the original number of hands, symmetry and the original number of legs were added to the model to better match the data.

All standardized factor loadings are significant ($p < 0.05$) and range from 0.22 to 0.67 with an average value of 0.45, which is an acceptable value.

Fig. 3. Factor structure of the Originality

Figure 4 shows the factor structure of the model for the Elaboration. In this model, correlations were also added between related indicators, namely rotation, the number of elements except the category Various, and the number of elements from the category Various.

All standardized factor loadings are significant ($p<0.05$) and range from 0.16 to 0.83 with an average value of 0.41.

Comparison of the process of performing a creative thinking task by students with high and low levels of creative thinking

To answer the first research question, we looked at the first images of a monster that were created by test takers when solving a task aimed at assessment creative thinking. Unigrams, bigrams, and trigrams were constructed, since longer sequences do not have a high frequency in the data and are difficult to interpret. Table 4-5 shows the chi-square value when comparing two groups of test takers by the level of formation of two creativity sub-constructs (originality and elaboration), and 200 students with the highest factor score for the corresponding substructure were selected in the high — level group, and 200 students with the lowest factor score were selected in the low-level group.

Among unigrams, there are no significant differences between students with a high and low level of originality. Based on bigrams, we can conclude that high-level students are more likely to use elements from the category Various, which is logical, since this category contains unique elements that responsible for originality of

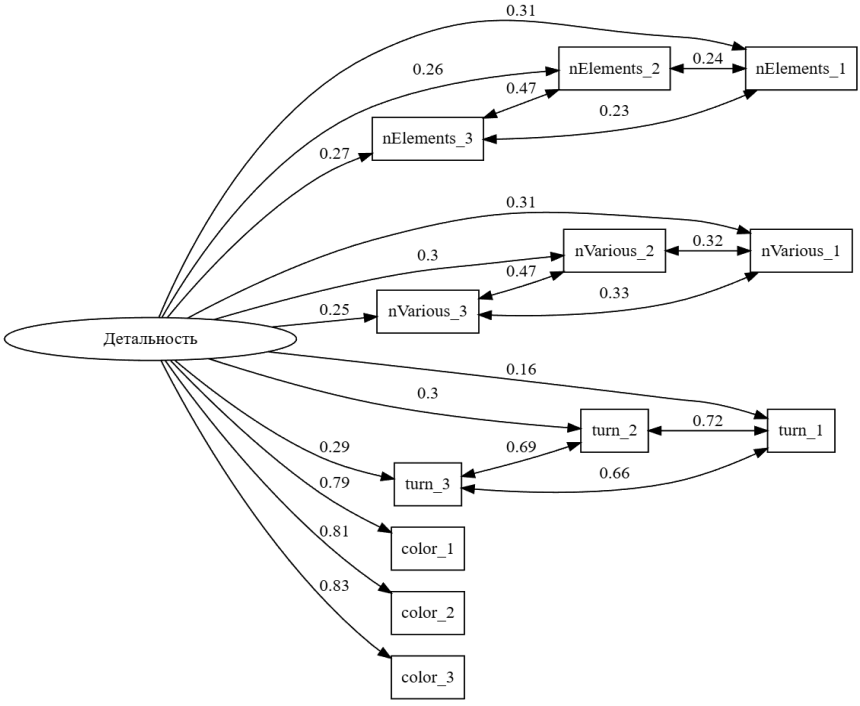

Fig. 4. Factor structure of the Elaboration

Table 4

Difference in the frequency of N-grams in the process of performing tasks for creative thinking in students with high and low levels of originality

High level		Low level	
Action	**χ2**	**Action**	**χ2**
unigrams (χ2>5)			
Tur_Various	5,3	Del_Mouth	8
		Tur_Legs	6,7
		Tur_Mouth	6,5
bigrams (χ2>10)			
Add_Various Add_Eyes	26,1	Tur_Hands Color	17
Add_Various Add_Various	17,1	Add_Eyes Add_Eyes	14,6
Add_Mouth Add_Mouth	15,1	Add_Mouth Tur_Mouth	12,9
Del_Legs Add_Eyes	15,1	Tur_Mouth Tur_Mouth	12,9
Add_Horns Add_Legs	14,8	Color Add_Horns	11,3
Add_Legs Finish	14,2	Tur_Horns Add_Various	10,8
Add_Various Del_Hands	10,3	Tur_Hands Add_Mouth	10,2
Color Del_Legs	10,3		
Del_Horns Add_Various	10,3		
Del_Horns Finish	10,3		
Del_Legs Color	10,3		
Tur_Horns Add_Legs	10,3		
trigrams (χ2>20)			
Add_Hands Add_Hands Add_Hands	33	Add_Mouth Add_Eyes Add_Eyes	24,5
Add_Eyes Add_Eyes Add_Eyes	27,1	Add_Eyes Add_Eyes Finish	20
Add_Hands Add_Legs Finish	27,1	Del_Torso Add_Torso Add_Legs	20
Add_Legs Add_Various Add_Hands	27,1		
Add_Mouth Add_Legs Finish	23,3		

the final image. Students with a high level of originality also have bigrams that include the action of deleting an element, which can indicate a creative process when the student tries different elements to create an original image. Among the trigrams, the greatest difference between students with different levels of originality is observed in the sequences of adding three elements from the category (hands and eyes). This confirms the existing scoring rules for originality, since for these categories the number of elements in the reference is two, and if the test taker adds three elements at once, this is associated with a high score for originality.

Students with a high level of elaboration are significantly more likely to change the color of the monster and rotate elements from different categories. This is consistent with the scoring rules for elaboration, as these actions are associated with higher scores for elaboration indicators. At the same time, students with a low level of elaboration remove items from different categories, which reduces the total number of monster items and indicates a low level of elaboration of the test taker. In addition, it is observed that unigram addressed to help button is more common in students with a low level of elaboration. This can be explained by the fact that such students

Table 5

Difference in the frequency of N-grams in the process of performing tasks for creative thinking in students with high and low levels of elaboration

High level		Low level	
Action	**χ2**	**Action**	**χ2**
unigrams (χ2>4)			
Color	64,4	Del_Torso	18,1
Tur_Horns	27	Que	18
Tur_Eyes	9,4	Add_Mouth	5,9
Tur_Various	8,6	Del_Eyes	4,8
Tur_Legs	7,2	Del_Hands	4,6
bigrams (χ2>35)			
Add_Torso Color	75,8	Add_Torso Add_Mouth	75,5
Color Color	59,6	Add_Torso Add_Eyes	73
Color Finish	47,1	Add_Torso Add_Hands	70,7
Color Add_Eyes	44,9	Add_Legs Finish	65
Color Add_Legs	43,4	Add_Hands Finish	62,2
Color Add_Hands	40,9	Add_Hands Add_Legs	58,4
Add_Horns Tur_Horns	39,5	Add_Eyes Finish	57
Color Add_Various	39,2	Add_Torso Add_Legs	47,9
Color Add_Mouth	35,6		
trigrams (χ2 > 25 for high level and χ2 > 45 for low level)			
Start Add_Torso Color	72,8	Start Add_Torso Add_Mouth	88,9
Add_Torso Color Color	42,6	Start Add_Torso Add_Hands	83,6
Add_Horns Tur_Horns Tur_Horns	37,2	Add_Hands Add_Hands Finish	74,3
Color Add_Legs Add_Legs	35,9	Add_Torso Add_Hands Add_Hands	72,4
Color Add_Hands Add_Hands	34	Start Add_Torso Add_Legs	66,7
Tur_Horns Tur_Horns Tur_Horns	32,5	Start Add_Torso Add_Eyes	61,9
Add_Horns Add_Horns Tur_Horns	30	Add_Torso Add_Legs Add_Legs	59
Add_Torso Color Add_Legs	30	Add_Hands Add_Hands Add_Legs	55,8
Color Add_Eyes Add_Eyes	30	Add_Mouth Add_Eyes Finish	51,2
Add_Torso Color Add_Eyes	26,7	Add_Torso Add_Mouth Add_Hands	51,2
Color Color Color	26,7	Add_Legs Add_Legs Finish	50,6
		Add_Torso Add_Eyes Add_Eyes	48,9

may not have understood how to work in the constructor and therefore could not create a monster and show their creativity.

Comparison of the process of completing tasks for creative and critical thinking

To answer the second research question, the first image of the monster was taken each, which were created by test takers while solving two parts of the task: to assess creative and critical thinking. As in the previous section, unigrams, bigrams, and trigrams were constructed, but among the trigrams, we selected those that occur at least 10 times in all solutions to remove very rare sequences, even if they allow us to distinguish solutions. Table 6 shows

the chi-square value when comparing two groups of monsters (N-grams with the highest chi-square value in each group were selected).

Among unigrams there are clear differences between the solutions. In the creative thinking task, test takers are significantly more likely to delete elements in all 7 categories. In the critical thinking task, test takers significantly more often add elements from the category Horns, which is explained by the task, because when compiling a sketch of a criminal, who according to eyewitnesses had horns, the addition of elements from this category shows that the test taker has correctly understood the task and has shown critical thinking. But at the same time, in the critical thinking task, test takers are more likely to add elements from other categories as well and turn hands and horns. Based on bigrams and trigrams, we can say that in the creative thinking task, students more often change the color of the monster, while in the critical thinking task, students leave its original color (gray). They also remove and rotate

Table 6

Difference in the frequency of N-grams in the process of performing tasks for creative and critical thinking

Creative thinking		**Critical thinking**	
м	**χ2**	**Action**	**χ2**
unigrams (χ2>15)			
Del_Legs	101,8	Add_Horns	73,8
Del_Hands	52,5	Tur_Hands	50,6
Del_Mouth	38,5	Tur_Horns	23,1
Del_Eyes	34,2	Add_Mouth	21,9
Del_Torso	30,3	Add_Eyes	20
Del_Horns	27,6	Add_Hands	18,3
Del_Various	24	Add_Legs	17,2
bigrams (χ2>60)			
Del_Hands Add_Hands	111,1	Add_Torso Add_Horns	238,4
Del_Legs Add_Legs	96,6	Add_Torso Add_Eyes	88,7
Add_Legs Del_Legs	88,2	Add_Eyes Finish	83,1
Color Color	79,4	Add_Horns Finish	72,1
Del_Legs Del_Legs	78,2	Add_Legs Finish	70,6
Add_Hands Del_Hands	64,7		
trigrams (χ2>60)			
Add_Torso Color Color	106,1	Start Add_Torso Add_Horns	187,8
Del_Legs Add_Legs Add_Legs	103,9	Add_Torso Add_Horns Add_Horns	109,9
Add_Hands Del_Hands Add_Hands	99,4	Add_Torso Add_Horns Add_Mouth	100
Add_Legs Add_Legs Del_Legs	85,5	Start Add_Torso Add_Eyes	79
Del_Hands Add_Hands Add_Hands	78,6	Add_Torso Add_Horns Add_Legs	74,6
Add_Legs Del_Legs Add_Legs	77	Add_Legs Add_Eyes Finish	68,4
Del_Hands Add_Hands Tur_Hands	66,2		
Add_Torso Color Add_Legs	63		
Tur_Legs Tur_Legs Tur_Legs	60,9		
Color Add_Legs Add_Legs	60,8		

elements from different categories, which indicates a creative process, while in the critical thinking task test takers try to simply assemble the monster from parts, so after weighing, actions related to adding elements prevail in the process of completing the critical thinking task.

Discussion of the results and conclusion

The purpose of this work was to determine the possibilities of using process data of the task performance in the framework of assessment creative thinking. Using instrument is implemented in a digital environment and consisting of two parts: for evaluating creative and critical thinking.

At the first stage of the analysis, CFA models were constructed to obtain test takers' scores for creative thinking. Further, these scores were used to identify groups of test takers with high and low levels of originality and elaboration.

At the next stage, the method of N-grams, small sequences of actions extracted from the test takers' action log, was chosen to analyze data about the task performance process. Sequences from one to three actions were used.

We used the $\chi 2$ criterion to compare the frequency of occurrence of different N-grams in students with high and low levels of creative thinking. As a result, a few N-grams were identified that are associated with different levels of creative thinking. For example, using an item from the category Various indicates a high level of originality, and deleting an item from the category Torso indicates a low level of elaboration.

In the second research question, we compared the performance of creative and critical thinking tasks implemented in the same constructor. Based on the frequency of occurrence of certain N-grams, we found out that different tasks work accordingly. So, in the creative thinking task, students are more likely to delete and rotate elements, change the color of the image, and in the critical thinking task, students are more likely to add those elements that are necessary for the correct solution of the task.

As a conclusion, it can be noted that the chosen method of analyzing data on the task performance process turned out to be useful and can be used to understand the behavior of test takers with different levels of skill development (in this study, creative thinking), it can also be usedin order to check the quality of tasks.

Using data about the task performance process can also enrich the scoring system and feedback on test results. For example, when analyzing students with a high and low level of originality, we found a correlation between the presence of bigrams in the test taker's profile(deleting and then adding elements), and a high level of originality. This relationship is not considered in the current scoring system. However, special attention should be paid in order to better understand the intended use of such data. This is important because expanding towards the accumulation of more complex data can challenge traditional approaches to scaling assessment results in educational testing and can be handled inadequately by test users [22].

Based on the analysis of the task performance process, we found that other characteristics of the test takers, such as their level of digital literacy, can also influence the result of the creative thinking task. This can be supported by the fact that students with a low level of elaboration more likely refered to the task reference, which contained on working with the constructor, than students with a high level. It can be assumed that due to the low level of digital literacy, they did not understand how to perform the task of evaluating creative thinking in a digital environment. This observation describes one of the limitations of modern assessment

instruments, namely the possible interference of other factors.

The limitations of this study include a small sample for analysis, which is why some N-grams were very rare in the aggregate of solutions. For this reason, during the analysis stage, we combined actions by category (for example, adding or turning a hand), and did not consider specific elements within the category (adding hand #1 or turning hand #2). Analysis at the level of individual elements is part of our plans to refine the constructor test takers use to create images. There is a hypothesis that certain elements within categories may be associated with the level of creativity, for example, test takers with a high level of originality will tend to add hand #3 than other hands.

Further areas of research include analyzing data on the task performance time, namely, the time between certain actions in the task execution sequence, as well as using other approaches to analyze data on the task solving process in a digital environment. One of these approaches is the Longest Common Sequence method [11], a sequence analysis method used in natural language processing and biostatistics in order to understand the strategy of test takers when solving digital problems. This approach can be applied to the task «Monster» considered in the article, since among the solutions you can select non-original solutions (repeating the reference) and calculate how much the students' solutions will differ from such a solution. It is also possible to calculate the proximity of decisions made by different students, which will allow us to identify certain clusters of decisions that can be used to draw conclusions about the creative thinking of test takers.

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Digital Literacy, Cognitive Control and Student Use of Digital Devices

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There is an idea that modern young people who grew up surrounded by digital devices spontaneously master digital skills, and their formation does not require special attention from the school. Teachers' observations and research results show that this is not the case. Most schoolchildren are not able to effectively solve problems in the digital environment, for example, correctly construct a search query, or ensure their information security. The purpose of the study presented in the article is to assess the relationship of digital literacy, including its individual components (for example, the ability to work with information in a digital environment), with some cognitive characteristics of students. In particular, the relationship of digital literacy with the features of cognitive control of students is considered, taking into account the frequency and specifics of the activity of using digital devices. The study is based on data from the assessment of the level of digital literacy by the developed measurement tool on a sample of 2860 students in grades 7 and 8 of schools in 4 regions of Russia in the fall of 2022.

Keywords: digital literacy; cognitive control; digital devices; measurement tool; test frame; multitasking.

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Цифровая грамотность, когнитивный контроль и использование цифровых устройств детьми

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Существует представление, что современные молодые люди, которые выросли в окружении цифровых устройств, стихийно осваивают цифровые навыки, и их формирование не требует специального внимания школы. Наблюдения учителей и результаты исследований свидетельствуют, что это не так. Большинство школьников не способны эффективно решать задачи в цифровой среде, например, корректно построить поисковый запрос или обеспечить свою информационную безопасность. Целью исследования, представленного в статье, является оценка связи цифровой грамотности, включая ее отдельные компоненты (например, умение работать с информацией в цифровой среде), с некоторыми когнитивными характеристиками учащихся. В частности, рассмотрена связь цифровой грамотности с особенностями когнитивного контроля учащихся с учетом частоты и специфики активности использования цифровых устройств. Исследование основано на данных оценки уровня цифровой грамотности разработанным инструментом измерения на выборке 2860 учащихся 7-х и 8-х классов школ 4 регионов России осенью 2022 года.

Ключевые слова: цифровая грамотность; когнитивный контроль; цифровые устройства; инструмент измерения; рамка теста; многозадачность.

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Introduction

Due to the increased frequency of children's use of digital devices (computers, laptops, tablets, smartphones), a growing number of researchers, teachers and education policy makers are concerned about how frequent use of electronic devices and the Internet may affect cognitive functions. Rather, the image of the negative consequences of frequent device and Internet use is spreading in the mainstream media. Just look at some of the headlines in the media: "Depression, laziness and addiction: How smartphones affect the brain. Scientists: smartphones dull human mental abilities"[1], "The Internet instead of your convolutions. Scientists have found out how gadgets affect the brain"[2]. A new term has emerged, "digital natives", referring to a generation of children for whom the use of the Internet and digital devices is a habitual part of life almost from birth [18; 29].

While most publications with such scary titles are based on a retelling of published studies, researchers themselves are more cautious about drawing unequivocal conclusions about the harms of using digital devices or the Internet. Existing meta-analyses suggest that research findings on the association between frequent use of digital devices and impairment of certain cognitive functions are inconsistent [38].

On the one hand, some studies have found a negative correlation between certain types of Internet activity, frequent use of digital devices, and cognitive function [20]. For example, such a feature of Internet activity as multitasking has received quite a lot of research attention. It has been shown that children and adults who frequently use digital devices become accustomed to quickly switching from one web-page or task to another without immersing themselves in any of the tasks for a long time. This rapid and frequent switching from one task to another can put additional strain on the attention system. Numerous studies have shown that long-term multitasking is associated with impairment of cognitive functions, especially sustained attention or cognitive control [20; 28].

Cognitive control (also known as inhibitory control, attention control, or inhibitory function) refers to the ability to inhibit stimuli irrelevant to the task, not to react to extraneous stimuli (distractors) [14]. In a broader sense, cognitive control may refer to the ability to self-regulate, the ability to follow instructions, focus on task performance, and maintain sustained attention without being distracted by extraneous stimuli.

Cognitive control is one of the components of executive function, which is one of the basic elements of working memory [31]. In this regard, many researchers discuss the importance of this function for successful functioning, including a child's academic achievement [2].

Studies have also shown changes in memory performance for children and adults who frequently use the Internet and digital devices [21]. It has been shown that

[1] Gazeta.ru. 12.03.2018. URL: https://www.gazeta.ru/tech/2018/03/12/11679529/phones_and_brains.shtml
[2] ria.ru. 19.12.2018. URL: https://ria.ru/20181219/1548211720.html

people who use the Internet more frequently are better at recalling not the information itself, but the resources where that information is stored (e.g., web pages) [32]. Studies also show lower working and long-term memory performance in children with high multitasking scores [36].

At the same time, some researchers have not found a significant relationship between constant multitasking and deterioration of attention, memory, and other functions [5; 30; 39]. Moreover, some studies have shown a positive correlation between practicing multitasking and cognitive functions [3; 22]. In particular, a study on an adult sample showed that adults (32—84) who frequently use a computer and practice Internet searching perform better on tests of cognitive control [35].

Studies also show the small to medium negative effects of multitasking and digital device use on different types of educational outcomes [7; 10; 19]. For example, in a longitudinal study on a large sample of 9-13-year olds, it was shown that students who had and used smartphones at age 9 showed lower math and reading scores later in life compared to students who did not have phones at that age [11].

Another type of activity discussed in terms of possible effects on cognitive processes is video games. Several studies have shown a positive effect of video games on a child's cognitive development. For example, it has been found that children who play video games, on average, show higher scores of cognitive control and are more successful on tasks in which it is necessary to ignore stimuli irrelevant to the task [8; 9; 33]. Children who play video games were also more likely to perform better on tasks involving tracking multiple objects and switching between tasks [15; 34].

Despite the increased number of studies on digital literacy, its formation, and development, as well as the increased number of studies on the correlation between the use of digital devices and cognitive functions, there is virtually no research that examines the correlation between digital literacy and cognitive functions, taking into account the frequency and specificity of the activity of using digital devices. Our study aims to fill this deficit.

The objectives of the study were:

1) To assess the correlation between measures of cognitive control and types of digital device use for students in grades 7—8.

2) To assess the correlation between digital literacy and indicators of cognitive control for students in grades 7-8.

3) Assessment of the indirect effect of the influence of different types of activity with digital devices on digital literacy through indicators of cognitive control.

Methodology

Sample

The analysis includes data from 2,860 students in grades 7—8 from 102 schools in four regions of the Russian Federation (Stavropol Krai, Krasnoyarsk Krai, Tomsk Oblast, Saint Petersburg) participating in the Federal Project "Digital Educational Environment" (36% of 7th grade students). The share of girls in the sample was 48%, and the average age was 13.60 years (standard deviation 0.61). At the regional level, schools were asked to decide on the number of test participants, including the parallel classes and the number of classes.

Procedure and measurements

Students were tested on individual computers in a computer lab. First they took a verbal-spatial test, followed by a digital literacy test, and then they were presented with a letter flanker test. All testing was administered on a unified system and took 60 minutes to complete.

Digital literacy test

The test is aimed at measuring digital literacy. Digital literacy is a complex latent

construct that includes a number of digital skills required to work in the digital environment, which is reflected in the definition — the ability to use digital technologies safely for oneself and others to search, analyze, create, manage information, communicate and work together to solve problems in the digital environment to meet personal and educational needs — and determines the approach to the development of the measurement tool [1].

The digital literacy measurement tool was developed based on Evidence-Centered Design (ECD) [25], which involves finding observable evidence that reflects the construct being measured and evaluating alternative explanations for that observed behavior. This made it possible to model these correlations given their complex nature and to move [27] from the overall construct to the variables on the basis of which test items were subsequently created. Thus, the method of evidence-based argumentation allowed an evidence-based approach to the development of the instrument.

Scenario type was chosen as a form of assignment — assessment based on such assignments actualizes the student's experience with a narrative context in order to add a layer of meaning to the actions in the simulation of the digital environment. In contrast to classical forms [10; 40], such tasks allow for maximum authenticity. They simulate real-life situations, such as planning a trip to an unknown place, searching for necessary information on the Internet or creating a visualization in a multimedia program [13]. This approach creates an environment conducive to capturing behavior that corresponds with the measured construct [4] and in general, helps to solve the problem of intrinsic motivation of performance, which is especially important for tests with low stakes [6; 16; 24; 26].

The test version consisted of 4 test items of varying difficulty. In the process of development, the principle of equal coverage was observed, so each task was aimed at assessing one or more components of digital literacy in such a way as to evenly cover each of the subcomponents presented in the frame [1]. The unit of measurement is the observed variable rather than the task itself. Each scenario includes a number of subtasks, which the test participant solves using interactive simulations of programs, services, and environments.

At the set testing start time, participants were seated at their workstations and entered an individual account to log into the testing system. In qualitative research (cognitive laboratories) with the target audience, it was found that the interface of both the system and the tasks is user-friendly, clear, keeps attention where it is needed, and is not overloaded with graphic elements. Nevertheless, after logging in to the system, all participants were shown instructions for test tasks, which described, among other things, important elements of the interface that could later affect the assessment.

The tasks were presented sequentially on the computer screen. Each task began with a short text (instruction) describing the general context of the situation, which was necessary to bring the test task closer to real life. The next screen presented a work area — a desktop simulator with a toolbar located at the bottom, specific to each task. Test participants had the opportunity to skip a task (go through the "Next task" button), as well as display instructions multiple times (the "Show task" button), which made it possible to reduce the influence of irrelevant constructs, for example, the ability to memorize. During the performance of each task, several digital simulators were used with the possibility of switching between them (Fig. 1).

Cognitive control

Two tests were used to measure cognitive control (suppression function): the Letter Flanker Test [12] and a new test devel-

oped in the Stroop paradigm (verbal-spatial test). According to the theoretical model of cognitive control proposed by Friedman & Miyake (2004), the Letter Flanker Test is aimed at measuring distractor resistance, while the Stroop Test is aimed at measuring another factor of cognitive control — the ability to suppress the dominant stimulus.

Verbal-Spatial Test

The test is designed in the Stroop paradigm, which is characterized by a combination of congruent and incongruent tasks [23]. In congruent tasks, the two parameters of each stimulus do not contradict each other, whereas in incongruent tasks, the two parameters of the task may require different actions. The test consisted of 4 blocks, each of which required the execution of a different type of instruction. Each block consisted of 12 tasks, the order of presentation of tasks within each block was randomized for each respondent.

In each block, the words “UP” or “DOWN” could appear on the screen. The words could be located at the top or bottom of the screen. In addition, up or down arrows could appear on the screen along with the words or separately (depending on the block and the type of instruction), which could also be located at the top or bottom of the screen. In the first block, the participant had to press the up or down arrow depending on the meaning of the word while ignoring the location of the word on the screen and the direction of the arrow (Figure 2). In congruent tasks, the meaning of the word and the part of the screen on which the word was located matched. If an arrow was also shown, then its direction also coincided with the meaning of the word (the word “UP” is shown at the top of the screen, the arrow is pointing upward). In incongruent tasks, the meaning of the word and the part of the screen on which the word was written did not match. If an arrow was added, it also did not match the meaning of the word.

In the second block, it was necessary to press the up or down arrow, depending on the direction of the arrow on the screen, ignoring the meaning of the word and the part of the screen where the arrow is located. In the third block, it was necessary

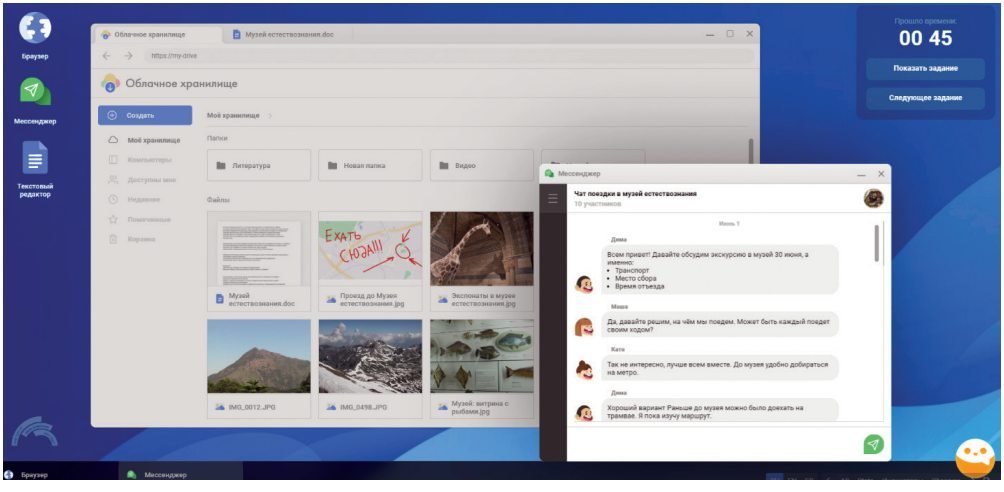

Fig. 1. An example of the workspace of the scenario task for measuring digital literacy. Used simulators: cloud storage (in the browser), messenger, text editor, virtual assistant

to trace the part of the screen where the arrow was located by pressing the corresponding key (up arrow on the keyboard if the arrow on the screen was at the top of the screen and down arrow if the arrow was at the bottom of the screen). One had to ignore the meaning of the word and the direction of the arrow. In the fourth block, you had to press the up or down arrow on the keyboard, depending on the part of the screen where the word was located. In each block, there were 4 congruent tasks and 8 incongruent tasks.

Letter Flanker Test

The letter flanker test was originally proposed by Eriksen & Eriksen (1974). In the version of the test used in our study, participants were presented with a set of 7 letters (one letter in the center, 3 letters on the left and right (flank letters)). If the center letter was L or H, the participant had to press the left arrow key. If the center letter was E or P, the participant was required to press the right arrow key. In congruent tasks, the central stimulus coincide the flanking stimulus in terms of the required action (e.g., LLLHLLL or EEEPEEE). In noncongruent tasks, the central stimulus did not coincide the flanking stimulus (e.g., PPPHPPP or EEELEEE). There were a total of 32 tasks in the test, half of them noncongruent tasks. The tasks were presented to each participant in random order.

Calculation of indicators

In most studies, a measure of cognitive control is calculated as the difference in accuracy or speed between congruent and incongruent tasks [31]. Some researchers have noted the low reliability of such an indicator [17]. As a possible alternative, some researchers suggest using standardized residuals obtained from a regression model. In this model, accuracy in incongruent tasks serves as the dependent variable, while accuracy in congruent tasks acts as the predictor [14; 17]. Positive residuals indicate a higher level of cognitive control, particularly in terms of accuracy.

We used this procedure to calculate a measure of cognitive control. For the letter flanker test, we considered standardized residuals for accuracy. For the verbal-spatial test, given the rather high level of accuracy and low difficulty of the tasks, we used a combined measure of accuracy and speed — the rate of correct scores (RCS) [37]. The RCS is calculated by dividing the sum of correct answers by the total time spent on all tasks. This indicator represents the number of correct answers given per unit of time (in our case, one second).

Types of Internet activity and ways of using digital devices

To take into account the types of online activity and the ways of using digital devices, students were asked questions about different types of activity and the frequency of each type of activity. For example, how often this school year have you done something on a computer, tablet, smartphone: 1) Read on the Internet about something that interests me; 2) Watched movies, TV series, cartoons or videos on YouTube and

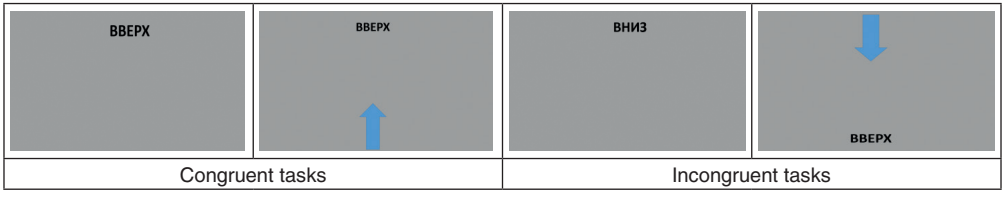

Fig. 2. Examples of verbal-spatial test stimuli, block 1

other services; 3) Played games; 4) Made presentations or projects on school subjects; 5) Spent time on social networks (for example, VKontakte, TikTok, etc.); 6) Studied programming; 7) Took online courses (not to prepare for school).

The student had to choose one of four response categories: 1) Never; 2) 1—3 times a month; 3) 1—3 times a week; 4) every day or almost every day. The two middle categories (1—3 times a month and 1—3 times a week) are combined into one. After analyzing the answers, they were grouped into three categories: never, sometimes (1—3 times a month or 1—3 times a week) and every day.

Statistical approach

Multilevel regression analysis and multilevel mediation analysis were used to assess the relationship between frequency and types of Internet activity and digital device use, digital literacy, and cognitive control. Digital literacy scores were the dependent variable, cognitive control scores were the mediator, and digital device use scores were the predictors.

Variables for different types of activity in different models were used to avoid multicollinearity. Several regression models were analyzed to estimate the indirect effect of different types of activity. The first step analyzed how Internet and digital device use indicators are related to cognitive control indicators (mediator-dependent variable relationship).

In the second step, several regression models with included predictors of indicators of digital device use and cognitive control were tested. The regression measures from this model show a direct effect of digital device use characteristics. In addition, indirect effects (the product of the coefficients of the relevant measures from the first model and the coefficients of the cognitive control test scores from the second model) and standard errors for each indirect effect (bootstrapping method) were calculated.

Several variables were also included for a more precise assessment of effects: gender (0 — boy, 1 — girl), grade (0 — 7th grade, 1 — 8th grade), number of books in the house (0 — less than 100, 1 — more than 100) and resource availability index. The material situation index was calculated as the sum of respondents' answers to the question about what of the listed items they have in the house (e.g., a computer, a separate room, a music center, a dishwasher, etc.).

The variable "Use of computers at school" was also created to capture the specific characteristics of the educational environment. Students were asked to note how often teachers (except for computer science teachers) ask them to use computers and gadgets for the listed activities (at lessons, for doing homework, etc.), on a scale from 0 (never) to 3 (at every or almost every lesson). First, the sum of scale indicators for each student was calculated, then the aggregate indicator for the school as a whole was calculated.

The analysis was made using the Stata 17.0 program.

Results

Descriptive statistics

The average score on the digital literacy test was 0.05 logits (standard deviation of 0.89 logits), with a minimum value of –2.61 logits and a maximum value of 2.62 logits. Table 1 below provides descriptive statistics for cognitive tests. Cognitive control parameters were calculated as standardized residuals from a model in which accuracy or RCS in congruent tasks served as a predictor, while accuracy (or RCS) in incongruent tasks served as the outcome. Table 1 also displays the regression models coefficients used to compute standardized residuals.

Table 1

Descriptive Statistics for Cognitive Control Tests

Test	Test Metrics/Parameters		Parameters in the Regression Model	
	Congruent Tasks	Incongruent Tasks	Standardized Regression Coefficient	R2
Letter Flanker Test (Accuracy)	0,72	0,69	0,73	0,53
Verbal-Spatial Test (RCS)	1,09	0,75	0,70	0,49

The standardized residuals for the two tests exhibit a statistically significant weak correlation (r=0.10, p<.001). The weak correlation between the outcomes of the two tests confirms that they likely measure different aspects of cognitive control.

Descriptive statistics for various types of digital device usage are presented in Table 2.

The results indicate that students in the 7th and 8th grades most frequently use digital devices for using social networks (75% reported doing this daily), watching videos (58% daily), playing games (53% daily), and reading (43% daily). At the same time, 60% of the students noted that they had never taken online courses or studied programming. 23% of the participants mentioned that they had never used digital devices for creating presentations and projects. It can be noted that these data may partially reflect the specificity of children's use of digital devices. Students in the 7th and 8th grades prefer to use digital devices not for educational purposes or for learning, but for searching and viewing information of interest to them, entertainment, and communication (i.e., for personal purposes).

The Correlationship Between Cognitive Control and the Use of Digital Devices

Furthermore, we assessed the relationship between the results of two cognitive control tests (verbal-spatial test and letter flanker test) and the frequency and methods of using digital devices. The results of the multilevel regression analysis are presented in Table 3.

The analysis results indicate that among all types of activities, the frequency of reading information on the internet correlates with the results of the verbal-spatial test (those who read sometimes or every day have higher scores in the digital literacy test compared to those who never read), as well as with the creation of presentations (those who occasionally create presentations have slightly higher test scores).

Table 2

Descriptive Statistics for Types of Activities Involving Digital Device Usage

Types of Activities	Never	Sometimes	Every day
I read online about something that interested me	8%	49%	43%
I watched movies, TV series, and cartoons	4%	38%	58%
I played games	6%	41%	53%
I created presentations or projects	23%	73%	4%
I spent time on social media	5%	20%	75%
I studied programming	50%	44%	6%
I took online courses (not for school preparation)	60%	36%	4%

Table 3

A Correlationship Between Cognitive Control Test Results and Types of Digital Device Usage (Results of Multilevel Regression Analysis)

Variables	Verbal-Spatial Test	Letter Flanker Test
	Coefficient (Standard Error)	Coefficient (Standard Error)
1	2	3
Fixed Effects		
Internet Reading:		
— sometimes[1]	0,17* (0,08)	–0,11 (0,08)
— every day	0,22** (0,08)	0,01 (0,08)
Watch video:		
— sometimes	0,19 (0,12)	–0,28 (0,12)
— every day	–0,16 (0,12)	–0,34 (0,12)
Games:		
— sometimes	0,10 (0,09)	–0,01 (0,09)
— every day	–0,03 (0,09)	–0,10 (0,09)
Creation of Presentations and Projects:		
— sometimes	0,10* (0,05)	0,05 (0,05)
— every day	–0,07 (0,11)	–0,12 (0,12)
Social Networks:		
— sometimes	–0,06 (0,10)	0,01 (0,10)
— every day	–0,10 (0,10)	0,06 (0,10)
Study Programming:		
— sometimes	–0,03 (0,04)	–0,02 (0,04)
— every day	0,07 (0,09)	0,16 (0,10)
Taking Online Courses:		
— sometimes	–0,06 (0,04)	–0,05 (0,04)
— every day	0,04 (0,11)	–0,16 (0,11)
Gender (1 = girl)	0,16*** (0,04)	0,03 (0,04)
Grade (1 = 8th grade)	0,07 (0,05)	0,04 (0,04)
More than 100 books at home	0,10* (0,04)	0,04 (0,05)
Material situation index	0,02 (0,02)	0,03 (0,02)
Index «Use of computers at school»	0,05 (0,03)	–0,02 (0,02)
Random effects		
Interschool Variance	0,03	0,01
Intraschool Variance	0,91	0,95

Note:[1] — here and in other variables indicating types of activities, the reference group is the 'never' category; ***p<0.001, **p<0.01, * p<0.05

As for the results of the letter flanker test, it only correlates with the frequency of watching videos. Students who reported watching videos sometimes or every day have higher scores on the letter flanker test, which can be interpreted as higher resistance to distractors.

It is also worth noting that girls have higher scores on the verbal-spatial test, while there were no differences between

boys and girls in the results of the letter flanker test. The number of books in the house is also associated with the results of the verbal-spatial test.

A Correlationship Between Digital Literacy, the Use of Digital Devices, and Cognitive Control

Next, regression models were tested with digital literacy as the dependent variable. Prior to inclusion in the model, the variable was standardized. First, a null model (a model without predictors) was evaluated to assess the level of intra- and interschool variance and calculate the intraclass correlation coefficient. The intraclass correlation coefficient was found to be 0.23.

The model with predictors includes variables describing the types of digital device usage and cognitive control variables. Table 4 presents the results of the multilevel regression analysis for the model with predictors.

The analysis reveals that internet reading and watching videos are positively associated with digital literacy. Stu-

Table 4

A Correlation Between Digital Literacy, Cognitive Control Test Results, and Types of Digital Device Usage (Results of Multilevel Regression Analysis)

Variables	Coefficient (Standard Error)
1	2
Verbal-Spatial Test	0,16*** (0,02)
Letter Flanker Test	0,07*** (0,02)
Internet reading:	
— sometimes	0,17* (0,07)
— every day	0,33*** (0,07)
Watching video:	
— sometimes	0,21* (0,11)
— every day	0,30** (0,11)
Games:	
— sometimes	–0,02 (0,08)
— every day	0,04 (0,08)
Creation Presentations and Projects:	
— sometimes	0.12** (0.04)
— every day	–0.20* (0.09)
Social Networks:	
— sometimes	–0,09 (0,09)
— every day	–0,14 (0,09)
Studying Programming:	
— sometimes	0,04 (0,04)
— every day	0,08 (0,09)
Taking Online Courses:	
— sometimes	–0,07 (0,04)
— every day	–0,30*** (0,10)
Gender (1 = girl)	0,13*** (0,03)
Grade (1 = 8th grade)	0,05 (0,05)

Variables	Coefficient (Standard Error)
1	2
More than 100 books at home	0,10* (0,04)
Material situation index	0,07** (0,02)
Index «Use of computers at school»	0,10* (0,04)
Random effects	
Interschool Variance	0,17
Intraschool Variance	0,71

Note: ***p<0,001, **p<0,01, * p<0,05.

dents who reported occasionally creating presentations have higher levels of digital literacy, whereas students who create presentations every day have lower levels of digital literacy compared to those who have never created presentations. Daily participation in online courses is also negatively associated with digital literacy.

It is worth noting that the results of both cognitive control tests are positively related to digital literacy. The analysis also indicates that Material situation index and the number of books in the house are positively associated with digital literacy, as well as the use of computers at school. On average, when accounting for other variables, girls have higher levels of digital literacy.

Analysis of indirect effects

At the final stage, indirect effects of types of digital device use were calculated. Since the analysis of indirect effects assumes the presence of a correlation between the predictor (use of digital devices) and the mediator (cognitive control), the analysis of indirect effects was carried out only for those predictors that showed a significant relationship with one of the tests of cognitive control (Table 5).

Analysis of indirect effects indicated that some activities may have indirect effects (either through the flanker test or the verbal-spatial test). In terms of direction, indirect effects enhance direct ones, but in all cases the indirect effects were very small.

Discussion

In this study, the results of a digital literacy test and two cognitive control tests, namely the verbal-spatial test (measuring the ability to suppress dominant stimuli) and the letter flanker test (measuring resistance to distractors), were analyzed. The primary objective of the research was to assess the correlations between the digital

Table 5

Results of the analysis of indirect effects

Predictors	Direct path	Indirect path	Overall effect
Mediator — Verbal-Spatial Test			
Reading (occasionally)	0,19** (0,07)	0,03 (0,02)	0,23*** (0,07)
Reading (every day)	0,35*** (0,07)	0,04* (0,02)	0,39*** (0,07)
Preparation of presentations (sometimes)	0,13** (0,04)	0,02* (0,01)	0,15** (0,04)
Mediator — letter test of flanks			
Watching videos (occasionally)	0,24* (0,10)	0,02* (0,01)	0,26** (0,10)
Watching video (every day)	0,31** (0,10)	0,03* (0,01)	0,34*** (0,10)

Note: ***p<0,001, **p<0,01, * p<0,05.

literacy test, cognitive tests, and certain parameters of digital device usage while controlling for some socio-demographic characteristics.

The results indicate that the use of digital devices for video viewing and reading is positively associated with cognitive test performance and digital literacy. However, different types of activities exhibit varying correlations with cognitive control factors. The ability to suppress dominant stimuli is linked to the frequency of reading information using digital devices. It is possible that children who frequently read online display lower impulsivity, although the study design does not permit causal conclusions. Conversely, there may be a reverse correlation, as children with higher resistance to dominant stimuli may exhibit lower impulsivity and, therefore, engage in more frequent reading with digital devices.

Regarding video viewing, the frequency of this activity is associated with higher levels of resistance to distractors. It is possible that during video viewing, children can concentrate on video content successfully, disregarding distractions. It is also possible that this skill can be transferred to other materials. But again, it must be emphasized that the research design does not allow us to draw conclusions about causal correlations and does not reveal the mechanisms of the discovered correlations. Further research with experimental designs is needed to explore these correlations in greater depth.

It should also be noted that some effects observed in previous studies, such as the positive impact of video games on certain cognitive functions, were not replicated in our study. Additionally, data did not confirm the negative effect of certain types of activities on cognitive functions. For instance, high activity on social media platforms showed no significant correlation with cognitive control or digital literacy.

Digital literacy also correlates with cognitive performance, although the effect size is small. The presence of a correlation between cognitive control and digital literacy may suggest the specificity of the test, indicating that tasks require the ability to sustain attention, ignore irrelevant stimuli, and so forth. On the other hand, this may also suggest that digital literacy is a complex construct associated with general cognitive abilities.

It is worth noting that the school environment is linked to the level of digital literacy. In schools where computer usage was higher on average, individual digital literacy scores were also higher. Additionally, the intraclass correlation coefficient for digital literacy scores was 0.23, indicating a moderate level of variation between schools in digital literacy test results. This finding is comparable to the level of variation observed in some academic achievement measures in international education studies [41]. It suggests that schools may have a certain impact on the development of digital literacy.

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Adaptation of the Academic Digital Literacy Scale for College Students: A Validity and Reliability Study

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Today's students can also be called "Generation Z", which cannot be separated from their digital life. Generation Z, "digital natives", very comfortable using digital devices in their social media life. Even though students as a whole are comfortable with digital technologies for entertainment, they are still learning how to incorporate digital devices into their academic lives. The aim of the research is to adapt a digital literacy to Indonesian version of student academic digital literacy. Adaptation methods include translation, synthesis, expert committee review, and pretesting. A total of 364 students in the province of East Java, Indonesia, were recruited for this study. Data analysis used confirmatory factor analysis with M-Plus software. The results showed that the loading factor values ranged from 0.47 to 0.87 and met the minimum criteria, so they could be considered valid. The reliability is indicated by the value alpha = 0.87 and CR = 0.89, which has met the minimum criteria, so it is reliable, while the AVE = 0.74 has met the minimum criteria, so it shows good convergence.

Keywords: Adaptation of measuring instruments, academic digital literacy, validity, reliability, students.

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Адаптация шкалы академической цифровой грамотности для студентов колледжей: исследование валидности и надежности

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Сегодняшних студентов можно назвать «поколением Z», они плотно встроены в мир цифровых технологий. Основная характеристика поколения Z, «цифровых аборигенов» они очень комфортно себя чувствуют в использовании цифровых устройств в жизни и в социальных сетях. Несмотря на то, что учащимся комфортно пользоваться цифровыми технологиями для коммуникации, они все еще не до конца умеют включать цифровые технологии в свою академическую жизнь. Цель исследования — адаптировать инструмент измерения цифровой грамотности в контексте Индонезии, создать свою версию инструмента измерения академической цифровой грамотности учащихся. Методы адаптации включают перевод, синтез, рассмотрение экспертной комиссией и предварительное тестирование. В исследовании участвовали 364 студента из провинции Восточная Ява, Индонезия. При анализе данных использовался подтверждающий факторный анализ с программным обеспечением M-Plus. Результаты показали, что значения коэффициента загрузки варьировались от 0,47 до 0,87 и соответствовали минимальным критериям, поэтому их можно было считать валидными. На надежность указывают значения альфа = 0,87 и CR = 0,89, которые соответствуют минимальным критериям, AVE = 0,74 и соответствует минимальным критериям, что показывает хорошую конвергентность.

Ключевые слова: Адаптация средств измерений, академическая цифровая грамотность, валидность, надежность, студенты.

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Introduction

In the current digital era, students are required to have a new form of academic literacy, so called academic digital literacy, which help them effectively assist in completing their academic assignments. It's not only about a traditional academic literacy, but also about an academic digital literacy, which helps students learn faster and complete their assignments [1; 2; 3]. In other words, academic literacy in today's all-digital educational environment is very important in the form of mastery of digital literacy that supports their academics.

Every student needs an academic digital literacy because it is an important aspect of functioning successfully in an academic environment, which is reading, writing, research, and communication. This involves high-level reading and writing skills, critical thinking, articulate writing, and discipline-specific skills for reading and writing [4; 5; 40].

There are several researches which reveal that digital literacy, self-control, and learning motivation can predict the academic achievement. Apart from that, digital literacy also contributes to increasing academic success, improving research skills, and boosting self-confidence [3; 5; 6; 41].

The results of the research explain that metacognitive knowledge, resource management, and motivational beliefs have a significant positive influence on digital literacy [7; 45]. By systematic literature mapping study on the basis of 298 articles published in two databases, Scopus and Web of Science (WoS), we found out, that the largest proportion of articles in Scopus in most of the cases frequently mentioned topic digital pedagogy. This provides a perspective on digital transformation studies in higher education, particularly related to academic digital literacy [8].

Students nowadays can also be called "Generation Z", the ones who cannot be separated from their digital life. Generation Z or "digital natives" are very comfortable using digital devices such as smartphones, iPads, and laptops in their online social lives. Although students feel comfortable using technology for social interaction in the virtual world, they are still learning how to incorporate digital devices into their academic lives [9; 42; 44].

Therefore, it is important to adapt the academic digital literacy scale measurement tool for college students so that it can be used to determine students' abilities in mastering digital technology in completing their academic tasks.

Academic digital literacy

Digital literacy is defined as the ability and awareness of using digital technology to perform tasks while demonstrating the right attitude in a learning environment by utilizing digital technology [10]. Following the model developed by [10], digital literacy includes cognitive, technical, and socio-emotional learning perspectives.

Digital literacy has also been identified as a key competency because it is considered the 'backbone' of current educational pedagogy, as it plays an important role in the world of education. Digital literacy significantly increases the employability of graduates because it empowers them to achieve more in the digital economy. In fact, even in the world of work, 90% of jobs require excellent digital literacy competencies [7; 11; 43].

Digital literacy is the ability to read and understand information in the form of hypertext or multimedia. It is different from traditional literacy because digital sources can produce various forms of information, including text, images, sound, and other formats [12; 13; 14; 15; 16]. Based on this explanation, it can be concluded that academic digital literacy is the ability and awareness to use digital technology as a learning resource and complete academic tasks in the correct manner, encompassing cognitive, technical, and socio-emotional dimensions.

Factors influencing academic digital literacy

Digital literacy is influenced by several factors including; 1) use of online media, 2) academic achievement 3) role of parents or family, 4) intensity of reading [17; 18]. Digital literacy skills are influenced by many factors, but the most important according to [19] is related to the drive or desire of individuals to understand digital literacy by reading and applying it.

Research results from Rosalina found that there are three factors that affect the level of students' digital literacy competence, including: 1) Environmental support factors consisting of the campus environment and family roles, 2) Socioeco-

nomic conditions factors, which include individual financial conditions and the criticality of the media, and 3) The intensity factor of media use, which includes the use of digital media in daily activities and the completion of academic assignments [20].

Thus, the main factor that can affect digital literacy skills in using technology is a skill that needs to be honed with daily activities. This emphasizes that the ability is a continuous process that is carried out consistently in the utilization and use of digital technology in literacy [21; 22].

Academic digital literacy dimension

The dimensions of digital literacy are the same as the model developed by [10] that digital literacy has three dimensions as shown in Figure 1 below.

The cognitive dimension of digital literacy relates to the ability to think critically when searching, evaluating, and creating digital information handling cycles. It also means being able to evaluate and select appropriate software programs to study or perform a particular task. This dimension of digital literacy requires individuals to have knowledge of related ethical, moral, and legal issues, and understand content that uses digitally based resources (e.g., copyright and plagiarism). This dimension involves the ability to intelligently navigate through a hypermedia environment to construct knowledge and synthesize new understandings using appropriate digital tools, which will understand and find meaning in the best sense [10]. Thus, the cognitive dimension is the ability to choose technology, search, assess, and select information using critical thinking skills.

The technical dimension generally means having technical and operational skills to use. This dimension can be applied to learning and daily activities. It involves being able to connect and use input devices and peripherals such as earphones/headsets, external speakers, smartboards, and more. This assumes knowledge of

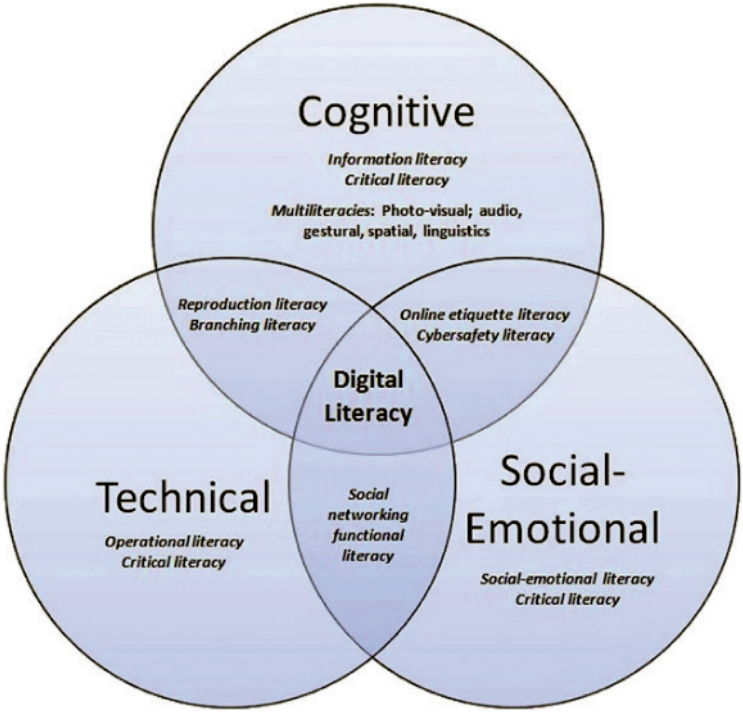

Fig. 1. Dimensions of digital literacy

working parts, file protection, and the ability to solve problems by reading manuals or via the "Help" function and other web-based resources, such as YouTube or other digital media. A digitally savvy individual should be able to adequately operate technology by understanding file structure, managing data transfer, including understanding file size and space required for storage, finding, downloading and installing applications, and uninstalling them when not needed. They should know how to use infrared and/or Bluetooth for mobile devices, understand data charges associated with downloading data, set up and use communication tools and social networks, update/change user account information on the Internet, send and retrieve attachments via email and/or Dropbox, and open them with a suitable application, such as opening a folder, and know about the main features of software programs [10]. Thus, this dimension is a major component of digital literacy, which includes the skills needed to operate digital technology for learning.

The social-emotional dimension involves the responsible use of the Internet in order to communicate, socialize, and learn by observing applying certain rules. These rules are similar to face-to-face communication, require respect and the use of appropriate language and words to avoid misinterpretation and misunderstanding. One should maintain safety and privacykeep personal information as confidential as possible, not disclosing more personal information than necessary. One should also understand when a threat is received and know how to deal with it, such as whether to ignore, report, or respond to it [10]. Thus, this socio-emotional dimension relates to individual behavior in the use of digital technology.

Academic digital literacy measurement

Measurements of digital literacy have been developed according to research objectives and contexts, and is based on certain theories. The measurement of digital literacy was first developed by [10] with three dimensions, namely technical, cognitive, and social-emotional.

Pala and Başıbüyük research on digital literacy skills uses a digital literacy scale measurement based on the four dimensions they developed, namely information processing, communication, security and problem solving [5]. Nabhan measures digital literacy using digital academic writing skill questionnaires which he developed, they consist of several dimensions, namely critical thinking, online safety skills, digital culture, collaboration and creativity, finding information, communication, and functional skills [23]

Mercado in his research, used qualitative case studies to explore academic digital literacy skills. This involved conducting semi-structured interviews and collating data from various sources, such as digital academic notes, informal conversations with facilitators, online activities on institutional platforms, interactions with research seminar facilitators, supervisors, and researchers, as well as drafts and final versions of academic manuscripts [24]. Anthonysamy [7] using a digital literacy scale in the form of a likert scale with a three-dimensional structure based on the instruments used by [10] and [11] [11] consisting of technical (6 items), cognitive (2 items), and social-emotional (2 items) to measure the use of technology in learning for students at the University of Auckland New Zealand.

In addition, the digital literacy scale instrument has also been adapted to various countries and one of them was adapted by [25] into Turkish. There are around 10 items based on the digital literacy scale developed by [10], the item scale factor loading varies between 0.46 — 0.74 and the Cronbach Alpha reliability is 0.86. Burçin Hamutoğlu also adapted a digital literacy scale for college students with an internal consistency coefficient (Cronbach Alpha) for the technical dimension = 0.88, the cognitive dimension = 0.89, and the social-emotional dimension = 0.79. [26].

Esfandiari [27] and Işık [13] determine the level of digital literacy using the digital literacy scale from the model [10]. Durak and Seferoğlu [28] in their research also used the digital literacy scale from [10] model which was adapted by [26]. Thus, referring to the study of previous research results, it is recommended to measure academic digital literacy using digital literacy scale instruments based on the dimensions of the [10]. The dimensions are the most appropriate for psychological variables and have been adapted to many countries. The digital literacy scale instrument consists of dimensions that can be scored individually or combined for a total score.

Method

The Ethics Commission of Research of the Faculty of Psychology at the University of Muhammadiyah Malang has approved the study (approval number for research ethics: E.6.m/161/FPsi-UMM/III/2023). The authors have assured the participants that their study data would be presented anonymously, and the participants signed a written agreement to participate.

Participants

The participants of this research were second, fourth, and sixth-semester students who had a GPA ≥ 2.00 and were currently studying at public and private universities in East Java, Indonesia, during May 2023. There were 283 female respondents and 81 male respondents, making a total of 364 students.

Adaptation procedure

The process of adapting measuring instruments in this study begins with a request for permission from the owner of the measuring instrument. The measuring instrument adaptation procedure in this study refers to [29] as shown in Figure 2 below.

Figure 2 describes the adaptation procedure according to the stages. *The first stage* involves translations by two linguists and experts in the field of educational psychology who graduated abroad and understand the context of measuring instruments for Indonesian students. The translations are done through the language center at the University of Muhammadiyah Malang. *The second stage* is synthesis, where the results of the translations from both translators are brought together to find similarities and differences until an agreed-upon translation is obtained. This translation is referred to as the draft translation measuring instrument scale. *The third stage* involves back translation and juxtaposition with the original measurement tool to find differences in meaning so that the meaning can be adjusted. The back translation is done by linguists and experts in the field of educational psychology who are foreign graduates and understand the context of measuring instruments through the language center at the University of Muhammadiyah Malang.

The fourth stage, the expert committee review, is to ensure there is a correlation of the

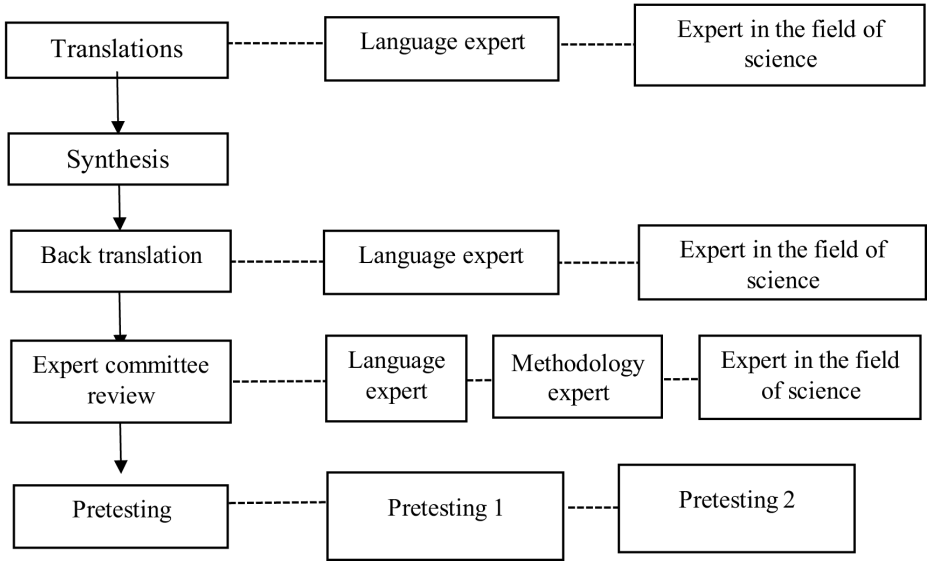

Fig. 2. Procedure for adapting an academic digital literacy scale

meaning and sociocultural context between between the original measuring instrument and the translated measuring instrument. The reviewers from the expert committee were linguists, methodologists, and educational psychologists, five experts in total. They were asked to provide assessments and corrections for improvements to ensure whether the adapted instruments were equal in measuring constructs and suitability for the cultural context of students in Indonesia. The results of the assessment were quantified using Aiken's V formula. The results of the analysis on each academic digital literacy scale instrument item obtained a minimum value of the Aiken's V index ranging from 0.81 to 0.94 with a minimum criterion of 0.040 based on the Aiken table (P > 0.05%). Thus, it can be concluded that all instrument items can be declared valid or equal in measuring the academic digital literacy scale construct in students in the context of Indonesian culture.

The fifth stage, pretesting, is to test the measuring instrument on a small number of subjects beforehand in order to find out whether the measuring instrument is well understood by the subjects or not. If the measuring instrument can be understood, then a trial is carried out with a larger number of subjects. Testing the measuring instrument on a small scale was done by giving it to 40 students as a pilot test to determine whether the instructions and statements on each item could be understood properly before being tested on a large scale. Based on the results of the small-scale trials using the pilot tests, the respondents stated that the instructions were easy to understand, and the items of all scales were also clear and well-understood. Thus, they were able to proceed with trials of measuring instruments on a large scale. The testing of the measuring instruments on a large scale was done by collecting data from 364 students to test their validity and reliability using CFA analysis.

Data analysis

Data analysis used Confirmatory Factor Analysis (CFA) with the help of M-Plus software, which gave rise to fit index values in the form of Chi-Square, RMSEA, CFI, TLI, and SRMR [30]. According to [31], what must be reported in the fit model analysis are the Chi-Square, RMSEA, CFI, and SRMR tests.

Results and Discussion

Based on the final modeling results from the CFA analysis that has been carried out in the form of the results of the fit model from the model feasibility parameters of the academic digital literacy scale as shown in Table 1 below.

Based on Table 1, we know that the output value of RMSEA = 0.07, SRMR = 0.04, CFI = 0.95, and TLI = 0.93 according to the criteria, so that it fulfills the feasibility parameters of the model fit (goodness of fit) which means there is no difference in measurements developed with empirical models or those which obtain data support. While the index in the form of Chi Square (P-Value) = 0.00 does not meet the criteria ≥ 0.05, it is not fit, but can be ignored because the respondents or samples are large.

The results of the reliability test for this scale use Cronbach's Alpha and the Construct reliability (CR) value and the Average variance extracted (AVE) value. See the results of the confirmatory factor analysis of the validity and reliability tests as in Table 2 below.

Table 1

The final results of the fit model based on the feasibility parameters of the academic digital literacy scale model (N=364)

Fit parameters	Output	Criteria	Information
Root mean square error of approximation (RMSEA)	0,07	≤ 0,08	Fit
Standardized root mean square residual (SRMR)	0,04	< 0,08	Fit
Comparative fit index (CFI)	0,95	≥ 0,90	Fit
Tucker-Lewis Index (TLI)	0,93	≥ 0,90	Fit

Table 2 and Figure 3 show that the loading factor values range from 0.47 to 0.87 and have met the minimum criteria of construct validity. Meanwhile, the reliability indicated by the value alpha = 0.87 and CR = 0.89 met the minimum criteria, so the scale was reliable, while the AVE = 0.74 met the minimum criteria so it indicated a good convergence.

Table 2

Validity and reliability of the academic digital literacy scale (N=364)

No	Dimensions	Item	Factor Loading	Alpha		CR		AVE	
1	Technical	adl1	0,47	0,83	0,87	0,83	0,89	0,46	0,74
		adl2	0,65						
		adl3	0,72						
		adl4	0,71						
		adl5	0,72						
		adl6	0,76						
2	Cognitive	adl7	0,76	0,64		0,64		0,48	
		adl8	0,62						
3	Socio-Emotional	adl9	0,87	0,72		0,73		0,58	
		adl10	0,64						

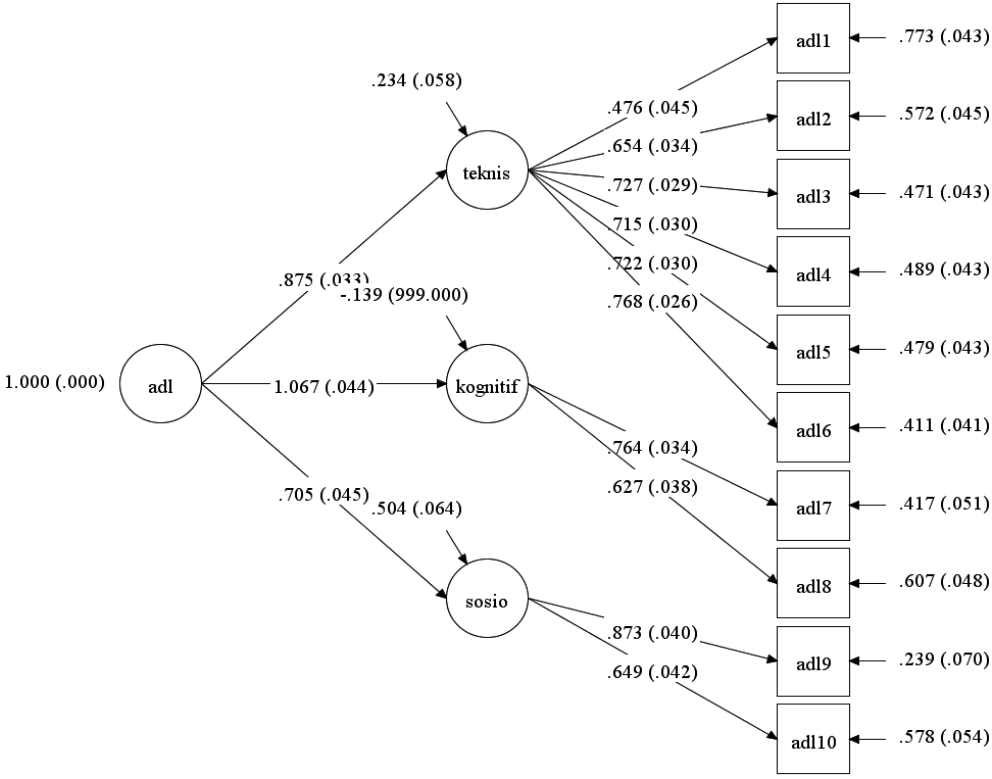

Fig. 3. Final model of the academic digital literacy scale

Academic digital literacy is measured using a digital literacy scale from [10] as many as ten items (academic digital literacy scale, see appendix) developed by researchers in an academic context based on technical, cognitive, and social-emotional dimensions. The blue print of the academic digital literacy scale before and after the try out is as shown in Table 3 below.

The construct validity of this research is based on internal structure evidence analyzed through CFA, as explained by the American Education Research Association (AERA) that construct validity can be demonstrated through five pieces of evidence, namely 1) test content, 2) cognitive/response test, 3) internal structure, 4) relations to other variables, and 5) consequences of tenting [32]. The CFA test was carried out to determine the feasibility of the model and the size of the factor loading of each item as evidence of construct validity based on the internal structure. The overall model feasibility parameters are as described by [33; 31; 34] as it is shown bellow:

A model can be said to be feasible if it fulfills one or more feasibility parameters. The more the better. According to [35] if 4 — 5 parameters are met, the model is considered sufficient to assess the feasibility. After fulfilling the feasibility parameters of the model, we can see the size of the factor loading or factor loading of the CFA. Factor loading with a value between 0.4 — 0.6 is categorized as sufficient validity and if the factor loading value is ≤ 0.7, it's categorized as high validity. However, if all items in one indicator are used up or do not represent the factor loading value it can be lowered to a value of 0.30 to 0.40, provided that there were at least 250 respondents [36].

In addition, to determine the reliability or consistency of the instrument, there was an instrument reliability test carried out. Instru-

Table 3

Blue print of academic digital literacy scale

No	Dimensions	No. Item	
		Before try out	After try out
1.	Technical	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6
2.	Cognitive	7, 8	7, 8
3.	Social-emotional	9, 10	9, 10
	Total item	10	10

Table 4

Model feasibility parameters

No	Fit parameters	Criteria
	Absolute Fit	
1	Chi square P-Value	≥0,05
2	Goodness of fit index (GFI)	≥0,90
3	Root mean square error of approximation (RMSEA)	≤ 0,08
4	Normed fit index (NFI)	≥0,90
5	Standardized root mean square residual (SRMR)	< 0,08
	Incremental Fit	
6	Comparative fit index (CFI)	≥ 0,90
7	Tucker-Lewis Index (TLI)	≥ 0,90
8	Adjusted goodness of fit index (AGFI)	≥0,90
	Parsimonius Fit	
9	Parsimonious Normal Fit Index (PNFI)	0,60 — 0,90

ment reliability relates to the instrument's ability to consistently measure instrument attributes [37]. Instrument reliability in this study was measured by calculating composite reliability or construct reliability (CR), and Average Variance Extracted (AVE) was used to determine how large the indicator size described its theoretical latent construct.

Hair explains that the calculation of CR is the square of the total value (sum) of standard loading divided by the square of the total standard loading value plus the sum error value. Meanwhile, the AVE calculation is the sum (total) squared value of the standard loading divided by the sum of the squared standards of loading plus the sum error value [35].

The reliability of a construct is said to be good if the CR value ≥ 0.70, but if the CR value is in the range of 0.60 — 0.70, then reliability is still in the good category. While the AVE value is more than 0.50 which is a good measure of reliability, but this AVE is usually an option (optional) in research [35; 38; 39].

This study aims to adapt the digital literacy scale to Indonesian in an academic context and to determine the validity and reliability of the construct to suit Indonesian culture. This scale consists of 10 items and three dimensions (Table 2). All of these scale items meet the minimum criteria so that this instrument can be declared valid and reliable and meets the standards for adapting measuring instruments and measuring psychometric properties, so this instrument is suitable for use in Indonesia.

Conclusion

The results of this study show that the academic digital literacy scale instrument for college students is suitable for use in Indonesia and has been adapted to the culture of students in Indonesia with the same number of items. The psychometric properties show that the loading factor value ranges from 0.47 — 0.87 which meets the minimum criteria, so it can be considered valid. While reliability is indicated by the value alpha = 0.87 and CR = 0.89 which have met the minimum criteria, they are reliable, while the AVE = 0.74 has met the minimum criteria, and it shows a good convergence.

APPENDIX: Instruments of the academic digital literacy scale for college students

Digital litercy scale versi asli

1= Strongly Disagree
2= Moderately Disagree
3= Neutral
4= Moderately Agree
5= Strongly Agree

No	Statement	1	2	3	4	5
1	I know how to solve my own technical problems.					
2	I can learn new technologies easily.					
3	I keep up with important new technologies.					
4	I know about a lot of different technologies.					
5	I have the technical skills, I need to use ICT for learning and to create artefacts (e.g. presentations, digital stories, wikis, blogs) that demonstrate my understanding of what I have learnt					
6	I have good ICT skills					
7	I am confident with my search and evaluate my skills in regards to obtaining information from the Web					
8	I am familiar with issues related to web-based activities e.g. cyber safety, search issues, plaigarism					

No	Statement	1	2	3	4	5
9	ICT enables me to collaborate better with my peers on project work and other learning activities					
10	I frequently obtain help with my university work from my friends over the Internet e.g. through Skype, Facebook, Blogs					

Academic digital litercy scale versi Indonesia

PETUNJUK PENGISIAN

Pilihlah pernyataan dibawah ini yang sesuai dengan diri Saudara dengan memberikan tanda centang (√) sesuai dengan ketentuan berikut:

1= Sangat Tidak Setuju
2= Tidak Setuju
3= Ragu-Ragu
4= Setuju
5= Sangat Setuju

No	Pernyataan	1	2	3	4	5
1	Saya tahu cara mengatasi masalah-masalah teknis saat menggunakan perangkat digital					
2	Saya mudah mempelajari teknologi digital terbaru					
3	Saya mengikuti perkembangan teknologi digital terbaru yang penting untuk keperluan akademik					
4	Saya mengetahui tentang berbagai jenis teknologi digital dalam menunjang akademik					
5	Saya memiliki keterampilan dasar menggunakan teknologi digital untuk pembelajaran dan membuat berbagai produk digital, seperti slide presentasi, yang menunjukkan pemahaman tentang apa yang telah saya pelajari					
6	Saya memiliki kemampuan teknologi digital yang baik dalam menunjang kegiatan akademik					
7	Saya sangat yakin mampu mencari dan menilai informasi dari internet terkait dengan keperluan akademik					
8	Saya cukup familiar dengan isu-isu terkait dunia digital seperti keamanan siber, *searching* dan *plagiarism*					
9	Teknologi digital membantu saya untuk berkolaborasi dengan teman-teman dalam berbagai tugas dan aktivitas pembelajaran					
10	Saya sering berinteraksi dengan teman-teman menggunakan media *online* seperti zoom, googlemeet, google drive atau lainnya untuk menyelesaikan tugas-tugas kuliah					

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Digital Learning Environment in the Modern Process of Education and Upbringing

Цифровая образовательная среда в современном процессе обучения и воспитания

Study of the Educational Process Participants Readiness to Applying Digital Technologies in Education

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The article presents an overview of various digital technologies used in the educational process; the problem of their perception and application by teachers and students is investigated. The purpose of the article is to identify the level of readiness of direct participants of the educational process to use digital technologies in their activities. The study was conducted on the basis of analysis and generalization of domestic and foreign scientific publications devoted to the problem of the use of digital technologies by participants of educational institutions. A sociological study was conducted by online questionnaire of students. The research methods are comparison, concretization, system and comparative analysis. The authors have revealed that the teachers' perception of the use of digital educational technologies in their activities depends on various factors, such as: age, gender, availability and degree of development of organizational and communicative abilities of a person, on the degree of motivation, as well as on the level of creativity of the teacher's personality. It is revealed that there are various barriers to the use of TSOT by teachers. Regarding the readiness of students to use TSC, it was found that students are not fully ready to use TSC in teaching, in particular, they are not aware of the essence of the concept of immersive technologies and do not identify them with virtual or augmented reality technologies. A significant part of students uses digital services that are quite similar in functionality. The actual digital technologies used in teaching in the world practice are revealed. The necessity of using digital services in virtual educational environments, including metaverses, is substantiated. In order to increase the ability of teachers to use TSOT, it is necessary that the curricula include courses on the use of TSOT in education in the context of vocational training. It is also proposed to encourage teachers to use technology in the educational process by allocating additional funding. Universities need to create conditions for students to use digital technologies.

Keywords: digital educational technologies; educational process; immersive technologies; virtual or augmented reality; metaverses; readiness of teachers; students' readiness.

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Исследование готовности участников образовательного процесса к применению цифровых технологий в образовании

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В статье представлен обзор различных цифровых технологий, используемых в образовательном процессе; исследована проблема их восприятия и применения преподавателями и студентами. Цель статьи — выявить уровень готовности непосредственных участников образовательного процесса к применению цифровых технологий в своей деятельности. Исследование проводилось на основе анализа и обобщения отечественных и зарубежных научных публикаций, посвященных проблеме применения цифровых технологий участниками образовательных учреждений. Проведено социологическое исследование путем онлайн-анкетирования обучающихся. Методами исследования являются сопоставление, конкретизация, системный и сравнительно-сопоставительный анализ. Авторы выявили, что восприятие преподавателями применения в своей деятельности цифровых образовательных технологий (ЦОТ) зависит от различных факторов, таких как: возраст, пол, наличие и степень развитости организаторских и коммуникативных способностей человека, степень мотивации, уровень креативности личности педагога. Выявлено, что существуют различные барьеры по использованию ЦОТ преподавателями. Относительно готовности студентов к применению ЦОТ обнаружено, что обучающиеся не в полной мере готовы к применению ЦОТ в обучении, в частности, они не осведомлены о сущности понятия «иммерсивные технологии» и не идентифицируют их с технологиями виртуальной или дополненной реальности. Значительная часть студентов используют довольно схожие по функционалу цифровые сервисы. Выявлены актуальные цифровые технологии, используемые в обучении в мировой практике. Обоснована необходимость применения цифровых сервисов

в виртуальных образовательных средах, в том числе в метавселенных. Для повышения способности использования преподавателями ЦОТ необходимо, чтобы в учебные планы включили курсы по применению ЦОТ в образовании в контексте профессиональной подготовки. Также предлагается стимулировать преподавателей к применению технологии в образовательном процессе путем выделения дополнительного финансирования. Университетам необходимо создавать условия по использованию студентами цифровых технологий.

Ключевые слова: цифровые образовательные технологии; образовательный процесс; иммерсивные технологии; виртуальная и дополненная реальность; метавселенные; готовность педагогов; готовность студентов.

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Introduction

Due to significant changes in the volume of generated knowledge and its transfer system (annually “5% of theoretical and 20% of professional knowledge is updated” [1]), the state, teachers, students and employers have to adapt to these changes. In accordance with the “Kronberg Declaration on the Future of Knowledge Acquisition and Transfer Processes”, the main role[1] is given to online technologies. The usage of digital educational technologies (DET) at the current stage of development of the world educational system is increasing every year. The pandemic and the need for rapid adaptation to new conditions have accelerated the process of DET dissemination at the global level[2] [2; 3].

Some technologies are in high demand, while others are still developing more slowly for economic or technical reasons. In recent years, the alternative market of educational technologies and products, which is more large-scale and customer-oriented, first of all, has been rapidly developing. In some niches, private organizations have already become leaders in terms of the amount of money earned and have surpassed traditional universities and business schools.

Transformation of the educational process in private organizations is much faster, they apply new approaches to the educational process: classes are conducted by well-known personalities, instead of traditional lectures they use a show involving practitioners and technical specialists (sound engineers, cameramen, assistants, etc.), they do recording and public broadcasting, use interactive approaches and gamification using a feedback from the audience, they create exciting educational content using wide range of educational methods, virtual reality and augmented

[1] Kronberg Declaration on the Future of Knowledge Acquisition and Sharing / Orenburg regional branch of interregional non-governmental organization UNESCO “Information for All” (translation) , 2007 [Electronic resource]. Access mode: http://ifap.ru /ofdocs/rest/kronberg.pdf

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reality technologies[3,4] [4—6], Such approaches cannot be economically justified in private universities with small amount of students, it requires a wider audience.

At the same time, the best educational programs of traditional universities are gradually beginning to yield to private EdTech companies in terms of the quality of content delivery. Only a few factors keep public universities from falling behind in terms of the number of students and graduates: the availability of budget-funded education, the availability of dormitories and a sports complex, obtaining a state diploma, historically established stereotypes about the necessity of higher education (in a university), and the lack of financial resources among the population. The *introduction of innovations* in the traditional educational process on open resources is more rapid than it is done by the leading universities and the most progressive teachers within classical educational institutions. The improving the educational process is most often limited by the personality of leaders of the educational organization and the quality of the teaching staff.

There are quite a few examples of systemic development at the Russian national and regional levels, it's not enough to modify educational system to modern conditions.

In Russia, as a positive example, we can name such initiatives as grant support for teachers to create high-quality electronic content, including the use of VR technologies (supported by the Moscow Government). At the same time, teachers from all over the country and legal entities can create content, which is open to all users of the regional library complex.

The website open.edu has become extremely popular, especially during the pandemic period, as it hosts educational courses from many universities, giving students all over Russia the opportunity to get additional knowledge in areas of their interest. However, this resource needs support in promoting and updating its content. Educational institutions face a new challenge to create an attractive and practice-oriented educational product at a new level. The basis for this transformation should be new digital educational technologies, as modernization of education is aimed not only at updating the content of disciplines, but also at applying new educational methods and techniques, increasing the involvement, interest and motivation of students[5, 6, 7, 8, 9, 10, 11].

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The increasing information saturation of the educational environment requires the use of learning tools that correspond to modern conditions [7], the availability of educational resources, educational and outreach programs to improve the effectiveness of learning, increase interest in learning, the ability to build a more rational learning process [8].

Some Russian universities, for example, ITMO University, give students the opportunity to prepare and implement educational courses on a competitive basis and with the support of mentors. If we compare this experience with global educational practices, such initiatives were implemented in the USA at Indiana University more than 50 years ago in the early 1970s, where students could take their own course if they received support from one of the departments or the dean [9].

The use of innovations in education at the present stage is largely associated with the use of various digital educational technologies.

Let us define the term *digital technologies*. They are interpreted by two main aspects: the use of digitized information and all technologies that allow creating, storing, distributing and transforming data (including electronic devices, programs, etc.).

Thus, in order to determine the prospects for the development and dissemination of digital technologies in education at present, it is necessary to determine how widely digital technologies are used in the educational process.

The application of digital technologies shows that there is a wide range of them. Researchers from the Institute for Statistical Research and Knowledge Economy (ISKEE) of the Russian National Research University Higher School of Economics have compiled a rating of the most promising digital technologies, consisting of the following positions: 1. deep learning; 2. convolutional neural networks; 3. computer vision; 4. reinforcement learning; 5. natural language processing; 6. unmanned cars; 7. recurrent neural networks; 8. transfer learning; 9. generative adversarial networks; 10. decision support systems; 11. smart contracts; 12. speech recognition. 13. quantum computer; 14. federated learning; 15. autonomous robotics1. These technologies may be promising for large-scale use in the industry, which will generate demand for training specialists with competencies in these areas.

Some of the described technologies are already included in master's degree programs. The researchers of this issue identify 9 fundamental technological trends that are directly related to modern digital technologies: big data; robotics; modeling; horizontal and vertical system industrial integration; industrial Internet of Things; cybersecurity; cloud computing; additive technologies; augmented reality [10]. A number of the above-mentioned technologies are actively used in the educational market (application of big data, cloud and blockchain technologies). Big data make it possible to train neural networks and use the potential of their capabilities to improve the educational process.

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A large number of sub-processes that make up the educational process can be automated: checking test assignments, submitting various applications (submission of documents, individual educational trajectory, applications, etc.), calendar planning, filling out various forms and reports, communication with students on typical recurring issues, e-tutoring, recommendation systems for participation in events, reminding about events and deadlines, educational and management analytics, attracting applicants and listeners, autonomous learning, and other processes. Many of the processes mentioned above can be improved by using RPA technologies (business process automation).

Taking into account the growth trends of the education market in general and online education and business process automation technologies, attempts are being made to automate both universities and EdTech companies. In addition to the automation of processes, the formation of metavillages as a learning environment is gaining wide development[12] prospects.

The market of educational technologies is actively developing. According to the Barometer project's open research on online education, the global education market has grown from $4.5 to $5.0 trillion in 2 years, with online education accounting for 3.5% ($175 billion). The Russian education market has grown over 5 years from 1.8 trillion rubles in 2016 to 2 trillion rubles in 2021, and the share of online education is about 2.6% (53.3 billion rubles)[13]).

The revenue of average online schools in Russia amounted to about 500 thousand rubles per month. Among the most popular directions of online courses in Russia were the following: 17% — industrial training; 13% — creativity, applied decorative skills, hobbies; 9% — sports, health; 7% — spiritual practices and personal growth; 6% — foreign languages, psychology, finance and taxes, narrow profile specializations (each category)[14].

SkyEng, one of the market leaders in online education in the Russian Federation, has already integrated neural networks and deep machine learning (artificial intelligence) into the educational process to a significant extent, adapting learning and making it more personalized, the technologies help to check assignments in real time. AI algorithms analyze video recordings of the class and track the student's progress. The neural network evaluates whether the lessons meet the quality criteria based on the laid down criteria, and at the end of the lesson gives the teacher advice on how to eliminate deficiencies, if any[15].

The postupi.online service has focused its efforts on helping university applicants to solve the problem of searching for education relevant to their interests and has automated the process of selecting universities and educational programs by profession and other specified characteristics[16].

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[12] Asako Miyasaka. Todai to offer metaverse studies to teach engineering // The Asahi Shimbun. 23 July 2022. [Electronic resource]. Access mode: https://www.asahi.com/ajw/articles/14677709 (access date: 28.11.2022).

[13] Dreval M. Research of the Russian market of online education and educational technologies: materials of the report for an international conference: Proceedings of the International Conference. 2021. Access mode: https://estars.hse.ru/mirror/pubs/share/211448255 (access date: 10.01.23)

[14] Dreval M. Research of the Russian market of online education and educational technologies: materials of the report for an international conference: Proceedings of the International Conference. 2021. Access mode: https://estars.hse.ru/mirror/pubs/share/211448255 (access date: 10.01.23)

[15] Teach a knowledgeable one: how English teachers are trained in Skyeng [Electronic resource] // SkyEng company magazine. Access mode: https://magazine.skyeng.ru/ uchi-uchenogo-kak-gotovjat-prepodavatelej-anglijskogo-vsky-eng/?ysclid=l916r05jud 749717 991. (access date 10.01.2023).

[16] See the service postupi.online for more information [Electronic resource]. Access mode: https://postupi.online/professii/ (access date 01.10.2022).

Nowadays, it is more important to help students to create their own projects and startups. The National Technology Initiative project implemented automated practices for more efficient selection of team members using AI algorithms. The developers conducted preliminary diagnostics and identified personal characteristics, values and skills in order to identify harmonious characteristics that formed the basis for the division into teams. Further work with the teams showed the success of this approach, for example, the longetivity of the developed projects were higher.

The Promobot company from Perm city published the statistics on the use of robots as teachers in the educational process all over the world. There were more than 4 thousand cases in general and 326 cases in Russia[17]. The company conducted an experiment on the use of robots in the educational process and made the robot "YURA" hold the exams for future medical doctors in the Perm State Medical University. The robot acted as a patient and checked how students made the examination according to one of the scenarios. Then the robot reported the results.

Globally, individual research groups, universities, schools and EdTech companies are experimenting with the integration of robotics into the educational process. In Germany at the University of Marburg, Professor Jürgen Handke uses a robot "Yuki" at his lectures on linguistics. Yuki gives students a task and checks the timing.

A good example of using robots as teaching assistants was realized by researchers from the University of Miami. The robot helped to conduct classes for young children doing physical exercises, teaching them using questions, children demonstrated him answers with cards that the robot could recognize [11].

Researchers are trying to find out how effective will be robots as co-learners being socialized (showing initiative in communication, taking into account individual characteristics of the person, actively moving) and non-socialized. The experiments showed that children who interacted with socialized robots had higher learning success. More than half of the children saw the robot as a friend (67%) [4]. However, the use of such technologies brings not only positive changes, but also has a risk associated with the confidentiality of data stored in robots, which can be hacked. There are also a risk of misinterpretation of answers or values transmitted by robots [12].

In some foreign universities, teachers started to implement the technology of blockchain in the preparation of students' final qualification papers. The use of the technology allowed teachers to track the dynamics of progress in the completion of final qualification papers more efficiently. Russian universities are also introducing innovations in the educational process, mastering new educational programs. Students of MIPT's Blockchain Master's program in 2022 received diplomas as non-interchangeable NFT tokens.

The smart-contract technology forms a digital smart-didactics using cloud and blockchain technologies in order to develop the education system as a whole and to promote better personal development of students. Digital smart-didactics helps teachers to better prepare the graduates, to make a personalized educational trajectory for them, to combine the educational and entrepreneurial aspects, prepare new skillful staff during a startup creation. This approach can be structered as decentral-

[17] Bunina V. The education system is over: can robots replace teachers // Gazeta.ru. [Electronic resource]. — 27.07.2021. https://www.gazeta.ru/tech/2021/07/27/13787258/Robo_teacher.shtml

ized autonomous organizations, connecting the needs of customers and providers of products and services [6].

In some foreign universities, technology such as blockchain has begun to be used in the preparation of graduation theses by students. The use of technology allowed teachers to track the dynamics of progress in completing the thesis more effectively. Russian universities are also introducing innovations into the educational process, mastering new educational programs. Students of the MIPT master's program "Blockchain" in 2022 received diplomas in the form of non-fungible tokens (NFT).

Smart contract technology makes it possible to create digital smart didactics using cloud and blockchain technologies in order to develop the education system as a whole and promote the greater effectiveness of personal development of students. Digital smart didactics makes it possible to increase the efficiency of graduate training, create a personalized educational trajectory, and connect the student's development with an increase in entrepreneurial culture and personnel training in the process of creating a startup. This approach could also be based on principles of building decentralized autonomous organizations, making it possible to tie together the needs of customers and the needs of suppliers of products and services [6].

Such technologies will help educational institutions to pay more attention to each student, to reduce the unpleasant for traditional higher education system factors, when more than 20% of students fail to cope with education and drop out, or are demotivated by its low quality, as well as the percentage of students who later work outside their field of study, which indicates the inefficiency of spending public funds and non-compliance of the education system with modern requirements.

By using of blockchain technology, industry representatives and partners of universities could adjust faster to educational programs and supplement them with the necessary skills and competencies that students need to acquire.

Dell Technologies specialists found out, that the following digital technologies will have a significant impact on society in the world by 2030: machine learning and artificial intelligence, robotics, virtual and augmented reality, cloud computing [2].

If the Russian government wants to create a digital economy, it is necessary to make changes in the education system by introducing the above mechanisms that facilitate the interaction between business structures and universities, involving business community in order to modernize educational programs and organizing as well as internships for teachers.

The program of the Digital Economy of the Russian Federation started in 2017 is supposed to improve the education system in order to provide the digital economy with competent personel[18].

One of the ways of digitalization of education is the development and implementation of online educational courses, it will increase the role of educational technologies in teachers' work. On the one hand, the expansion of the range of educational technologies helps students to obtain "a guaranteed specified educational result" [13]. On the other hand, the level of teachers' mastery of digital technologies is rather low.

Methodology This study analyzes the application of digital technologies in education, highlights the most promising ones from the point of view of teachers' application in the educational process.

[18] On the strategy for the development of the information society in the Russian Federation for 2017–2030. Decree of the President of the Russian Federation dated May 9, 2017 No. 203 Official Internet portal of legal information. [Electronic resource]. URL://www.pravo.gov.ru/news/2017/news_0105.html (access date 01.10.2022).

To determine the readiness of teachers to use digital educational technologies, we analyzed domestic and foreign scientific publications on how digital technologies were used by teachers of educational institutions.

There are many studies that highlight the importance of using digital technologies to improve student learning. Various factors influence receptiveness of teachers to technology. Gender and age of teachers are important factors, which influence ICT training of the teaching staff [14]. The results of individual studies indicate that female teachers had greater digital competence in the use of ICT than male teachers [15—19]. In terms of age, young teachers have more knowledge; moreover, recent graduates feel more confident when introducing these technologies [20; 21]. An important factor is the level of readiness of the leaders to inform about changes when introducing digital technologies into teaching and learning in the higher education system [19].

In Russian publications there is a small number of works related to the readiness and ability to use digital educational technologies by teachers [22—25] with different assessments. The study [24] identifies among teachers "skeptics" and "enthusiasts" according to their use of digital educational technologies, the group of "enthusiasts" makes up 48.7% (73 people). The paper [25] revealed that the readiness of future teachers to use innovative technologies is influenced by various factors, such as the degree of motivation to use innovative technologies, "creativity, communication and organizational abilities." Another article revealed the low level of qualifications of teaching staff regarding the use of information and communication technologies. More than 50% of teachers do not have a "clear idea of what needs should be to implement the project." The main barriers are identified:

1) so-called "risky" barriers, due to the fact that teachers believe that digital technologies have a negative impact "both on society and on the individuals and their education", about 50% (47.13%) of teachers who participated in a survey, work in The Sverdlovsk region. They see more shortcomings than prospects in the use of social networks and messengers in teaching activities;

2) barriers associated with the ruining the teacher's image, which comes as a result of the availability of the teacher's personal information in the social networks [24, p. 132]. About 1/3 of teachers insisted on the an inadmissibility (reluctance) to be registered on social networks;

3) barriers to the uptake and use of new digital technologies.

The study[19] shows that according to 32% of the 634 teachers of higher education do not confidently use digital technologies or do not use them at all. At the same time, the vast majority of teachers (more than 90%) actively use the Internet and do not experience difficulties in working on a computer and other digital devices. Moreover, 59% of them actively use social networks. This is evidenced by the high level of the digital literacy index of university teachers (88% out of 100 possible[20]).

Regarding the readiness of students to use digital competencies, it should be

[19] Aimaletdinov T.A., Baymuratova L.R., Zaitseva O.A., Imaeva G.R., Spiridonova L.V. Digital literacy of Russian teachers. / Readiness to use digital technologies in the educational process. — M.: NAFI Publishing House, 2019. — 84 p. URL: https://d-russia.ru/wp-content/uploads/2019/10/digit-ped.pdf

[20] Aimaletdinov T.A., Baymuratova L.R., Zaitseva O.A., Imaeva G.R., Spiridonova L.V. Digital literacy of Russian teachers. / Readiness to use digital technologies in the educational process. — M.: NAFI Publishing House, 2019. — 84 p. URL: https://d-russia.ru/wp-content/uploads/2019/10/digit-ped.pdf

noted that despite the relatively low level of development of basic digital skills of Russians[21, 22], Russian students have a higher level of digital literacy, which makes 77% out of 100 possible. This level is lower than that of teachers, but much higher than the average for the Russian population (52% out of 100%). At the same time, with the development of critical thinking the self-assessment of the level of digital literacy of students becomes lower, and the demand for the use of digital technologies in the educational process increases. Among 248 undergraduate students of 1st — 4th year of the university in non-digital areas at Novosibirsk State University of Economics and Management ("Human Resources Management", "Management", "Economics") [26], only 25% of respondents assessed the disciplines in the curricula as useful to increase their own digital literacy level are sufficient, 34.5% of respondents claimed that these disciplines at the university are extremely insufficient. In addition, the research [27] showed that PhD students have significantly higher readiness to use digital technologies than bachelor students s and those to study to be a Doctor in Sci.

It can be noted that there is an imbalance between the level of digital literacy and readiness to use digital technologies in teaching. However, university teachers, having a fairly high level of digital literacy, are not striving to introduce new technologies into practice. While students, who also have a high level of digital literacy, want to increase it through the introduction of new technologies in the educational process (expecting this from the teacher as well).

On the one hand, the level of development of basic digital skills of the Russian population is far behind in comparison with similar indicators in European countries. The State strives to accelerate digitalization in all sectors of the economy through the implementation of programs such as "Digital Economy of the Russian Federation" and "Priority 2030"; on the other hand, employers need trained personnel with a high level of digital proficiency, creating a demand for competent specialists. At the same time, the readiness and ability to use digital technologies in the educational activities at universities is different for different participants, the question is whether the main participants of the educational process, both teachers and students — are ready to use them.

To analyze the readiness of students to use digital technologies in education, we carried out an analysis of scientific publications and conducted a sociological study using online survey in Google among students in the areas of ICT at ITMO University. The survey described the frequency of use of digital technologies by students, the degree of their awareness of specific digital tools, and the level of use of such tools by teachers in the educational process. 100 undergraduate and master students took part in this. The survey was conducted on a voluntary and anonymous basis. Respondents were found in social networks, messengers and the portal of ITMO University. The survey was conducted from December 2021 to July 2022.

In the study, the authors used systematic analysis and comparative analysis, methods of generalization, and systematization of the analytical grouping.

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[21] Children and technology / T.A. Aimaletdinov, L.R. Baymuratova, V.I. Gritsenko, O.A. Dolgova, G.R. Imaeva. — M.: NAFI Publishing house, 2018. — 72 p. — p. 36. The electronic version is available on the website of the NAFI Analytical Center at the link : https://nafi.ru/projects/sotsialnoe-razvitie/deti-i-tekhnologii/

[22] Abdrakhmanova G.I., Vishnevsky K.O., Gokhberg L.M. and others. Digital economy: 2020. / Brief statistical collection. — M.: National Research University Higher School of Economics, 2020. — 112 p.

Results

To analyze the readiness to use digital educational technologies for students who have an understanding of various digital technologies, ITMO University students of ICT were invited to participate in the study. The results (Fig. 1, Fig. 2) showed that a significant proportion of students (70%) used four technologies: computer equipment (84 people), mobile Internet (82 people), multimedia (projector, speakers, TV) (81 people), software systems (programming languages, translators, compilers, operating systems, software packages, etc.) (71 people).

49 to 51 out of 100 respondents used during their education the high-speed Internet (49 people), local information networks (51 people), 3D modeling and prototyping (49 people), information system for students and employees (47 people). The last figure is interesting,, since currently all students interact with a system of this type, however, only 47 out of 100 noted this, which may be either due to a misunderstanding of what is meant by “information system for employees and students”, or a different interpretation of it by the students..

Analyzing the use of digital services, the following services were identified: Kahoot (74 people), Online Test Pad (65 people), Quizizz — (45 people). The functionality of the seservices is quite similar, so are simplicity, easy to use and variability of the functions.

The answers to question about full understanding of the essence and use of im-

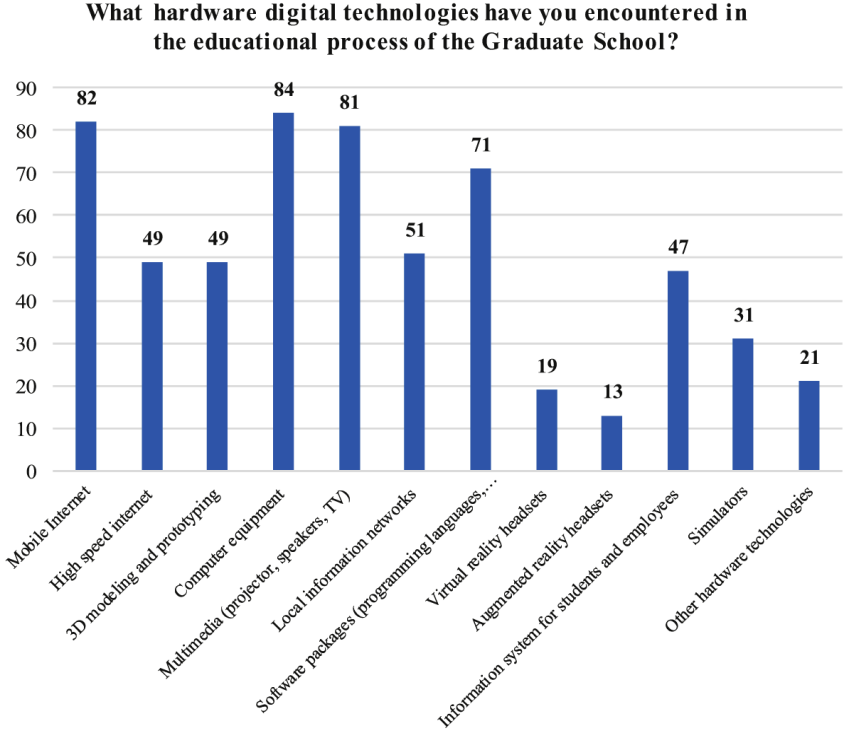

Fig. 1. The level of use of hardware digital technologies in the educational process

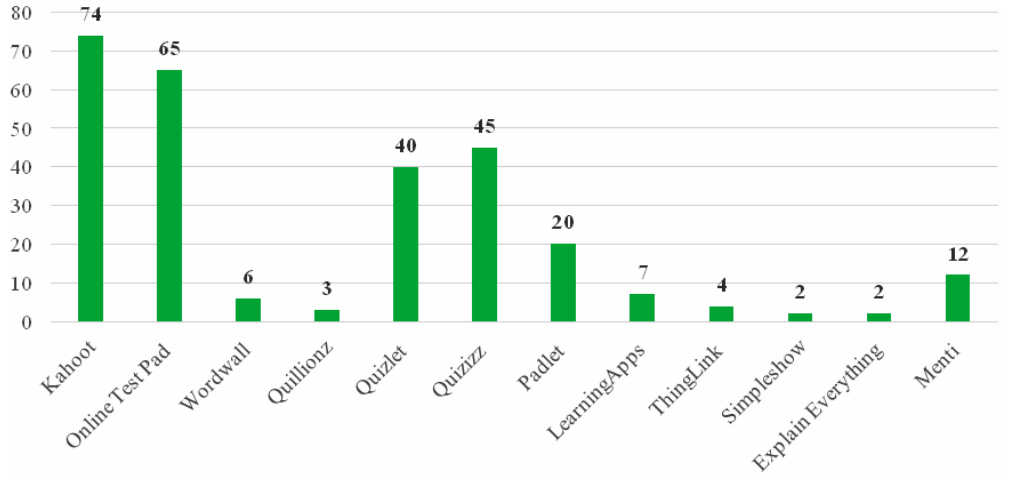

Fig. 2. Level of use of digital interactive services in education

mersive technologies showed that the majority of respondents were not familiar with this concept (62%). Further questions were about students' experience in using virtual reality (VR), augmented reality (AR), and 360-degree video technologies. 56% of respondents indicated that they used a virtual reality headset and only 38% claimed having used an augmented reality headset. This indicates that students are not fully aware of the essence of the concept of immersive technologies and they don´t identify them with virtual or augmented reality technologies. As for 360-degree video, which also makes it possible to immerse students in a certain environment, 61% of respondents mentioned this technology.

There are several factors which are important for the large-scale development of the technology, , relating not only to technical characteristics and cost, but also to the positive experience students (customers) had. 43% of the respondents who had experience using a VR headset, rated their experience as 8-10 out of 10. Only two respondents gave 5 points, which was the lowest rating among all respondents, indicating a high degree of perceived positive user experience and high user satisfaction (Figure 3).

However, despite the positive assessment in general, VR headsets, like other technologies, have disadvantages associated with both economic factors (high price) and technical ones. The number of respondents who encountered discomfort using a VR headset is almost equal to the number of those who did not experience discomfort (51% and 49%, respectively). This may indicate inherent shortcomings in the technology that are important to half of consumers and have a significant potential for technical improvement.

Discomfort among users when using a VR headset was associated with several factors: dizziness (9 people), headaches (4 people), eye fatigue (4 people), sweating of the face and tearing (4 people), difficulties in orientation in space (5 people), technical shortcomings (excessively heavy weight of the headset, bad fit to the face, uncomfortable ergonomics, flickering, bad quality of the graphics, long connection time) (5 people).

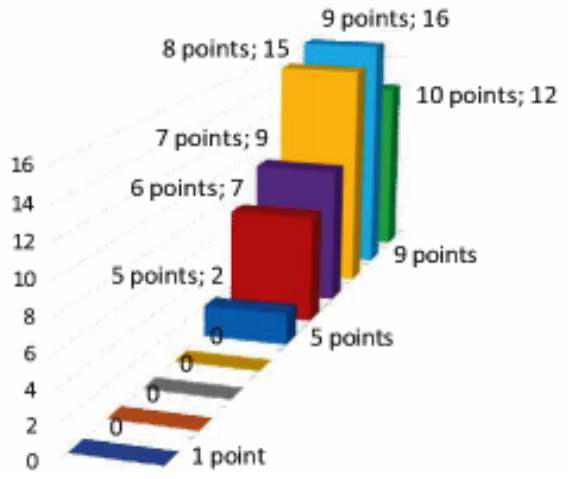

Fig. 3. Rating the experience of using a VR headset from 0 to 10 scores (scores/person)

In addition to AR headsets, users usedother types of devices (Figure 4).

At the same time, the majority of respondents believe that the use of virtual reality technologies can improve the quality of education, and only 8 people thought that they could not (Fig. 5).

Regarding the duration of using VR and AR headsets, the majority believe that VR headset can be used no more than 4 hours a day (40 people), respondents are more cautious about AR headsets and the majority (25 people) do not recommend using it more than 2 hours a day (Table 1).

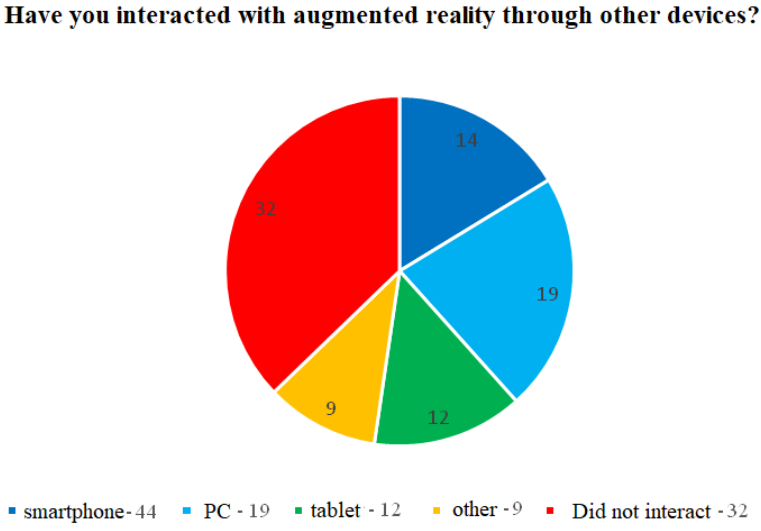

Fig. 4. Devices used to interact with augmented reality (persons)

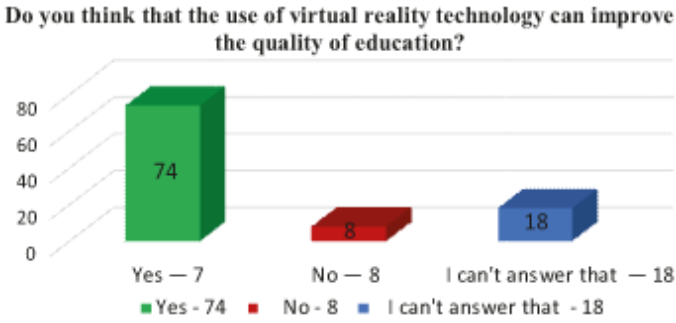

Fig. 5. Can the use of virtual reality to improve the quality of education (persons)

Table

Results of a surveys of students on the duration of use of VR and AR headsets per day

Use of VR glasses per day		Use of AR glasses per day	
Duration, hours	**Number of respondents who chose the option, persons**	**Duration, hours**	**Number of respondents who chose the option, persons**
No more than 4	40	No more than 4	-
up to 2	16	up to 2	25
up to 3	-	up to 3	11
up to 1	11	up to 1	10
0,5	5	0,5	2
5	5	4-8	1
6	1	6-8	1
-	-	14	1
2	1	24	2

The most popular VR headset manufacturers were: Oculus, HTC and Sony (Fig. 6).

Regarding the use of VR headsets, according to respondents, it is most useful and interesting to use it in the study of various disciplines: chemistry (1st place), 3D modeling (2nd place), physics (3rd place), as well as history, astronomy, biophysics, circuit design, electrical engineering, systems administration, economics, geography, mathematics, geometry, biology, driving courses and psychology.

A very small number of respondents (7%) have their own VR headset, while 35% would like to purchase a VR headset (Fig. 7).

Respondents' opinion on the frequency of using a VR headset range from several times a day to several times a year (Fig. 8)

The main reasons explaining why a significant portion of respondents do not use a headset are lack of financial means, high cost (8 people), no time to use (2 people), safety (2 people) and other reasons (Fig. 9) .

External reasons for the wide use of remote learning services were dictated by the pandemic. Different educational organiza-

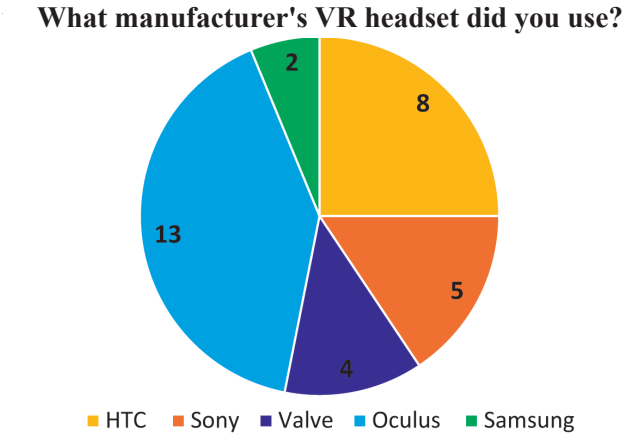

Fig. 6. The most popular VR headset manufacturers

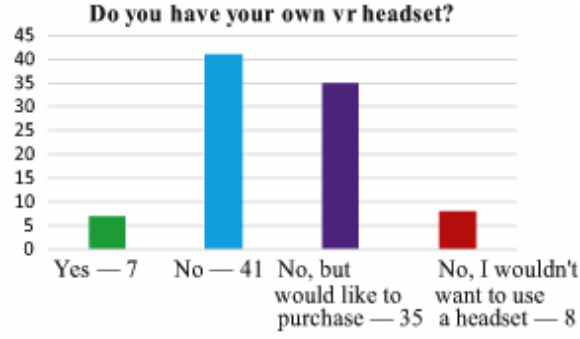

Fig. 7. Students having their own VR headset

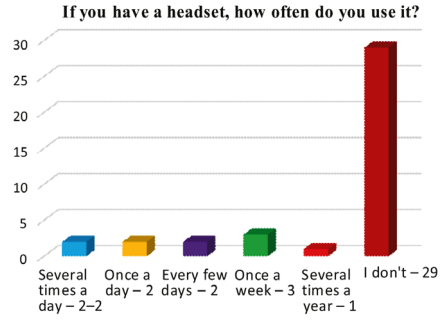

Fig. 8. Frequency of use of the headset by users (persons/times)

tions and teachers have chosen their preferred services by their own experience. A number of teachers chose digital services for distance classes based on their audience preferences. As a result, the majority of respondents used different services dur-

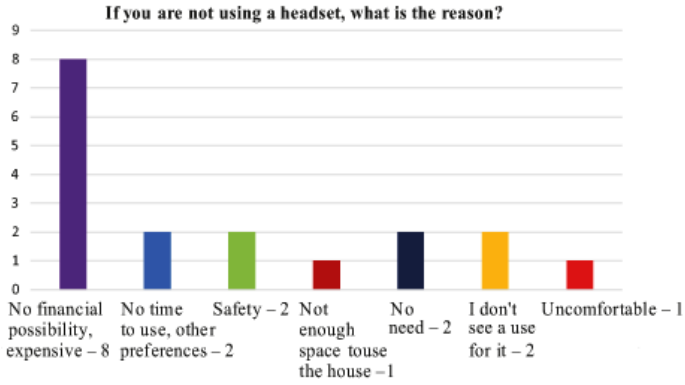

Fig. 9. Reasons for not using a headset

ing the learning process. The most popular remote learning services turned out to be: Zoom, Discord, Google class, Skype, VK (Fig. 10).

A new stage in the development of both VR/AR technologies and educational technologies will be their use in *metaverses*. Some innovative teachers have already tried to implement their courses via computer games and the Roblox metaverse.

As the survey results showed, only a small number of respondents managed to try out a VR headset in the metaverses(9 participants), while 30 participants responded that they didn't have such experience (Fig. 11).

In some Asian countries, individual universities use educational technologies in metaverses. For instance, the University of Tokyo (Todai) is starting to implement a number of *educational programs in the metaverse*. The project is implemented by the Faculty of Engineering and the Graduate School related to Engineering. The course in the metaverse is planned to be open to everyone, both high school students and adults. By using the metaverse, developers want to make an access open for everyone to a high-quality education in

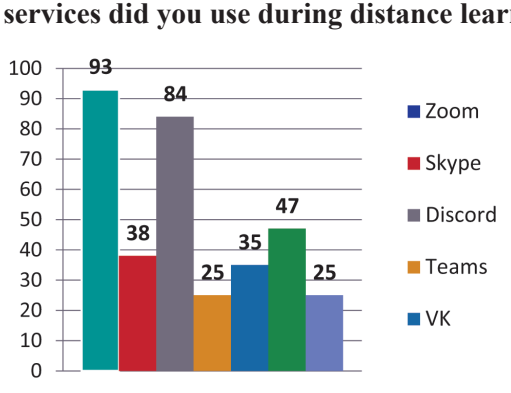

Fig. 10. Most popular remote learning services (%)

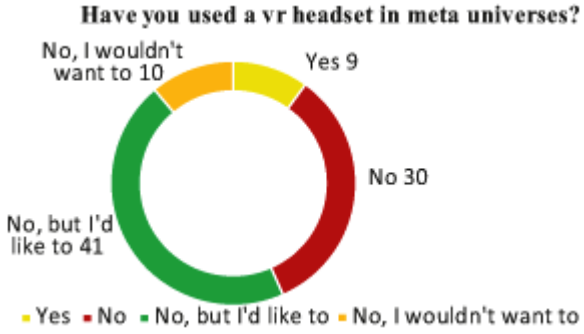

Fig. 11. Have you used a VR headset in the metaverses?

the field of engineering and computer science[23].

The University of Hong Kong (Hong Kong University of Science and Technology) started teaching in virtual classrooms and planned to launch a campus in the metaverse[24].

China has announced a two-year plan for the development of *metaverses* in 2022—2024. The plan is intended to stimulate the development of the Web 3.0 Internet and focuses on promoting the development of sectors related to metaverses, as well as smart city management for the digital economy[25]. This way China is trying to promote development scenarios of the digital education, strengthen cooperation between technology companies and educational institutions, expand interactive online education models and develop new digital teaching platforms. The action plan for the development of the metaverse became an impetus for providing all possible support for the development of virtual reality in districts and municipalities.

Russia also has started implementing educational projects related to metaverses. At the annual conference "Digital Industry of Industrial Russia" held in Nizhny Novgorod, was presented a prototype of the country's first educational metaverse, Neymark.MetaVerse. It was created by the Gorky Center for Artificial Intelligence in cooperation with the Project Office for the Development Strategy of the Nizhny Novgorod region and the IT company AVM Technologies[26]. The EdTech company Geek Brain launched a twelve-month course: "Developing Metaverses. Advanced Technologies of the IT Engineering: Metaverses".

Conclusion

The perspectives for introducing new digital technologies into the educational

[23] Newspaper The Asahi Shimbun. [Electronic resource]. – URL: https://www.asahi.com/ajw/articles/14677709

[24] In a class of its own? Hong Kong University of Science and Technology to launch virtual reality lessons in bid to create metaverse campus. [Electronic resource]. URL: https://www.scmp.com/news/hong-kong/education /article/3186907/class-its-own-hong-kong-university-science-and-technology (access date: 28.11.2022).

[25] Prashant Jha. Beijing announces two-year Metaverse innovation and development plan 24 Aug 2022 [Electronic resource]. URL: https://cointelegraph.com/news/beijing-announces-two-year-metaverse-innovation-and-development-plan

[26] The prototype of Russia's first educational metaverse "NEIMARK.MetaVerse" was presented at Digital industry of industrial Russia. Nizhny 800. — 02.06.2022. [Electronic resource]. https://nizhny800.ru/news/prototip-pervoj-v-rossii-obrazovatelnoj-metavselennoj-nejmark.metaverse-predstavili-na-cipr?ysclid=l91q8abry l965964142 (access date: 10.01.2023).

process open up a number of positive opportunities for improving the educational system. There is a significant part of business processes that can be automated using RPA technologies and AI algorithms.

The use of virtual educational environments can significantly improve the quality of education and implement the best educational practices. Gaming ecosystems like Roblox facilitate the gamification of the learning process and help to experience the benefits of a virtual environment, but they have limited functionality compared to the metaverse. Environments such as Minecraft, Roblox or Fortnite are too connected to the gaming style and can be unnecessarily distracting. However, it did not stop some innovative teachers from conducting their educational courses in these environments. The use of digital technologies has a lot of positive aspects, but also a number of significant risks. In the case of using virtual educational environments, there are limitations for using headsets students with sensory dysfunction

According to the surveys, headsets have a number of disadvantages; their if used for a long time it can cause dizziness, headaches, eye fatigue and a number of other negative consequences. If headsets are used for educational and also for entertainment, then their usecan be excessive. The main obstacle limiting the spread of virtual reality headsets is their price.

To improve teachers' ability to use these new technologies, it is necessary to introduce courses on the use of digital educational technologies professional curricula. Educational centers for teachers should support it in the following ways: (a) to create courses and seminars on the use of digital educational technologies; (b) to organize open events, panel discussions about best practices, where professionals could get new information regarding new methods of adding digital educational technologies. We also propose to encourage teachers to use technology in the educational process by providing them with additional funding, for example, project grants. Universities need to create conditions for students in order have access to the digital technologies.

This research may be useful for developing approaches to teaching IT professionals. In future researchers should try to identify ways to improve the effectiveness of teachers' use of sdigital educational technologies.

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Investigating the Correlations between Problem Solving Ability, Resilience and Academic Burnout of Virtual Medical Education Students Using Structural Equation Modeling

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The purpose of the present study is to investigate the correlations between academic resilience and academic burnout analyzing the problem-solving ability of the students. In 2021 the research questionnaires (demographics, academic burnout, academic resilience and problem-solving ability) were sent online through Press Online software, 260 students of virtual medical education were recruited for this study. Descriptive statistics, Pearson correlation and Structural equation modeling were used to examine the characteristics of the participants, correlation between main variables in order to test the study hypothesis. Based on the results, we found out that the model fit indices, CFI (comparative fit index), NFI (normed fit index), TLI (Tuckere Lewis index), X2/DF (the ratio of X2 to degrees of freedom) and RMSEA (Root mean of square error approximation) were appropriate. We discovered, that the academic burnout with problem solving skill ($\beta = -0.77$), academic resilience ($\beta = 0.26$) and problem-solving skill with academic resilience ($\beta = 0.96$) has a statistically significant correlation. Also, it was found that most of the correlations between academic burnout and academic resilience are indirect, we get them through the mediator variable of problem-solving skills (-0.871).The results of this research determined that there is a certain group of students at risk, who are suffering from burnout and weak problem-solving skills, who are at risk. Such students should be identified and provided with short courses for the developing of adaptive coping skills, such as problem solving, in order to prevent their academic burnout.

Keywords: academic burnout, academic tolerance, problem solving ability, structural equation modeling, students.

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Исследование взаимосвязи между способностью к решению проблем, устойчивостью и академическим выгоранием у студентов, получающих виртуальное медицинское образование с использованием моделирования структурными уравнениями

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Цель настоящего исследования заключается в изучении взаимосвязи между академической устойчивостью, академическим выгоранием и способностью решать проблемы у студентов виртуального медицинского образования. В рамках исследования были использованы анкеты, включающие демографические данные, а также данные по академическому выгоранию, академической устойчивости и способности решать проблемы. Анкеты были разосланы онлайн с использованием программного обеспечения

Press Online в 2021 году. В исследовании были применены описательная статистика, корреляционный анализ Пирсона и моделирование структурными уравнениями для изучения характеристик участников и проверки гипотез исследования. По результатам исследования были определены индексы соответствия модели CFI (индекс сравнительного соответствия), NFI (индекс нормированного соответствия), TLI (индекс Такера-Льюиса), X2/DF (отношение X2 к степеням свободы) и RMSEA (среднеквадратичное значение ошибки). Все эти индексы указывают на подходящее соответствие модели. Было обнаружено, что академическое выгорание имеет статистически значимую связь с навыком решения проблем (β=–0,77), академической устойчивостью (β=0,26) и навыком решения проблем с академической устойчивостью (β=0,96). Также было установлено, что основная часть связи между академическим выгоранием и академической устойчивостью происходит косвенно через медиаторную переменную навыков решения проблем (–0,871). По результатам данного исследования было выявлено, что существует группа студентов, которые испытывают академическое выгорание и имеют недостаточные навыки решения проблем. Эта группа находится в зоне риска. Рекомендуется выявлять таких учащихся и предлагать им специальные краткие курсы, направленные на развитие адаптивных навыков преодоления трудностей, включая решение проблем. Эти курсы помогут предотвратить академическое выгорание у студентов и будут способствовать их общему успеху в образовании.

Ключевые слова: академическое выгорание; академическая толерантность; способность решать проблемы; моделирование структурными уравнениями, студенты.

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Introduction:

Although attending university is often linked with positive experiences, for some individuals it might result in indifference, exhaustion, and inefficiency (1). Academic burnout manifests as ineffectiveness, exhaustion, and apathy. Academic burnout is characterized by a lack of enthusiasm for learning, a negative outlook, and a sense of academic inadequacy (2). Academic burnout is the primary result of long-term stress, which is brought on by the excessive amount of homework and disregard for psychological factors. It decreases a person's capacity to cope with stressful situations while in school, which negatively affects cognitive commitment, interest in the course material, participation in class activities, and the sense of being able to learn the material and makes students feel incompetent and helpless. It therefore results in their poor performance. According to studies, in addition to making individuals less equipped for the workforce and increasing absenteeism and the desire to quit the service, studying also reduces people's motivation to work (5). Resilience is

one of the things that may protect individuals from stressful conditions and keep them from experiencing depression (6—7). The capacity to bounce back from ongoing problems and be able to rebuild oneself is resilience. Despite being subjected to intense stresses, this human potential may help him overcome unpleasant situations, and he can also increase his social, intellectual, and professional competence which reduces academic fatigue (8—9). A construct called resilience has elements related to learning, behavior, and emotion. Academically resilient students are those that remain highly motivated to succeed and perform at their best in spite of adverse environmental circumstances that may otherwise lead to poor academic performance or even dropping out (9). The capacity to address issues is another important factor in academic burnout. The term "problem solving skill" refers to a cognitive-behavioral process that offers a variety of potential and alternative solutions to deal with problematic situations. This process increases the likelihood of selecting the best and most efficient alternative solutions and effectively dealing with current and potential future problems (10). In many ways, developing problem-solving skills may be considered as a process of fostering personal development and, as a consequence, raising the likelihood of successful coping in a variety of circumstances. People find, develop, or uncover resources for successfully dealing with traumatic life situations throughout this phase (11). Oral et al. (2006) discovered that a person's health and successful development depend greatly on their capacity to confront difficulties and use problem-solving techniques. They point out that via problem-solving, individuals learn to cope with difficulties rather than avoid them, utilize the resources they already have, and think creatively, all of which help to build resilience (12). Depression is a problem that is particularly prevalent among students, because they experience a lot of stress throughout their education. Students experience a lot of stress due to a variety of factors, such as a relocation and an abrupt separation from their families, unfamiliarity with the university setting and culture, a lack of interest in their field of study, interpersonal difficulties, academic pressure,exam anxiety, and a lack of financial and welfare resources (13). Additionally, online education due to the COVID-19 pandemic may also have an impact on the students' academic performance. Some courses involve practical and laboratory workshops, and there are many courses to choose from, students don't have enough mobility and they must spend hours learning online. Many researchers examined an academic burnout using straightforward statistical correlations, they found, that the modeling facilitates a better and more precise understanding of interactions between various factors. The current study's objective is to use structural equation modeling to ascertain the association between students enrolled in virtual medical education and their capacity for problem solving, resilience, and their risks of academic burnout.

Hypotheses and research questions

1) Is there a correlation between academic burnout and problem solving ability?

2) Is there a correlation between problem solving ability and academic resilience?

3) What is the correlation between academic burnout and academic resilience?

Methods:

The present research is cross-sectional and descriptive. All master's students at Tehran's Shahid Beheshti University who participate in online education were recruited for the statistical analisis. Based on the research conducted by McCallum in 1999 (14), the sample size was estimated using the ratio of the sample size to the free parameter. According to it, the lower limit is five to one, the average is ten to one, and the maximum is twenty to one. The sample size for this research was determined to be 300; of the total number of issued questionnaires, 260 were fully completed and returned, and these were the questionnaires that were examined in this study.

The tool used:

Demographic Information Questionnaire: online questionnaire included demographic variables, such as age, sex, occupation and marital status, year and academic term.

Academic Resilience Questionnaire: Samuels created the academic resilience question-

naire in 2004. (15). The participants are asked to score their degree of academic resilience on a 5-point Likert scale, from strongly disagree (1) to strongly agree (3), in 41 items that make up the final form of this questionnaire (5). There are three parts to this scale. These elements include problem-solving abilities, an optimistic outlook, and communication skills. In 2012, Soltaninejad et al. standardized the current questionnaire in Iran (16). They found Cronbach's alpha coefficients in the student sample ranging from 0.62 to 0.76.

Academic burnout questionnaire:

The modified general version of the Maslesh burnout scale was used to assess academic burnout (17). In 2002, Schaufli and colleagues modified it (18). There are three subscales and a total of 15 items on the survey. Five questions are used to assess emotional exhaustion, four to assess doubt and pessimism, and six to assess intellectual self-efficacy. Every question is graded on a 7-point scale, with 0 being never and 7 being always (6). Academic burnout is indicated by high emotional tiredness, uncertainty, pessimism and low self-efficacy scores. For the female students of Isfahan University in 2013, Zainab Rostami conducted the standardization of this scale. The emotional exhaustion subscale had a Cronbach's alpha of 0.89, uncertainty had a 0.84, and self-efficacy had a 0.67. (19).

Problem solving ability questionnaire:

To measure problem solving ability, we use Hepner's problem solving skill survey, which was developed in 1988 (20). This survey asks 35 questions on a Likert scale with 6 levels, from fully agree (1) to completely disagree (6). 15 statements with negative connotations are presented and graded backwards to guard against fraud. The questionnaire's overall score is calculated by adding the scores of each response. 11 statements address problem-solving confidence; 16 statements address tendency-avoidance style; and 5 comments address personal control. Rastgo et al study in 2011 determined the reliability of this questionnaire, and the alpha coefficient for self-confidence in problem solving was 0.80, for welcoming or avoiding issue solving activities it was 0.78, and for managing emotions and behavior it was 0.70. (21).

Variables' normality test:

Kolmogorov-Smirnov test is used to examine and confirm the normality of the sample distribution and the data. The null hypothesis is rejected in this test if the P-Value decision threshold is less than 0.05, which suggests that the data cannot come from a certain distribution like the normal, Poisson, exponential, or uniform. All factors seem to be normal based on the findings, which are shown in Table 1.

Correlation test:

The next stage is to confirm that there is a meaningful link between the variables in order to verify the study hypotheses using the structural equation modeling approach, which is based on regression analysis. The Pearson correlation analysis will be applied since each variable is normally distributed. Table 2 lists the findings of the connection. If the correlation coefficient between two variables is less than 0.25, the correlation is deemed weak; if it is between 0.25 and 0.6, the correlation is deemed average; and if it is more than 0.6, the correlation is deemed strong. It implies that the two variables have a significant link.

Sample size adequacy test:

KMO (Kaiser-Meyer-Olkin) criterion shows whether a data set is enough for factor analysis. Kaiser-Mayer-Olkin index, KMO: this index must be above 0.7, although between 0.5 and 0.7 it is also acceptable with caution. Furthermore, Bartlett's test is to show the ability of the variables to act, and for this purpose, this test must be meaningful.

Fit of measurement and structural models:

The adequate fit of both measurement types and structural models is important to consider when using modeling structural equations. The components of the overall model that depict the link between manifest and latent variables are known as measurement models. Six measurement models for the first and second order hidden variables based on the conceptual frame-

work of this study are reflective, i.e., the obvious variables or survey questions explain the properties of the model's hidden variables. First, factor loadings and significant t-numbers for all obvious variables must be determined in order to start evaluating the fit of measurement models. There is no need to remove any of the obvious indicators or variables describing the measurement models because the coefficients of the factor loadings for all indicators are greater than 0.4, the significant numbers are greater than 1.96, and the relationship between the structure and the indicators is significant.

To assess the fit of the model, several indices were applied, including CFI and RMSEA.

The greater the comparative fit index (CFI), which ranges from zero to one, the better the model fits the data. RMSEA statistic, also known as the root mean square error of approximation statistic, may be used to measure how well a model fits the data. Another measure is the chi square to measure a degree of freedom ratio, or X2.df-1; if this ratio is less than 2, the model concidered well-fitted; if it is more than 2, the model concidered acceptable. Table 1 lists further useful indicators. Based on the Table's data, all of the acquired indicators are at a level that is acceptable, and the measurement and structural models fit together well (22—23).

Results:

260 students were evaluated using study scales for the current research. Of them, 247 questionnaires were examined, and 13 questionnaires were eliminated for lack of data. The participants' ages, which ranged from 35 to 49, were on average 40. Among them, 98.8% were married, 2% were single, and 71.1% of the participants were women. 23.07% of the respondents were in their second semester, with the remaining respondents being in their third semester or later. Additionally, 100% of the population was working, and those who did work, worked as nurses, midwives, doctors, public health workers, and laboratory scientists, respectively.

The link between the first and second was examined using Pearson's correlation coefficient, and the results are shown in the table. The results of the correlation study demonstrate a substantial corrlation between the research variables, and it can be said that all of the research variables have a significant relationship with one another at a confidence level of 0.99%. Additionally, it was determined that none of the variables' significance levels are above the error level of 0.01, allowing the correlation between the variables to be accepted.

Table 1

The results of descriptive statistics and indicators of reliability, normality of variables and adequacy of sample size

KMO test	BT test	Kolmogorov-Smirnov test	Cronbach's alpha	Mean and standard deviation	Variables
0.85	0.001	0.26	0.7	26.3 (5.6)	Academic self-efficacy
			0.7	7.5 (1.5)	Emotional exhaustion
			0.7	23.9 (5.3)	Doubt and pessimism
			0.85	57.8 (11.2)	Academic Burnout
0.77	0.001	0.14	0.7	41.3 (8.8)	Confidence to solve problems
			0.9	64.4 (14.2)	Tendency-avoidance style
			0.6	18.5 (4.4)	Personal control
			0.93	124.3 (24.9)	Hepner's Problem solving
0.91	0.001	0.48	0.8	48.7 (8.6)	Future orientation
			0.8	37.5 (6.8)	Communication skills
			0.7	23.4 (4.4)	Problem-oriented and positivity
			0.92	109.7 (18.6)	Academic resilience

X^2/DF and RMSEA statistics have numbers below 3 and 0.08 respectively, what indicates the good fit of the model. Due to the results of the modeling among the variables of academic burnout, academic resilience and Hepner's problem solving ability, it was found that the variable of academic burnout with problem solving skills (β = –0.77, p = 0.00), academic resil-

Table 2

Correlation coefficients between research variables

No		1	2	3	4	5	6	7	8	9	10	11	12
1	Emotional exhaustion	*											
2	Doubt and pessimism	.725**	*										
3	Academic self-efficacy	.612**	.564**	*									
4	Confidence to solve problems	-.625**	-.610**	-.432**	*								
5	Tendency-avoidance style	-.447**	-.426**	-.302**	.712**	*							
6	Personal control	-.511**	-.484**	-.339**	.741**	.670**	*						
7	Communication skills	-.456**	-.419**	-.295**	.672**	.764**	.625**	*					
8	Future orientation	-.495**	-.472**	-.373**	.681**	.739**	.621**	.821**	*				
9	Problem-oriented and positivity	-.391**	-.362**	-.279**	.598**	.671**	.579**	.830**	.749**	*			
10	Hepner's Problem solving	-.568**	-.546**	-.386**	.893**	.942**	.822**	.785**	.773**	.698**	*		
11	Academic burnout	.930**	.916**	.715**	-.663**	-.468**	-.533**	-.468**	-.524**	-.406**	-.597**	*	
12	Academic resilience	-.487**	-.454**	-.340**	.704**	.785**	.656**	.962**	.926**	.898**	.814**	-.506**	*

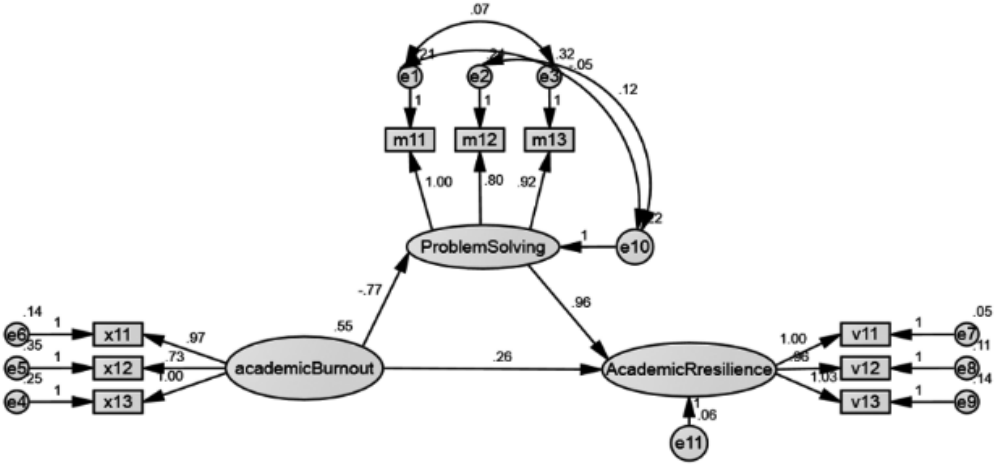

Figure 1- The final research model

Table 3

Model fit indices

Structural model	Recommended value	Fit indices
43.25		X^2
2.06	1—3	the ratio of X2 to degrees of freedom (X^2/df)
0.992	≥0.90	comparative fit index (CFI)
0.984	≥0.90	normed fit index (NFI)
0.986	≥ 0.90	Tuckere Lewis index (TLI)
0.052	< 0.08	Root mean of square error approximation (RMSEA)

ience (β = 0.26, p = 0.00) and problem solving skills and resilience statistically are pretty much related (β = 0.96, p = 0.00). Moreover, based on the results of mediating variable analysis, it was found that most of the correlations between academic burnout and academic resilience are indirect and via the mediating variable of problem solving skills (–0.871).

Discussion:

The goal of the current research was to examine the correlation between academic resilience, academic burnout and problem-solving skills among students enrolled in online medical education. via the mediation of problem-solving skills. It has an excellent fit based on the results of structural equation modeling, and the model's fit indices support it. We used positive fit indicators GFI 0.93, RMSEA 0.07, and other indicators, which were above 0.9. Bahrami et al. (2016) revealed that the model of the influence of perception of the classroom environment through academic resilience on academic burnout has a suitable value, which supports the results of the proposed model (1). The findings of the current study are compatible with the research of Abol-Maali et al., which also has strong fit indices of RMSEA 0.055 and GFI 0.94. (24). Aarabian et al.demonstrates the proper fit indices of the research model, and the RMSEA indices 0.069, GFI 0.95, suggesting the direct influence of problem-solving ability and its indirect effect through the mediation of resilience on lowering academic burnout. (25). According to the current findings, academic resilience and academic burnout have a substantial and inverse correlation. The research by Bahrami et al. (2015) discovered a substantial connection between resilience factors and academic burnout (1). Academic stresses have an impact on the factors of academic burnout, academic motivation, and academic resilience, according to a research by Yazdakhasi and Fazel (2015). They discovered that individuals with strong resilience preserve their psychological flexibility in challenging and bad circumstances, and as a result their productivity and job satisfaction grow(26). Hope, resilience, and emotional intelligence are negative predictors of academic burnout, according to research by Sadouqi et al. (27). The study of Viskarmi and Gashnigani (2017) concluded that academic resilience and cognitive adjustment strategies play a significant role in decreasing academic burnout (28). A study by Syprine Aoko Oyoo et al., a study by Liselotte N Dyrbye et al., and a study by García-Izquierdo M et al. also found similar results (29—31). Thus, it can be concluded that enhancing the level of resilience as well as training students and long-term planning to increase resilience will play a decisive role in decreasing academic burnout. In fact, those who are resilient can handle and even excel in challenging circumstances in life, and this quality helps them adjust to stressful events, increasing productivity and reducing academic burnout. Students that show more resilience are more efficient and feel more capable to overcome obstacles in their lives. Students who are more resilient are able to see problems as problems and feel less alone and forlorn. They search for alternatve solutions or methods to change the situation . Since optimism is one of the traits of resilient people, it helps these students, despite being in high-risk and traumatic environments, to not be mentally damaged and to look at problems in learning and problems in

life in a positive and optimistic way. This gives them a positive outlook and optimism towards life. Consequently, these individuals experience less academic burnout, show higher flexibility in challenging circumstances, and feel more productive and satisfied at work.

According to the results, problem-solving abilities and academic resilience are directly related in a substantial way. There was a positive and substantial linear connection that demonstrated the correlation and prediction of resilience and coping mechanisms in the research by Jess de la Fuente et al. published in 2017. These elements had a big positive impact on the university students' academic performance. (32). The results of a study by Coşkun et al. demonstrate that college students are quite flexible. Additionally, there were no discernible differences in university students' resilience levels according to their gender, grade level, monthly income, or housing options. But when it comes to a talent, job experience, academic success, potential professional growth, father's educational level, parenting style, and self-description, the results vary significantly in terms of resilience. Additionally, according to the average problem-solving score, university students have average problem-solving abilities. However, the Pearson correlation coefficient of 0.67 ($p>0.05$), calculated to see thecorrelation between students' resilience and problem-solving abilities, revealed a favorable and somewhat strong connectionbetween university students' resilience level and their problem-solving abilities (33). We could suggest that making effective use of students' social standing enhances their flexibility and resilience in social interactions.

According to ourresults, academic problem solving abilities and academic exhaustion are inversely related. According to a Shin and Hwang research, academic resilience is an important characteristic. Students who possess it are more likely to pursue their education and gain from initiatives that improve their social skills (35—34). The research ofArabian and colleagues, which is congruent with the current study, demonstrates the direct relationship between problem-solving skills and resilience (25). In Abol-Maali et al study likewise produced comparable outcomes (24). It should be taken into account that students who are better at solving problems perform better and with higher quality, are more productive, and are more motivated. This is true even when a cause of environmental stress is minimal and manageable. It can even make people happy and prevent problems. When a person believes that his professors and classmates are rooting for him and that he has an identity, he feels content and happy. This issue may also be brought on by the fact that a positive work environment boosts motivation and workers' performance. When high-level employees have a collaborative work environment, they will build more engaging relationships with one another. People who are experts at solving problems tend to cooperate well, act with motivation and interest, and project a positive image in the university setting. As a consequence, psychological pressure and burnout are reduced in this setting.

The corelation between academic resilience, academic burnout and problem-solving skills is effectively explained by the current study's theoretical model. Having effective problem-solving, resilience, and adaptability skills is one of the benefits. Social support, which reduces the student's emotional exhaustion and prevents him from feeling worried, is closely connected to his resilience and adaptability. Students also possess problem-solving skills and a sense of responsibility, which are related to competence, self-control, a desire to grow, and improvement. As a result, the student's consistency in responsibility and consciousness enable him to carry out his responsibilities well while he studies and finishes his job. He is also more likely to be engaged in his work, which reduces the possibility of burnout.

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Determinants of Blended Teaching-Learning Performance in New Normal Environment: Exploring the Role of Teachers' Technostress as Mediation

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This research desires to analyze the determinants of blended teaching-learning performance in the new typical environment by exploring the role of teachers' technostress as mediation. This study uses a quantitative approach. Quantitative research methods aim to test the hypotheses that have been set. This approach uses numerical results from measurements made using a questionnaire about the study's variables. Using the complete sampling technique, which involves selecting the whole population as the research sample, it consisted of senior high school teachers in South Sumatra. The researchers used 712 research data in this investigation. The research used the structural approach of the Equation Model (SEM) and the intelligent application of PLS for analysis. According to the outcomes of this investigation, understanding technical and pedagogical content has a considerable positive impact on blended learning and teaching performance and teachers' technostress. Teachers' self-efficacy has a considerable positive impact on combined learning-teaching performance and blended teaching-learning performance and is significantly mediated by teachers' technological stress. Teacher experience significantly impacts teachers' technostress and is mediated considerably by teachers' technostress. Administration and school support show a considerable positive impact on blended teaching and learning performance and teachers' technostress, which is significantly mediated by teachers' technostress. Teachers' technological stress has a large positive effect on combined teaching-learning performance.

Keywords: technological pedagogical content knowledge; teachers' technostress; blended teaching-learning performance; teachers' self-efficacy; teacher experience; administration school support.

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Детерминанты эффективности смешанного преподавания-обучения в новых условиях: исследование роли технострессa у преподавателей

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Цель данного исследования — проанализировать факторы, определяющие эффективность смешанного типа преподавания и обучения в новой типовой среде посредством изучения технострессa преподавателей. В данном исследовании используется количественный подход. Количественные методы исследования направлены на проверку выдвинутых гипотез. При таком подходе используются числовые показатели переменных, полученные по данным анкет. Был использован метод полной выборки, то есть было опрошено все население, в выборке участвовали учителя старших классов школ Южной Суматры, в результате было получено 712 анкет. В исследовании использовалось моделирование структурными уравнениями (SEM) и интеллектуальное приложение PLS для анализа данных. Согласно результатам исследования, понимание технического и педагогического содержания обучения оказывает положительное влияние на эффективность смешанного обучения и преподавания, а также на уровень технострессa учителей. Собственная эффективность преподавателей положительно влияет на эффективность и результативность процесса смешанного обучения и преподавания, существенно обусловлена наличием технострессa. На уровень технострессa влияет опыт, которым обладает преподаватель. Поддержка администрации и школы положительно сказываются на эффективности смешанного преподавания и обучения, уменьшают уровень технострессa учителей.

Ключевые слова: Технологический педагогический контент знаний; учительский технострессс; результативность смешанного преподавания-обучения; собственная эффективность преподавателей; преподавательский опыт; административная школьная поддержка.

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Introduction

Teachers hold various roles that must be carried out as a teacher. This part encompasses all activities undertaken by an individual or group to achieve the desired result. With the teacher's role, everything will work as it should.

The teacher's role in developing the quality of education is one of the steps that can be taken to improve and advance human resources. A *formal educational institution* is an educational institution that must be developed and fostered continuously. In this case, the teacher is essential in increasing student motivation in the teaching and learning process [1] [2]. The teacher is responsible for implementing the learning system so that it works well and has an essential role for students.

One way to develop the learning quality of teachers is by developing science and technology [3]. According to Wulandari (2018) [4], a teacher must understand and develop TPACK abilities, which eight PCK Shulman developed in 1986. According to Quddus (2019), [5] TPACK is knowledge for integrating technology into education. Shulman had already developed PCK in 1986. Pierson proposed incorporating technological knowledge into Shulman's PCK in 2001, which later evolved into the TPCK and was used as knowledge about technology integration in pursuits. In 2007, Mishra and Koehler proposed a new name for TPCK to become TPACK [6].

Mishra and Matthew J.J. Koehler founded TPACK in 2006 to accelerate the advancement of technology in society. Rapid technological advancements in society and a balance with technological change are the cornerstones of development [7]. According to Koehler (2009) [8], the foundation of TPACK is the integration of content or material with pedagogy and technology used in a setting. According to Suyamto (2020) [9], TPACK is the primary foundation for technology-enhanced teaching and necessitates understanding the constructive depiction of technology-enhanced concepts and technological methodologies. It is possible to overcome, assist, and alleviate challenges teachers and students face by using technology to teach a subject that is more challenging to understand.

Regarding the form of knowledge, the teacher's teaching experience also needs to assist students while learning [10]. Thus, it will ease the burden on experienced teachers to address student issues in the learning and teaching process relevant to the subject matter, and even teachers can inspire and foster student passion for learning. They can maximize the teacher's abilities [11]. Teachers need to be able to understand their abilities so that they can optimally channel their knowledge [12]. If a school aims to improve the quality of its education, it can do so not only by improving the quality of its teachers but also by providing administrative support. School administration is a series of processes consisting of controlling, managing, and managing various efforts to implement school goals.

Its original goals were to assess the performance of blended teaching and to learn in a school setting with the help of teachers and school administration. As a result, the title of this study was "Determinants of Blended Teaching-Learning Performance in the New Normal Environment: Exploring the Role of Teachers' Technostress as Mediation."

Theoritical review

Technological Pedagogical Content Knowledge (TPACK)

Technological Pedagogical Content Knowledge (TPACK) is an understanding that transcends the three categories of content, pedagogy, and technology. It is different from the knowledge that is discipline-specific or technological, as well as the pedagogical knowledge that teachers across disciplines possess [13]. Pedagogical Content Knowledge is a clear picture of how an educator teaches the subject matter, what is known about the students he teaches, what is known about the curriculum related to the subject, and what is used to teach the content of the material [14]. TPACK can be measured through the knowledge of pedagogical, content, technological, and technological content [15].

Teachers' Self-efficacy

According to Bandura (2010) [16], self-efficacy is the conviction that a person can plan out and carry out the tasks required to accomplish specific goals. Besides, Santrock (2012) [17] states that self-efficacy greatly influences behavior. A low-self-efficacy teacher

frequently gives up in trying circumstances. Meanwhile, a high-self-efficacy teacher will work harder to address current difficulties. Komarraju & Nadler (2013) [18] agreed, providing evidence that instructors' perceptions of their efficacy are critical in inspiring them to complete complex tasks to meet their objectives. Self-efficacy motivates us to set challenging targets and keep going when things get tough. According to Badura (2010) [16], teacher self-efficacy can be measured through the dimensions of magnitude, strength, and generality.

Teaching Experience

Teaching experience for a teacher is something precious. Teaching is not just a science of technology and art but also a skill. Teaching as a skill is the actualization of theoretical knowledge through the interaction of the learning and teaching processes. Teaching skills need to be owned and mastered by teachers in order to be able to carry out the interaction of the learning and teaching processes effectively and efficiently. Theoretical knowledge mastered by the teacher will be better if it is complemented by teaching experience [19]. According to Yin and Yun (2021) [20], teaching experience can be measured through social presence, setting the climate, teaching presence, selecting content, and cognitive presence.

Administration School Support

Facilities and infrastructure are essential educational tools to support education's success. Therefore, it is vital to have good education management, as it is said that a school can be successful or run smoothly if the management of facilities and infrastructure is good [21]. Administration school support can be measured through non-instructional support, nonpublic schools, and systemwide costs.

Teachers' Technostress

Due to the necessity of using ICT, technology stresses are prevalent in numerous fields, including computer science, ergonomics, education, business, and technostress. Previous research has demonstrated that technological stress negatively influences performance, health, and productivity [22]. Teachers' classroom roles are changing due to technological advancements and digitization procedures [23]. In this situation, teachers' attempts to implement technology into the teaching-learning process are all influenced by outside factors like educational policies, corporate management, communication, and collaboration with colleagues. They either need to be recognized for their efforts or fall short of expectations. They all show signs of technological stress [24]. Additionally, Efilti & Coklar (2019) [25] explains that the learning and teaching process, professional issues, technical issues, personal issues, and societal issues can all be used to quantify teachers' technological stress.

Blended Teaching-Learning Performance

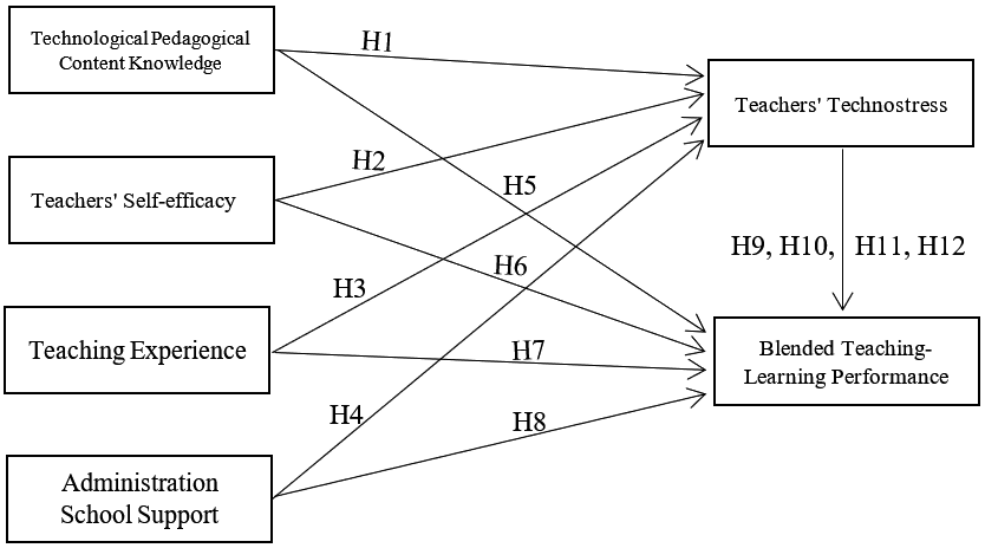
The combination of traditional teaching techniques, such as in-person and online instruction, is frequently referred to as "blended learning" [26; 27]. When it combines face-to-face instruction with computer technology, online and offline activities and materials, it is referred to as "blended learning" [28]. Izuddin (2012) [29] argues that blended learning is defined as a flexible method of instruction that uses the combination of traditional classroom instruction with online learning conducted through the usage of communication and information technology (ICT). According to [30], the elements of offering a straightforward explanation, developing fundamental skills, drawing conclusions, providing an additional explanation, and determining strategy and tactics are utilized to analyze the effectiveness of blended teaching and learning.

Research method

Research Design

Testing previously established hypotheses is the goal of quantitative research [31]. A quantitative methodology is used in this investigation. This approach uses numerical results

Thinking Framework



from measurements made using a questionnaire about the study's variables. They are employing a whole population sampling technique, which involves using the entire population as the research sample. The population utilized here consisted of senior high school teachers in South Sumatra. Researcher in this investigation used 712 participants. The structural approach of the Equation Model (SEM) and the intelligent application of PLS were used for analysis in this work [32].

Instrument Testing

Table 1

Instrument Testing

Instrument Test	Test used
Validity test	Convergent Validity AVE
Reliability Test	Cronbach Alpha Composite Reliability

R Square test

When evaluating the impacts of several independent latent variables on the latent dependent variable, the R-square for the dependent construct is utilized, which displays the magnitude of the influence.

Inner Model Analysis

When utilizing Smart PLS, the internal model analysis process involves testing the hypothesis in light of the t-statistical and probability values. The value of the t-statistic used to test the hypothesis, i.e., by applying statistical values, is 1.96 for an alpha of 5%, and the beta score is used to ascertain the direction of the influence of the link between variables. The following are the criteria for accepting or rejecting the hypothesis:

if t-statistic > 1,96 and p-values < 0,05, H is accepted;

if t-statistic < 1,96 and p-values > 0,05, H is rejected.

Results

Outer Model Analysis

Validity test

Convergent validity and AVE were used in this study's validity assessment. If the individual reflection measure correlates with the measured concept reaches more than 0,7, it is considered high (Dahri, 2017).

Table 2

Validity Test Results

Variable		Outer Loading	AVE	Information
Technological Pedagogical Content Knowledge (X1)	TPACK. 1	0.741	0.550	Valid
	TPACK. 2	0.729		Valid
	TPACK. 3	0.741		Valid
	TPACK. 4	0.756		Valid
	TPACK. 5	0.766		Valid
	TPACK. 6	0.749		Valid
	TPACK. 7	0.708		Valid
Teachers' Self-Efficacy (X2)	TSE.1	0.754	0.533	Valid
	TSE.10	0.705		Valid
	TSE.2	0.717		Valid
	TSE.3	0.727		Valid
	TSE.4	0.718		Valid
	TSE.5	0.724		Valid
	TSE.6	0.714		Valid
	TSE.7	0.729		Valid
	TSE.8	0.751		Valid
	TSE.9	0.756		Valid
Teacher Experience (X3)	TE. 1	0.778	0.533	Valid
	TE. 2	0.771		Valid
	TE. 3	0.763		Valid
	TE. 4	0.627		Valid
	TE. 5	0.701		Valid
Administration School Support (X4)	ASS. 1	0.534	0.523	Valid
	ASS. 2	0.711		Valid
	ASS. 3	0.761		Valid
	ASS. 4	0.723		Valid
	ASS. 5	0.675		Valid
	ASS. 6	0.767		Valid
	ASS. 7	0.750		Valid
	ASS. 8	0.815		Valid
	ASS.9	0.739		Valid
Blended Teaching-Learning Performance (Y)	BTLP. 1	0.711	0.513	Valid
	BTLP. 2	0.710		Valid
	BTLP. 3	0.714		Valid
	BTLP. 4	0.726		Valid
	BTLP. 5	0.713		Valid
	BTLP. 6	0.703		Valid
	BTLP. 7	0.732		Valid
	BTLP. 8	0.717		Valid
	BTLP. 9	0.717		Valid

Variable		Outer Loading	AVE	Information
Teachers' Technostress (Z)	TT. 1	0.767	0.590	Valid
	TT. 2	0.779		Valid
	TT. 3	0.789		Valid
	TT.4	0.780		Valid
	ST. 5	0.725		Valid

Reliability Test

Composite reliability quantifies a variable's true level of dependability. A composite reliability score greater than 0,7 indicates that the data is reliable.

The test results demonstrate that all items have a Cronbach's alpha value as well as a Composite reliability of > 0,7, which are considered reliable.

Test Convergent Validity after modification

After removing the indicators that didn't fulfill the requirements for the loading factor value, the findings of the PLS SEM model's measurement are shown in the following diagram. The study continues on to the discriminant validity test because, as can be observed in the diagram, the loading factor values for the indicators in every variable are not below 0,6.

R-Square Test

According to the data analysis completed with the help of the smartPLS application, the R-Square figures are obtained as depicted in the corresponding table.

According to the test results, the mixed teaching-learning performance (Y) has an R-Square score of 0,735, which demonstrates 73,5% of it is affected by the following factors: teacher experience (X3), teachers' self-efficacy (X2), teachers' technostress (Z), teachers' knowledge of technological pedagogical content (X1), administration school support (X4), and another 26,5% is impacted by factors excluded from this study. The findings indicate that the R-Square value for teachers' technological stress (Z) is 0,534. It further indicates that teachers' technological stress is impacted by teacher experience, teachers' technological pedagogical content competence, self-efficacy, school administration support, and other factors by 53,4% and 46,6%, respectively.

Hypothesis Test Results

The hypotheses can only be accepted or rejected if the t-statistic is more significant than the t-count. When utilizing probabilities to reject or accept a hypothesis, the hypothesis is accepted if the p score is higher than 0,05.

Table 5 shows that the p-value is 0,367 ($p < 0,05$), the t-statistic value is 0.903 ($t > 1,660$), and the beta score is 0,081, indicating H1 is accepted. In addition, the p-value is 0,000 ($p < 0,05$), the t-statistic is 3,576 ($t > 1,660$), and the beta score is 0,299, indicating that H2 is accepted. On the other hand, the results of testing the teachers' self-efficacy hy-

Table 3

Reliability Test Results

	Cronbach's Alpha	Composite Reliability
Administration School Support (X4)	0.884	0.907
Blended Teaching-Learning Performance (Y)	0.881	0.904
Teacher Experience (X3)	0.783	0.850
Teachers' Self-efficacy (X2)	0.903	0.919
Teachers' Technostress (Z)	0.826	0.878
Technological Pedagogical Content Knowledge (X1)	0.864	0.895

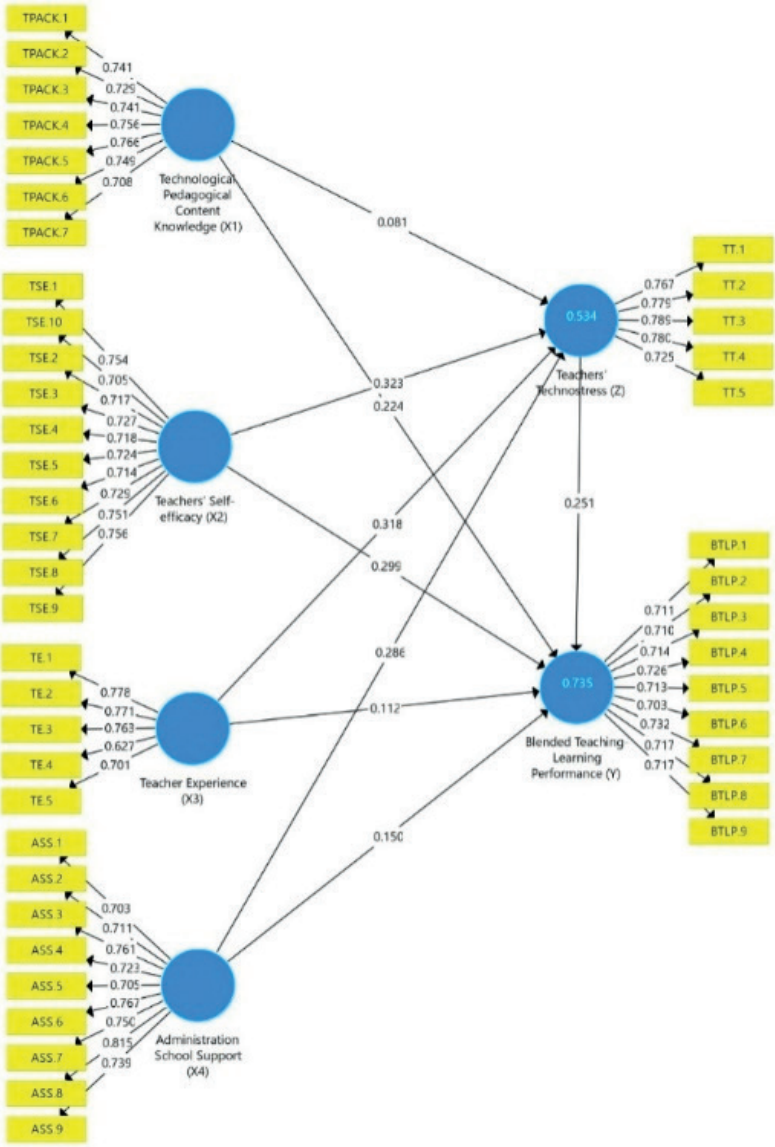


Fig. 1. Convergent Validity test after modification

Table 4

R-Square Test

	R Square	R Square Adjusted
Blended Teaching-Learning Performance (Y)	0.735	0.727
Teachers' Technostress (Z)	0.534	0.522

Table 5

Hypothesis Test Results

	Original Sample (O)	T Statistics (|O/STDEV|)	P Values
Administration School Support (X4) -> Blended Teaching-Learning Performance (Y)	0.150	1927	0.055
Administration School Support (X4) -> Teachers' Technostress (Z)	0.286	2,903	0.004
Teacher Experience (X3) -> Blended Teaching-Learning Performance (Y)	0.112	1,293	0.197
Teacher Experience (X3) -> Teachers' Technostress (Z)	0.318	3,257	0.001
Teachers' Self-efficacy (X2) -> Blended Teaching-Learning Performance (Y)	0.299	3,576	0.000
Teachers' Self-efficacy (X2) -> Teachers' Technostress (Z)	0.323	3,414	0.001
Teachers' Technostress (Z) -> Blended Teaching-Learning Performance (Y)	0.251	3,960	0.000
Technological Pedagogical Content Knowledge (X1) -> Blended Teaching-Learning Performance (Y)	0.224	2,327	0.020
Technological Pedagogical Content Knowledge (X1) -> Teachers' Technostress (Z)	0.081	0.903	0.367
Administration School Support (X4) -> Teachers' Technostress (Z) -> Blended Teaching-Learning Performance (Y)	0.072	2.123	0.034
Teacher Experience (X3) -> Teachers' Technostress (Z) -> Blended Teaching-Learning Performance (Y)	0.080	2,626	0.009
Teachers' Self-efficacy (X2) -> Teachers' Technostress (Z) -> Blended Teaching-Learning Performance (Y)	0.081	2,513	0.012
Technological Pedagogical Content Knowledge (X1) -> Teachers' Technostress (Z) -> Blended Teaching-Learning Performance (Y)	0.020	0.856	0.392

pothesis on teachers' technostress obtained a p-value of 0,001 ($p < 0,05$), a t-statistic value of 3,414 ($t > 1,660$), and a beta score of 0,323, indicating H3 was received. The results of the teacher experience hypothesis test on blended teaching and learning performance obtained a p-value of 0,001 ($p < 0,05$), a t-statistic value of 3,257 ($t > 1,660$), and a beta score of 0,318, indicating H4 is accepted. Then, the results of testing the teacher experience hypothesis on teachers' technological stress obtained a p-value of 0,197 ($p < 0,05$), a t-statistic value of 1,293 ($t > 1,660$), and a beta score of 0,112, indicating H5 is accepted. The results of the administration-school support hypothesis test on blended teaching and learning performance obtained a p-value of 0,055 ($p > 0,05$), a t-statistic value of 1,927 ($t > 1,660$), and a beta score of 0,150, indicating that H6 is accepted. The results of the administration school support hypothesis test on teachers' technological stress obtained a p-value of 0,004 ($p < 0,05$), a t-statistic value of 2,903 ($t > 1,660$), and a beta score of 0,286, indicating that H7 is accepted. The results of testing the teachers' technostress hypothesis on blended teaching and learning performance obtained a p-value of 0,000 ($p< 0,05$), a t-statistic value of 3,960 ($t > 1,660$), and a beta score of 0,251, indicating H8 is accepted. The results of testing the hypothesis of technological pedagogical content knowledge mediated by teachers' technostress on the blended teaching-learning performance obtained a p-value of 0,392 ($p > 0,05$), a t-statistic value of 0,856 ($t < 1,660$), and a beta score of 0,020, indicating H9 was accepted. The results of testing the teachers' self-efficacy hypothesis mediated by teachers' technological stress on blended teaching-learning performance obtained a p-value of 0,012 ($p < 0,05$), a t-statistic value of 2,513 ($t > 1,660$), and a beta score of 0,081, showing that H10 is accepted. The results of testing the teacher experience hypothesis mediated by teachers' technological stress on blended teaching-learning perfor-

mance obtained a p-value of 0,009 ($p < 0,05$), the t-statistic value is 2,626 ($t > 1,660$), and the beta score is 0,080, indicating that H11 is accepted. The results of testing the administration school support hypothesis mediated by teachers' technological stress on blended teaching and learning performance obtained a p-value of 0,034 ($p < 0,05$), a t-statistic value of 2,123 ($t > 1,660$), and a beta score of 0,072, showing H12 accepted.

Discussion

TPACK helps teachers in the learning process to make it easier to understand and can improve students' analytical skills [34]. The application of learning technology is carried out using strategies that combine material, technology, and learning strategies. The teacher carries out the learning process by integrating technology, lesson content, and learning strategies. In terms of learning technology media, for example, searching the internet for images that are relevant to learning materials and learning strategies. Another example of the use of learning technology is showing videos related to objectives and learning materials using laptops and projectors. The outcomes of an earlier study also indicated that the better the teacher's pedagogical ability, the higher the learning achievement of students [35]. This means that prospective teachers must improve their pedagogical abilities to have a variety of teaching strategies that focus on students [36]. Prospective teacher students' pedagogical abilities are critical in developing and increasing student confidence [37]. As a result, prospective teachers' self-confidence in their knowledge and skills is required to increase their readiness to become teachers later [38].

In addition, based on this research, the better the teachers' self-efficacy, the more it will affect teacher technological stress. Self-efficacy is the state in which a person believes that they can control the results of their efforts. Self-efficacy will influence how individuals interact with stressful situations [39]. Individuals with a high level of self-efficacy will always believe that they can carry out a task well and can find reasonable solutions if they have obstacles in doing their work. Magistra et al. (2021) [40] revealed that self-efficacy did not significantly affect technostress and vice versa. In addition, Siddiqui et al. (2022) [41] also explained that self-efficacy influences technostress.

The basic education taken by a teacher is one of the things that determines the quality of competence possessed. The level of competence possessed by a teacher grows in direct proportion to their level of education, because the higher the education obtained, the broader the academic knowledge possessed by the teacher. Therefore, in the end, they can increase their competence as teaching staff, and the more provisions the teacher has to carry out their duties, the more knowledge and skills related to the ability to carry out learning they will have. It will make the teacher more capable in his work. Furthermore Law et al. (2019) [42] defines that the more educated a person is, the more likely he is to succeed in his career.

According to the study, the greater the teacher's experience, the less this affects the teacher's technostress. It means that the longer a person pursues the profession of teacher, the higher the level of professionalism will be, and vice versa. The teacher's extensive role in education plays a vital part in determining the quality of educational outcomes. A teacher must not only be capable but also thrive in the classroom. One of the elements assisting in the implementation of academic activities is work experience. The amount of professional experience a teacher has will affect the learning goals students must achieve to achieve the school's goals. The teacher's tenure in performing his duties as an educator in a specific academic unit in line with an assignment letter from a recognized institution is the teacher's work experience (it can be from the government or community groups providing education). Thus, the more experience the teacher has, the less stressful it will be, according to Gupta et al. (2018) [43].

According to this study's findings, the better the administration and school support, the better the blended teaching and learning performance will be. Education administration alludes to a method for achieving educational objectives. Planning, organizing, directing, monitoring, and evaluating are the first steps in the process.

Planning involves deciding what has to be accomplished, how it will be accomplished, how long it will take, how many people will be required, and how much it will cost. This plan is made before an action is implemented. The primary job of teachers is to manage the teaching and learning process in a school environment, and all teachers should understand what is happening in their work environment. The process of planning, organizing, directing, coordinating, financing, and assessing curriculum activities, student affairs, buildings and infrastructure, school staff, finance, and school-community connections must be carried out by teachers in a proactive manner. All of this must be properly administered. Finally, the teacher's performance will be valuable if all actions are completed as effectively as possible. Thus, a teacher's performance will be even greater if they carry out their administrative tasks as honestly and effectively as feasible to enhance the effectiveness of mixed teaching and learning.

Conclusion

The current data highlight the importance of several variables that can significantly influence blended teaching and learning performance, with teachers' technological stress as a mediating variable. Therefore, it is hoped that schools will have a particular stress management program for educators and education staff so that blended teaching and learning can be done correctly. Further research must identify the characteristics influencing blended teaching and learning success. It is because the study had its limitations in that it only included a small number of variables, including administration and school support, teachers' technostress, teacher experience, technological pedagogical subject competency, and teachers' self-efficacy.

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Formation of Methodological Readiness for Mediation in Masters' Students of the Psychological and Pedagogical Faculties Using a Hybrid Learning Model

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The article analyzes the conceptualization of the phenomenon of "methodical readiness for mediation". It is a special case case that shows the professional readiness of educational psychologists to implement mediation in education. The article describes the results of an educational experiment on the methodological readiness of master's students using a hybrid learning model. The main idea of the study is that methodological training is a propaedeutics of professional readiness for mediation. The educational process is based on the principles of practice-oriented and event-based approaches. Students learn the basics of mediation in a hybrid learning form. The study defines the features of the formation of methodological readiness for mediation based on the principle of humanitarization and innovative use of the mediation approach in educational practices. 92 students pursuing a psychological and pedagogical master's degree at the Siberian Federal University (SibFU) in 2020—2023 were recruited for this study. The study offers methodological materials for mediation, which were developed and implemented by SibFU master's students during their professional preparation.

Keywords: mediator of social conflicts; methodical readiness for mediation; methodical creativity; educational psychologist; hybrid learning; digital transformation of education; humanitarization of education; digital portfolio.

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Формирование методической готовности магистрантов психолого-педагогического направления к медиации в условиях смешанного обучения

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В статье представлена проблема концептуализации феномена «методическая готовность к медиации» как частного случая профессиональной готовности педагога-психолога к реализации медиации в образовании. Описаны результаты педагогического эксперимента по формированию методической готовности магистрантов в условиях смешанного обучения. Основная идея исследования заключается в том, что методическая подготовка является пропедевтикой профессиональной готовности к медиации в целом. Организация образовательного процесса основана на принципах практико-ориентированного и событийного подходов и предполагает погружение магистрантов в основы медиации в условиях смешанного обучения. Определены особенности формирования методической готовности к медиации в условиях смешанного обучения, основанные на принципе гуманитаризации, обеспечивающие инновационность использования медиативного подхода в практиках воспитания. В опытно-экспериментальной работе приняли участие 92 магистранта Сибирского федерального университета (СФУ), обучающихся по программам психолого-педагогической магистратуры в 2020—2023 гг. Представлены методические материалы в области медиации, разработанные и реализованные магистрантами СФУ в ходе профессиональной подготовки.

Ключевые слова: медиатор социальных конфликтов; методическая готовность к медиации; методическое творчество; педагог-психолог; смешанное обучение; цифровая трансформация образования; гуманитаризация образования; электронное портфолио.

Финансирование. Исследование выполнено при финансовой поддержке краевого государственного автономного учреждения «Красноярский краевой фонд поддержки научной и научно-технической деятельности» в рамках научного проекта «Модель формирования медиативной компетентности педагогов в условиях поликультурного социума Енисейской Сибири», код заявки № 2022103008985 (КФ-920).

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Introduction

In the context of the development of digitalization of the education system and, in particular, its gradual transition to the stage of digital transformation, the role of blended learning in the organization of educational activities, updated by regulatory documents, is increasing (Strategy for the development of the information society in the Russian Federation for 2017—2030 [25], Strategy for scientific and technological development of the Russian Federation [26], Strategy for the development of the information technology industry in the Russian Federation for 2014-2020 and for the future until 2025 [14], Program "Digital Economy of the Russian Federation" [15], priority project "Modern digital educational environment in the Russian Federation" [9]).

Modernization of education in the conditions of the information society requires improvement of methodological approaches to the use of e-learning tools and distance learning technologies in the logic of digital transformation, implying a systemic update of the forms, methods, means and results of education, evaluating the latter in conditions of active use and development of the digital educational environment.

One of the consequences of the emergence of the information society is the emergence of new professions in the 21st century, which include the mediator of social conflicts. In the educational sphere, the position of mediator and curator of the school reconciliation service is occupied by teachers, educational psychologists, social educators and additional education teachers. With the advent of new functional responsibilities, the problem associated with the professional training of teaching staff in the field of mediation and restorative approach has become urgent for the implementation of mediation practices in the education system.

The relevance of the development of mediation as a resource for harmonizing interpersonal relationships is confirmed by the Professional Standard of a Teacher. Mastery of technologies for the prevention and resolution of conflicts is one of the pedagogical tasks and labor functions of an educator, which includes the formation of a culture of dialogue through discussions on problems related to the resolution of conflict situations; protecting the interests and dignity of students in a conflict situation, providing them with pedagogical support [12]. In accordance with the Professional Standard "Teacher-Psychologist (Educational Psychologist)", the specialist's knowledge in terms of conflict management training includes methods of managing socio-psychological safety and conflict resolution [13]. The Strategy for the Comprehensive Safety of Children in the Russian Federation for the period until 2030, approved in May of this year, identifies among the main tasks and directions in the field of ensuring safety in the children's environment the implementation of restorative technologies and the development of reconciliation services in educational organizations, countering the escalation of interfaith and interethnic conflicts among students [27].

Despite the demand for mediation in education, today there is no state educational standard for training mediators for the education system. The professional standard "Specialist in the field of mediation (mediator)" does not explicitly include the humanitarian and educational component of the activity of a mediator of social conflicts, which is characteristic of the professions

of a teacher and educational psychologist. Implicitly, the professional standard reflects aspects of the mediator's activity taking into account the specialized (educational) field, including restorative mediation in education, and also presents the interdisciplinary nature of mediation, integrating content from at least 4 areas:pedagogy, psychology, conflict management and jurisprudence.

Being a central component in the structure of a teacher's professional readiness, methodological readiness has an integrative nature, representing the unity of the theoretical and practical components of readiness to solve professional problems. However, in the context of mediation, methodological readiness as a subject of research has not previously been considered in scientific research, which determines the relevance of this study and confirms the advisability of choosing methodological readiness for mediation as a pedagogical category for consideration and conceptualization.

Features of the sample, means used and stages of the study

N.V. Lomonosov defines the system of blended learning for students as the interconnection of elements (administrative, methodological, technological and pedagogical support) aimed at solving social problems and implying taking into account the interests of students, while the basis of this system is electronic educational resources [7].

O.P. Polukhina reveals the essential characteristics of blended learning as a technology that promotes the effective formation of the personal and professional position of a bachelor's psychologist. A blended learning system is a teaching and learning system that includes interdependent methods and tools that make up a single whole, such as:

— telecommunications tools, web forums and web quests, video conferencing;

— heuristic teaching methods, collaborative learning, case studies;

— information resources [10].

In the context of blended learning, updating the problem of developing methodological readiness is justified, since the methodological component in the structure of a teacher's professional readiness ensures the effectiveness of mastering the content [24], and blended learning acts as a mechanism for influencing the effectiveness of the interaction of participants in educational relations with the content. Thus, we complement the educational potential of blended learning — as an external condition for promoting the effective development of educational content — with a methodological component in the structure of professional readiness — as a factor in ensuring the effectiveness of students' work with educational materials.

The pedagogical feasibility of integrating the principle of humanitarization and the didactic possibilities of blended learning in the context of the formation of methodological readiness is due to the fact that mediation is an interdisciplinary field of knowledge and has an integrative nature, just as blended learning integrates various models and ways of organizing the pedagogical process (independent learning, flipped classroom, rotational training, face-to-face training with web support, online laboratory, etc.). In addition, digitalization and humanitarization today are among the leading and mutually determining trends in the development of the education system. Methodological readiness, in turn, also has an integrative nature in the structure of professional readiness; it is a set of knowledge, skills and personality traits associated with the possibilities of implementing various types of methodological activities [24].

Review of master's programs in mediation [20; 21] revealed the scarcity of devel-

opments and methodological materials for training professional mediators for the education system, taking into account the specifics of the implementation of multicultural education.

The pedagogical experiment was carried out in the process of training master's students in the psychological and pedagogical direction of the Institute of Pedagogy, Psychology and Sociology of Siberian Federal University. The sample of this study consisted of 92 people (42 people in the control group and 50 in the experimental group).

The study was conducted from 2019 to 2023. in three stages. At the first stage (2019—2020), a multidimensional analysis of the literature and legal documentation on the problems of the work was carried out, the relevance of the chosen topic was confirmed, the methodological apparatus of the study was determined, and the essence of the methodological readiness of master's students in psychological and pedagogical directions for mediation was clarified. At the second stage (2020-2023), educational and methodological tasks and the content of expert assessment were developed and tested for the formation and assessment of the methodological readiness of master's students in psychological and pedagogical areas for mediation in the context of blended learning. At the third stage (2023), experimental work was completed, the results of the expert assessment of the electronic portfolio of undergraduates were processed.

Analysis and discussion of research results

In the study by A.S. Chupris defines readiness for mediation as a universal personal competence, including:

— experience in conducting mediation meetings;

— a complex of cognitive and predictive abilities for processing information about the mediation process, for recognizing and preventing negative emotional reactions of negotiators;

— ability to use mediation appropriately;

—emotional and value-based attitude to the democratic style of communication and participation in the conciliation procedure [30].

Based on this work, as well as research by scientists devoted to the formation of mediation competence and ensuring readiness for pedagogical (R.G. Redun) [17] and online mediation (O.G. Smolyaninova, E.A. Alekseeva) [1], methodological readiness is considered in this study as a special case of readiness for mediation and professional activity in general, in the structure of professional and methodological competence (R.V. Ryumin, R.V. Ardovskaya) [18], defined in a general sense as an activity characteristic motivated the ability of a teacher-psychologist to methodologically support the educational process based on mediation material, i.e. reflects the methodological nature of the formation of the components of readiness for mediation activities. Methodological activity acts, in essence, as a propaedeutic of readiness for mediation in general, which is pedagogically appropriate and significant due to innovative content of the restorative approach and mediation, the heterogeneity of the contingent of master's students with different life, professional and educational experiences, all this actualizes the task of primary value-semantic understanding master's students in mediation and the restorative approach, which determines his professional position [5].

Clarifying the range of methodological tasks of a teacher in the aspect of mediation and restorative approach is advisable on the basis of analysis and synthesis of unified legal acts that reflect the state and social order for conflict management training of teaching staff. A comparative analysis of the Federal State Educational

Standard of Higher Education 3++ in the direction of 44.04.02 Psychological and pedagogical education (master's degree) [11], the Professional Standard "Teacher-Psychologist", as well as the Professional Standard "Specialist in the field of mediation (mediator)" made it possible to identify their relationship in aspect of the theoretical prerequisites for methodological readiness for mediation, which is not directly indicated in legal acts, but is implicitly reflected in the relationship of educational results and labor functions with each other, the actualization of mediation. The relevance of preparation for mediation is confirmed by universal and general professional competencies and labor functions in the specified regulatory documents. In accordance with them, the professional and methodological tasks of a teacher-psychologist in the aspect of mediation and restorative approach in education involve not only the organization and conduct of the mediation procedure and the conclusion of a mediation agreement (A/01.6, A/02.6, A/03.6, B/01.7, B /02.7), since this is, in essence, a subject area of training.

From the point of view of methodological activities and, accordingly, the methodological direction of preparation for mediation, the tasks of a teacher-psychologist are associated with a critical analysis of problem situations and the development of a strategy for resolving them (UK-1), the use of modern communication technologies (UK-4) and effective psychological and pedagogical technologies for individualization of education (GPC-6), taking into account intercultural diversity in social interaction (UK-5), self-organization and self-development of a teacher-psychologist (UK-6), compliance with professional ethics and the provisions of legal acts in professional activities (GPC-1) , designing individual and group educational activities of students (GPC-3), creating conditions for the spiritual and moral education of children and youth (GPC-4), organizing interaction between educational subjects (GPC-7), methodological support of educational activities (A/01.7), examination of the safety and comfort of the educational environment (A/02.7), psychoprophylaxis and psychological correction of behavior and development of students (A/07.7, B/04.7), education of participants in educational relations (B/01.7).

In 2020—2023 We designed and implemented the content of methodological preparation for mediation within the framework of psychological and pedagogical master's programs, which is divided into three stages. The theoretical prerequisite for building a methodological system of preparation for mediation was the distribution and integration of disciplines, practices and original methodologically oriented modules in the structure of master's training disciplines (Table 1). The logic of the distribution and interconnection of the components of educational activity implies the mastery of disciplines in integration with practical training in 1—4 semesters, prolonged for the entire period of study in the master's program. Integration and, as a consequence, the interdisciplinary nature of training are ensured through practice-oriented educational and methodological tasks that activate the creative potential of educational psychologists in the development of methodological support for the educational process, its implementation within the framework of semester-long distributed practice, rich in educational events. The effectiveness of methodological training was ensured by combining various models of blended learning: independent work on educational and methodological tasks; mastering educational and methodological materials on preparation for mediation in the format of electronic, asynchronous learning; a combination of full-time and distance learning, optimal use of Internet support resources.

Table 1

Contents of methodological preparation for mediation with undergraduates Psychological and pedagogical orientation

Stage	Name of the discipline in the curriculum	Semester	Name of integrative methodologically oriented modules in the structure of the discipline/practice	Practice-oriented educational and methodological tasks
1	Legal and ethical foundations of professional activity	1 semester	"Mediation culture in the professions of a teacher and educational psychologist", "Mediation as a resource for the development of human ecology"	Development of a group creative mediation project as an interdisciplinary brand (corporate style of multicultural mediation in Yenisei Siberia; atlas of the profession of social conflict mediator)
	E-portfolio in presentation and recognition of achievements	1 semester	"E-portfolio and imageology of a teacher-mediator"	
		3rd semester		
	Ethnopsychology and practices of multicultural mediation in Europe	1 semester	"Mediation in education in the multicultural society of Yenisei Siberia"	
2	IT in professional activities	2nd semester	"Mediation in the context of digital culture, cyberbullying"	Development of a group methodological project "Pedagogical design of Olympiad tasks on mediation and multicultural education for schoolchildren in grades 10-11"; development of information and educational resources to support career guidance work at the end of the project (network community for children and adults in social media, posting, chatbots on mediation terminology and navigation of universities teaching mediation, as a means of educational work)
	Peer Mediation	2nd semester	"Pedagogical support and career guidance for peer mediators"	
3	Practical training — introductory, teaching practice, Research, technological (design and technological), pre-diploma internship	1—4 semesters	Elements of all the above modules	Development of a questionnaire, survey or test in accordance with the theoretical and methodological foundations of mediation (*1 semester, research work*)
				Preparation of abstracts and participation in a conference with a report on mediation (*2nd semester, research work*)

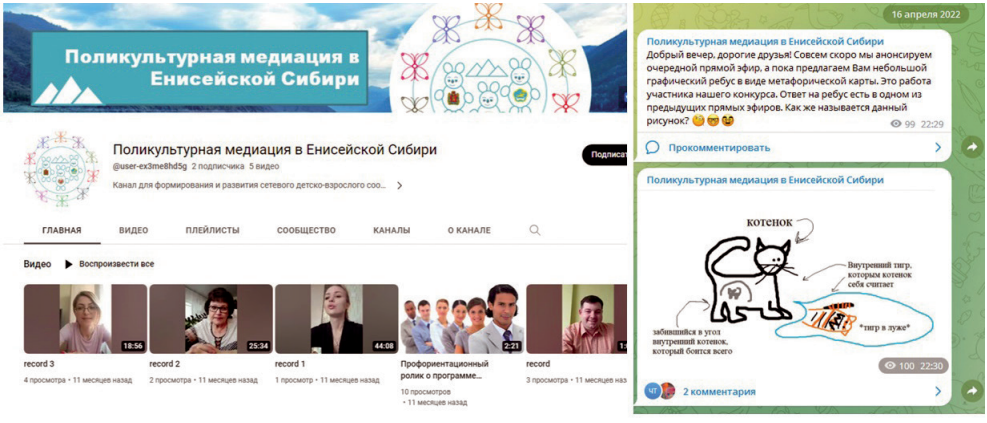
Stage	**Name of the discipline in the curriculum**	**Semester**	**Name of integrative methodologically oriented modules in the structure of the discipline/practice**	**Practice-oriented educational and methodological tasks**
				Development of an individual project to accompany a student as part of his participation in the school section on mediation at an international conference — analysis of a video recording of the speech and drawing up methodological recommendations for promoting the personal and educational growth of the student in the aspect of mediation; support for the preparation of teams of peer mediators for a competition to develop web quests on mediation topics and the subsequent development of methodological recommendations for improving the organization of creative work of students at the intersection of ICT and mediation (*3rd semester, technological practice*)
				Participation in playing, solving and methodically understanding cases on the topic of intercultural conflicts in education in the conditions of Yenisei Siberia (within the framework of the interregional case championship in mediation, *4th semester, pre-diploma practice*)
State final certification in the format of presentation and defense of an electronic portfolio professional and methodological achievements				

As part of mastering the methodologically oriented module "Pedagogical support and career guidance for peer mediators", students created and put into practice a collective project "Pedagogical design of Olympiad assignments in mediation and multicultural education for schoolchildren in grades 10-11", structured in the MOOC [8]. From a psychological and pedagogical point of view, the master's students in the project passport justified the choice of the age category of the intended participants in the Olympiad, associated with the transition of leading activities from intimate and personal communication to educational and professional activity, which occurs at a given age. In accordance with this, the structure and topics of assignments are determined in a general cultural, interdisciplinary logic that promotes successful professional socialization in the field of mediation at the level of conceptual thinking.

Since in the second semester, in addition to the discipline "Peer Mediation", the course "Information Technologies in Professional Activities" was implemented, the project described above was of a prolonged nature. The continuation was the creation and development in social services of the network child-adult community "Multicultural mediation in Yenisei Siberia" (Fig. 1) [19], uniting peer mediators and teacher-mediators from the macroregion of Yenisei Siberia. Master's students played the role of community moderators, selected speakers for live broadcasts, were engaged in posting, selecting thematic content for publication and discussion.

The design and implementation of educational events was preceded by the development in the first semester of the value-semantic foundations of mediation and the restorative approach within the framework of related modules of methodological training "E-portfolio and imageology of a teacher-mediator", "Mediation culture in the professions of a teacher and educational psychologist", "Mediation as resource for the development of human ecology", "Mediation in education in the conditions of a multicultural society of Yenisei Siberia".

As a resource for online support of educational activities, the electronic portfolio is a recognized and resource-intensive means of blended learning and acts as a tool for authentic student assessment. An electronic portfolio is a pedagogically appropriate means of humanitarizing meth-



Rice. 1. Fragments of the interface and content of the online community for children and adults created by undergraduates as part of their methodological training

odological training in the logic of digital transformation. Since its content is not only a representation of a professional and personal image, but also educational and methodological material that is mastered, simultaneously created, and improved during training, implemented in the context of the digital culture of self-presentation on the Internet, in the format of a digital trace with background, reflection on education and life path professional, personalized artifacts of professional and methodological activity in the form of labor products and achievements.

From the position of imageology and, accordingly, social branding as a resource for humanization, an electronic portfolio can be considered as a means of forming and developing digital identity. As well as broadcasting the value and semantic parameters of the branding object. Therefore, as part of the first stage of methodological training, students were immersed in the basics of mediation and the restorative approach, including through simulation branding of mediation, in particular, the implementation of a group creative project in the format of developing a corporate style for multicultural mediation in Yenisei Siberia (Figure 2). Master's students developed brand books in electronic document format [4; 28], where, in addition to visual constants, they defined the value-semantic parameters of mediation as a social, educational and cultural brand, that is, in interdisciplinary logic; The features of the professional portrait of a mediator were determined (Fig. 2). As a conceptual basis reflecting the values and principles of the restorative approach, most typical for mediation in the education system, the undergraduates chose the philosophical parable "Everything is in your hands", and from there they also borrowed the butterfly symbol to develop the visual component of the brand and slogan — as the basis for understanding the role mediator in the formation of the subjective position of the parties to the conflict regarding the conflict interaction.

Humanitarianization as a condition for the effectiveness of methodological training determines the interdisciplinary aspects of mediation in the structure of the methodological readiness of a teacher-psychologist, and is ensured not only through the integrative nature of the training content, but also through the implementation of the logic of digital transformation in the conditions of blended learning, expressed in the use of Internet support resources and an electronic

Rice. 2. Fragments of group projects to develop a corporate style for multicultural mediation in Yenisei Siberia and an booklet explaning what is mediator of social conflicts as a profession, reflecting the value and semantic parameters of mediation as an object of branding

portfolio in interdependence with the content of education and its development.

In addition to the examples described above, which, from the point of view of the systemic logic of digital transformation, reflect the rather indirect nature of its implementation for preparation in mediation, and are associated with the development and understanding of the psychological and pedagogical aspects of the mediator's activity as a methodologist. As part of their training, master's students also purposefully developed practice-oriented methodological resources aimed at solving professional and methodological problems, taking into account the interdisciplinary aspects of mediation. Since one of the components of methodological readiness (in particular, theoretical and methodological) is directly related to the tasks and mission of master's training in terms of solving applied problems in professional activities using scientific methodology, then, for example, in the first semester, within the framework of research practice, master's students it was necessary to develop and test diagnostic tools aimed at solving one or more professional and methodological tasks of a mediator in an educational organization, such as:

— professional socialization of schoolchildren in the field of mediation;

— humanitarian examination of the socio-psychological safety of the educational environment;

— study of ideas about the mediator profession and mediation as an interdisciplinary brand;

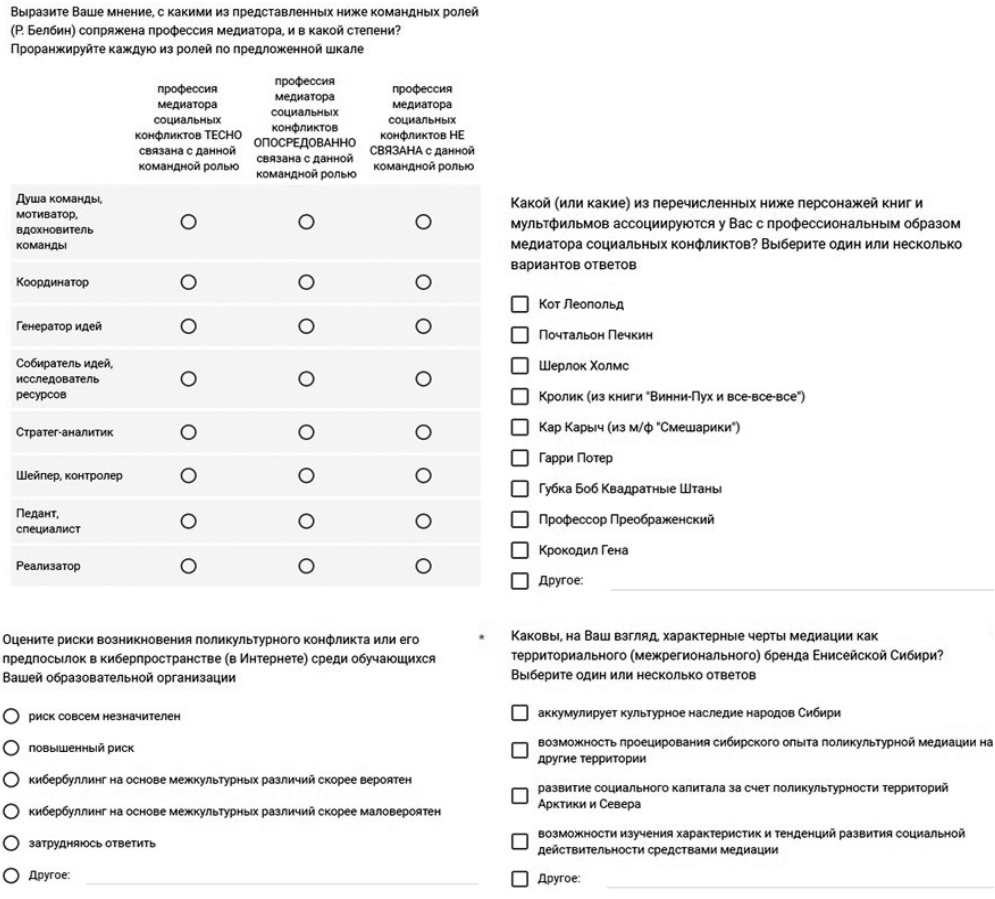
— monitoring the activities of school reconciliation services in the focus of multiculturalism and cyberbullying;

— psychological and pedagogical education in the field of mediation.

Examples of the content of questionnaires and questionnaires [2; 3], developed by undergraduates, are presented in Fig. 3. For example, future educational psychologists studied the ideas about mediation among subjects of the educational process, in particular, associative series and characters from works of art were selected for questions, taking into account the value-semantic parameters of the mediator's activity. As part of their research practice, students prepared reports and theses on mediation for the International Conference [16].

In the second semester, students, while solving educational and methodological problems, developed chatbots on the subject of mediation as a means of methodological support of the educational process, in particular the activities of the online child-adult community described above. Today, a chatbot is one of the most interesting and promising forms of content implementation, including in the context of blended learning, as it represents an example of the effective and interactive use of artificial intelligence and machine learning technology, which, due to its conversational interface, makes it possible for automated mediation between students and content [6], which expands the opportunities for self-education inherent in master's programs. For example, master's students developed a practice-oriented chatbot using the terminology of the mediation approach, which can be used within the framework of psychological and pedagogical education [29].

Pedagogical support of peer mediators, acting as a propaedeutic of methodological support and a condition for mastering it, was implemented over a long period of time, both in the second and third semester. As part of the technological practice, students provided individual and group pedagogical support for the participation of talented schoolchildren in specialized mediation competitions — within the framework of an international conference, a city team competition of web quest projects (online communities, chat bots, websites, etc.). Based on the subsequent analysis of video recordings of schoolchildren's speeches at the conference [31] and the products of ac-



Выразите Ваше мнение, с какими из представленных ниже командных ролей (Р. Белбин) сопряжена профессия медиатора, и в какой степени? Проранжируйте каждую из ролей по предложенной шкале

	профессия медиатора социальных конфликтов ТЕСНО связана с данной командной ролью	профессия медиатора социальных конфликтов ОПОСРЕДОВАННО связана с данной командной ролью	профессия медиатора социальных конфликтов НЕ СВЯЗАНА с данной командной ролью
Душа команды, мотиватор, вдохновитель команды	○	○	○
Координатор	○	○	○
Генератор идей	○	○	○
Собиратель идей, исследователь ресурсов	○	○	○
Стратег-аналитик	○	○	○
Шейпер, контролер	○	○	○
Педант, специалист	○	○	○
Реализатор	○	○	○

Какой (или какие) из перечисленных ниже персонажей книг и мультфильмов ассоциируются у Вас с профессиональным образом медиатора социальных конфликтов? Выберите один или несколько вариантов ответов

- ☐ Кот Леопольд
- ☐ Почтальон Печкин
- ☐ Шерлок Холмс
- ☐ Кролик (из книги "Винни-Пух и все-все-все")
- ☐ Кар Карыч (из м/ф "Смешарики")
- ☐ Гарри Потер
- ☐ Губка Боб Квадратные Штаны
- ☐ Профессор Преображенский
- ☐ Крокодил Гена
- ☐ Другое:

Оцените риски возникновения поликультурного конфликта или его предпосылок в киберпространстве (в Интернете) среди обучающихся Вашей образовательной организации

- ○ риск совсем незначителен
- ○ повышенный риск
- ○ кибербуллинг на основе межкультурных различий скорее вероятен
- ○ кибербуллинг на основе межкультурных различий скорее маловероятен
- ○ затрудняюсь ответить
- ○ Другое:

* Каковы, на Ваш взгляд, характерные черты медиации как территориального (межрегионального) бренда Енисейской Сибири? Выберите один или несколько ответов

- ☐ аккумулирует культурное наследие народов Сибири
- ☐ возможность проецирования сибирского опыта поликультурной медиации на другие территории
- ☐ развитие социального капитала за счет поликультурности территорий Арктики и Севера
- ☐ возможности изучения характеристик и тенденций развития социальной действительности средствами медиации
- ☐ Другое:

Rice. 3. Examples of diagnostic tools in the field of mediation, developed by undergraduates as part of research practice in the first year

tivity created as part of a team competition [23], undergraduates developed methodological recommendations to ensure the effectiveness of promoting the development of schoolchildren in the field of mediation, the effective organization of creative work of students at the intersection of mediation and digital technologies.

In the final, fourth semester, master's students, as part of practical training, took part in the interregional case championship in mediation, playing and resolving cases reflecting the problems of intercultural conflicts in education in the multicultural society of Yenisei Siberia (using the example of the characteristics of the indigenous peoples of the North) [22] . Questions for solving the case were aimed not only at the substantive component of the mediator's work in resolving the conflict, but also at the methodological understanding of cases on conflict topics.

Methodological preparation for mediation included the accumulation and recording of learning results in an electronic portfolio in the form of products of educational and methodological activities and artifacts

confirming the acquired professional and methodological experience, participation or victory in an educational event. Based on the electronic portfolio, the level of methodological readiness of undergraduates for mediation is assessed upon completion of training, during the state final certification.

The maturity of methodological readiness within the framework of the pedagogical experiment was diagnosed through an expert assessment of the electronic portfolio of each graduate of the psychological and pedagogical master's program. Traditionally, a level approach to scaling results was used (0-20 points according to the criterion). The expert assessment sheet contains 5 assessment criteria directly related to methodological readiness for mediation, respectively, the maximum possible score is 100:

— the portfolio of achievements acts as a resource and information base for the implementation of practical activities (OPK-1), includes practice reporting materials reflecting the specifics of interaction with participants in the educational process, social partners in solving research problems, its leadership functions in conducting experimental work (OPK -7);

— contains scientific (articles, monographs, abstracts), educational, methodological and information publications, documents confirming participation in research projects (OPK-2);

— includes developed and used methods for organizing educational activities, psychological, pedagogical and methodological support for the implementation of basic and additional educational programs, diagnostics of children and students (PC-1, PC-5);

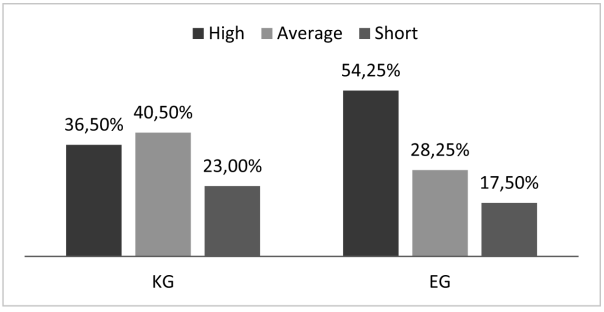
— contains reports on research work demonstrating awareness when conducting research work, the ability to provide psychological counseling to subjects of the educational process (PC-3), includes artifacts demonstrating the ability to self-educate, see one's own professional prospects and build a career, awards for the results of research work (UK-6);

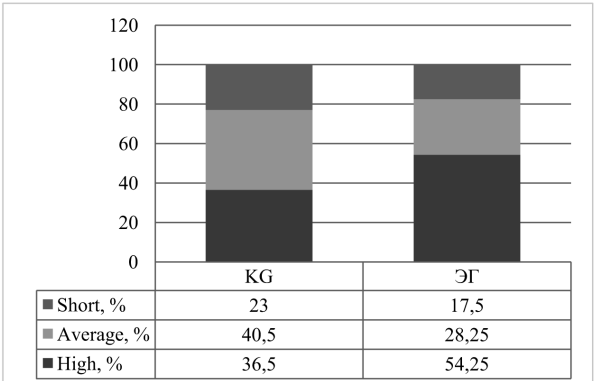
— contains practice reporting materials showing mastery of methods of psychological education of subjects of the educational process (PC-6), the ability to provide psychoprophylaxis (PC-7) [11].

The results of the expert assessment of the portfolio in the control groups (CG) and experimental groups (EG) are clearly reflected in Fig. 4 in percentage terms, and demonstrate significant differences in the data of the pedagogical experiment in the CG and EG. In particular, a high level of formation of methodological readiness for mediation prevails in the experimental group, and an average level in the control group. In addition, the low level of readiness in the EG is lower in percentage terms than in the CG. The data obtained indicate the effectiveness of developing the methodological readiness of undergraduates in psychological and pedagogical areas for mediation in the conditions of blended learning.

Conclusion

In modern conditions, the contradiction between the demand for mediation in education and insufficient scientific understanding, legal and methodological support for its implementation in the context of education is becoming more urgent. Therefore, the targeted formation of methodological readiness of master's students in psychological and pedagogical areas for mediation is justified and makes it possible to ensure the pedagogically appropriate use of mediation for the prevention and resolution of conflicts between subjects of the educational process. The phenomenon of methodological readiness in relation to conflict management training is of a proactive nature and is associated with the solution of professional and methodological tasks to harmonize the psychological climate of the educational environment. At the same time, consideration of methodological readiness as a subject of research requires interdisciplinarity in the





	KG	ЭГ
Short, %	23	17,5
Average, %	40,5	28,25
High, %	36,5	54,25

Rice. 4. Formation of methodological readiness, CG and EG

study of this pedagogical phenomenon, taking into account the specificity of the field of mediation and the professional position of the mediator of an educational organization, integrating the functions of a teacher, methodologist and mediator.

As part of this study, a methodological approach was developed to prepare undergraduates in psychological and pedagogical fields for mediation, which is based on the integration of the principle of humanitarization and blended learning technology. Methodological readiness is an integrative, activity-based characteristic of the personality of a professional mediator, expressed in his ability to design and solve professional and methodological problems, taking into account the interdisciplinary aspects of mediation. It is formed and revealed in methodological creativity, in the design and implementation of methodological activities. It is advisable to determine the range of professional and methodological tasks of a mediator of an educational organization through the competencies and labor functions enshrined in the Federal State Educational Standard for Higher Education 3++ in the direction of 44.04.02 Psychological and pedagogical education (master's degree), Professional standards of a teacher-psychologist and mediator.

The conducted research represents one of the options for developing a promising theoretical and practical problem of methodological preparation for mediation; it does not pretend to be a complete disclosure of all aspects of the topic raised. The described theoretical and practical developments can be extrapolated and continued by other educational organizations.

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Digital Storytelling as a Means of Education and Formation of Spiritual and Ethical Values in Adolescence (on the Base of Classic Literature Material)

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The article presents the results of the study that identifies the possibilities of applying activity technologies in education to create digital stories for the purposes of formation of spiritual and ethical values in adolescents. The study took place in March, 2023, on the basis of MBOU SOSH school No. 4 in Kashira town, 38 schoolchildren of the 7th grade aged 13—14 years old took part in it. As part of the study, during three sessions 9 cartoons were created in the stop-motion animation technique, they were based on the literary material of A.P. Chekhov. The article presents an analysis of the production process of animation products creation, it also discusses the aspects of the formation of spiritual and moral values while creating cartoons. The article also focuses on the empirical data that demonstrate the peculiarities of the adolescents' perception of joint activities when working on cartoons and according to the degree of motivation for the activity. The study proves the effectiveness of the use of practices for creating digital stories by adolescents for establishing interpersonal communication, appropriating moral and prosocial behavior patterns, developing interest in classic literature, and creative self-realization.

Keywords: drama; moral (value) education; digital storytelling; stop-motion animation; adolescents; classic literature; spiritual and moral education.

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Цифровой сторителлинг как средство воспитания и формирования духовно-нравственных ценностей в подростковом возрасте (на примере литературного материала)

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В статье представлены результаты исследования, посвященного изучению возможностей применения деятельностной технологии по созданию цифровых историй в целях духовно-нравственного воспитания подростков. Исследование проходило в марте 2023 г. на базе МБОУ СОШ № 4 г. Каширы, в нем приняли участие 38 школьников 7-х классов в возрасте 13—14 лет. В рамках исследования в течение трех занятий были созданы 9 мультфильмов в технике stop-motion анимации на основе литературного материала А.П. Чехова. В статье представлен анализ творческого процесса создания анимационных продуктов, рассмотрены особенности формирования духовно-нравственных ценностей в процессе создания мультфильмов. Также представлены эмпирические данные, демонстрирующие особенности восприятия совместной деятельности по работе над мультфильмами в зависимости от степени мотивации к деятельности. Доказана эффективность применения практик по созданию цифровых историй подростками для налаживания межличностной коммуникации, присвоения нравственных и просоциальных моделей поведения, развития интереса к классической литературе, творческой самореализации.

Ключевые слова: цифровой сторителлинг; stop-motion анимация; подростки; классическая литература; духовно-нравственное воспитание.

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Digital storytelling in an educational aspect

Today, digital storytelling has become an integral educational practice in both higher education and schools [8]. In education, digital storytelling is seen as a pedagogical technology that involves delivering the content of education in the form of a story with its typical structure and components (introduction, development of events or con-

flicts, climax, resolution), but with a focus on digital visualization and the use of digital tools. Though digital stories can take forms of multimedia presentations, documentary films, animated videos, infographics, web publications, etc. The advantages of digital storytelling in education include its memorable narrative due to emotional impact, effective delivery of information, presentation of a large amount of material in a concise, dynamic, and visual form, stimulation of motivation for learning and individualization of education [5]. Digital storytelling is often used in school to develop ICT and communication skills, linguistic and intercultural competencies, critical and creative thinking, multimodal and functional literacy [17; 18].

Currently, it is passive storytelling that predominates in Russian pedagogical practice. It implies the teachers' use of digital stories to support and visualize their explanations, simplify communication with "digital natives" or teach online. According to this approach, teachers use technology to enhance their own speech, while students are supposed to be attentive viewers and listeners[1]. At the same time, it can be assumed that more effective practices involve active storytelling, when it is students themselves who become authors of stories, whereas the teacher's role is to articulate the initial event or a problem to develop in the plot as well as to control the process of creating a story and evaluate results. In this approach, the teacher imparts not only explicit knowledge but also "hidden" knowledge — skills that are difficult to assess or distinguish but the ones that encompass a range of acquired skills (communication skills, self-regulation, reflection, logical thinking, etc.). The most convenient form of implementing active digital storytelling is through project-based work [1]. Digital storytelling projects can address one or several academic disciplines, establish interdisciplinary connections, bring together different groups, and contribute to the formation of prosocial behavior.

However, it should be noted that despite the growing interest in digital storytelling in the educational context, it is still rarely used by Russian educators as a tool for character education, particularly for the purposes of spiritual and moral values formation.

Digital storytelling and classic literature

Spiritual and moral education in secondary school not only stands for students' integration into society, but also encompasses the formation of a communicative and empathetic personality, which is characterized by such qualities as *kindness, mindfulness, responsibility, respectfulness, empathy,* and *willingness to help*. Spiritual and moral education also aims at "realizing the moral and aesthetic value of literature". Classic literature serves as a "guide and manual" for shaping moral ideals and value orientations [3; 6; 13, p. 1321]. However, contemporary teenagers have shown a decline in interest in reading, partly due to a lack of understanding of moral ideals and orientations presented in classic literature [9, p. 253]. In addition, according to N.N. Kaznacheeva, today's youth is characterized by "the contradiction in the formation of value orientations that causes a slow internalization of values, which leads to the phenomenon of moral infantilism that results in social immaturity" [4, p. 20]. Among the reasons why teenagers refuse to read are: the trend towards simplification, the prevalence of visual culture, the preoccupation with social media and self-presentation, the preference in reading hypermedia texts rather than classic literature

[1] Digital storytelling. Opportunity to develop skills in modern technologies, creativity and imagination URL: https://ug.ru/czifrovoj-storitelling/

texts [10; 14; 15].

To address this situation, a systematic solution is required, such as expanding a variety of educational systems and pedagogical technologies[2]. *Digital storytelling* could be considered as a tool to help teenagers pay attention to classic literature, analyze it from a spiritual and moral perspective, form their own value orientations as a mature and cultural personalities.

It is worth to mention that in recent years digital storytelling has been actively developed for the purposes of school literature classes. Students are encouraged to prepare essays, writers' biographies reports, simulated interviews, virtual excursions, and book trailers (creative videos by students with reviews of the books they have read) in digital format [5]. To increase the range of active digital storytelling practices as well as to explore the ways of integrating ICT into the educational process for the spiritual and moral development of contemporary teenagers, a study was conducted as part of the project "Teenage Theater as an Activity Technology of Upbringing and the Formation of Spiritual and Moral Values". It was carried out on the basis of the Center for Interdisciplinary Research of Contemporary Childhood, MSUPE, the research objectives were:

- studying teenagers' perception of digital storytelling as a new creative practice and experience;
- assessing the educational potential of active digital storytelling and evaluating its role in the moral development in contemporary teenagers;
- examining the impact of digital storytelling on teamwork within project-based activities;
- assessing the acquisition of new digital competencies;
- evaluating readiness for artistic reinterpretation and presentation of spiritual aspects of classic literature in digital format;
- identifying difficulties in the process of learning digital storytelling.

Research design

The research was conducted in March, 2023, on the basis of school № 4 in Kashira town, Moscow region; 38 teenagers aged from 13 to 14 years old took part in it. The teenagers were divided into two groups:

- *unmotivated teenagers* (17 students from the 7th "A" class, characterized by detachment, conflicts, weak academic achievements, lack of motivation for new types of activities);
- *motivated teenagers* (21 students from the 7th "V" class, distinguished by friendly relationships within the class, high performance and involvement in school life).
- During three sessions (1.5 hours each), the teenagers created 9 cartoons that were included in the final performance of the project — in the play "Who Are You, Mr. Chekhov?". After finishing the cartoons, the teenagers filled in:
- a questionnaire "How I created a cartoon", consisting of 10 mostly open-ended questions, aimed at revealing their roles in the creative process; self-assessing contribution to the teamwork, analyzing the difficulties of realization of ideas and implementation of plans; evaluating the value of the acquired experience;
- reflexive diaries, the purpose of which was to reveal the teenagers' emotional attitude to the activities on animation production, their reflexive observations of their own progress, changes in the teammates.

The results of the surveys were processed with the use of descriptive statistics and qualitative analysis.

[2] Order of the Government of the Russian Federation No. 996-r from May 29, 2015 "On approval of the strategy of development of education in the Russian Federation for the period until 2025".

Stop-motion animation for upbringing and educational purposes

As a literary basis and reference for digital stories the teenagers chose short stories and words of wisdom (quotes) by A.P. Chekhov, since the educational potential of his texts has been noted by researchers [6; 16]. They created cartoons in the stop-motion technique, which presents frame-by-frame animation. Its production involves sequential shooting of photographs with further montage of these photographs into a video or animated story [12]. This technique was chosen due to its simplicity. For teenagers it is both easy to understand and use for artistic self-expression, also it allows to work in groups of 3—5 students and create creative products relatively quickly. The plan of work (stages) is shown in Fig. 1.

Fig. 1. Stages of cartoon creation process with the use of stop-motion animation technique

Considering the specifics of the activities, the main criteria to assess the educational achievements and the results of formation of spiritual and moral values were figured out, they are [7]:

spiritual and moral interpretation of literary material;

established relationships between students and students as well as students and teachers, based on mutual understanding, respect and cooperation;

organization of students' independent work (interest, motivation, consciousness, self-assessment, reflection, self-realization, self-determination and etc.);

students' mutual assistance (willingness to help, patience, sensitivity, respect).

The sessions were conducted in accordance with the indicated goals, the content of the sessions is presented in the table 1.

While teaching the sessions, the educators created and implemented the personality-developing situations: teenagers had to organize their activities without adults' help, distribute equipment (tripods, lamps), share tools and craft materials, assign responsibilities for different types of activities and actions, formulate the moral "core" of their stories and critically assess achievements.

Analysis of the cases on creating animation

From a pedagogical point of view, spiritual and moral education is a multi-stage work. Within the framework of the process of cartoons creation, these stages included [2]:

• *formation of ideas about values* — analysis and discussion of literary material, inventing a plot and characters, thinking over the moral foundations for characters, their motives and etc.;

• *consolidation of values in the structure of the personal value system and formation of readiness to act in accordance with them* — development of effective communication in teams, formation of responsibility for task fulfillment, acting independently from teachers (self-organization), expression of empathy, helping the "lagging behind";

• *practical activities based on previously formed values* — self-control of behavior, the spread of developed behavioral models to both school life and daily life.

According to the assessments by teachers, who worked with teenagers during the sessions, the project participants started experiencing difficulties already at the stage of analyzing the moral value of the literary material. Also, they couldn't interpret the essence of what they were reading. Thus, the most active teenage team took on the making a cartoon based on the short story "Enemies" by Chekhov. This story raises the question of a doctor's duty and responsibility. "Enemies" tells about the moral conflict between two characters, a doctor, whose only son has just died because of the illness, and his visitor, Mr. Abogin, a selfish and manipulative person. Mr. Abogin is of a higher social status; his fake grief turns out to be a farce and mortally insults the doctor as he is suffering from the real loss. Initially, the story was perceived by teenagers only as a certain sequence of events and characters' actions ("the external level of the story"), they justified Abogin's actions by the fact that any doctor, whose service is paid, has to obey and do his job, neglecting his own dignity, demands and feelings. During their work on the cartoon, teenagers not only repeatedly analyzed the text of the story, but also researched the writer's biography and letters, watched the film adaptation directed by Yu.P. Egorov (1960). As part of this work, the teenagers discussed and in collaboration interpreted such concepts as "humanity," "vulgarity," "offense," and "human cruelty," which were initially completely incomprehensible to them. The teenagers carefully worked on the story's characters, focusing attention on their motives and emotions. Such practice was useful for the teenagers as later they incorporated their experience in the final play of the project. They played themselves the episode with the doctor and his visitor on the school stage.

Table 1

Characteristics of digital storytelling sessions

	Goals and tasks	Content of the activities	Formed values
Session 1. Pre-production stage	1.1. Getting acquainted with stop-motion animation. 1.2. Formulating the plot or the main idea of the cartoon. 1.3. Visualizing the plot with the use of digital storytelling technique (including the selection of means of artistic expression to enhance the morality of the story). 1.4. Conflict-free teamwork, development of patience towards others' opinions.	1.1. Self-organize into teams, choose literary material for digital story (for the unmotivated teenagers — Chekhov's quotes (words of wisdom) previously studied and discussed; for the motivated teenagers — one of the Chekhov's short stories — «Enemies», «The weakling», «The Rook», «Surgery»). 1.2. Learn how to convey the text/ verbal content through a visual image — formulate the idea of a cartoon, create a brief script and a storyboard. 1.3. Distribute responsibilities among the team members.	1. Orientation on moral values and norms in situations of moral choice, with an evaluation of the characters' behavior and actions in literary works, readiness to assess one's own behavior and actions, as well as the behavior and actions of others from the standpoint of moral and legal norms, taking into account the awareness of the consequences of actions; active rejection of antisocial actions, freedom, and personal responsibility in the context of individual and social space[3]. 2. Development of moral feelings (honesty, duty, justice, parliament and friendliness), development of empathy and maintaining a positive attitude towards people, supports positive life guidelines and planning[4].
Session 2. Production stage	2.1. Designing a situation of a moral choice for the cartoon character, the moment of his decision-making and analyzing its consequences. 2.2. Developing a critical view of the digital story, analyzing the integrity and logic cohesion of the statement. 2.3. Conflict-free teamwork, developing patience towards others' opinions.	2.1. Draw preliminary sketches, backgrounds and characters, minding their movable body parts and elaborated ideas. 2.2. Shoot the first frames/ photos of the cartoon. 2.3. Redraw, correct or finish characters (puppets) and the backgrounds if there were misfortunes and mistakes during shooting. 2.4. Shoot photos in reversible technique according to the approved plot. 2.5. Try to montage the photo-material to assess the quality and correctness of it. 2.6. Re-shoot the photo-material if necessary.	
Session 3. Post-production stage	3.1. Improving ICT competencies. 3.2. Increasing teenagers' unity, solidarity and social integration. 3.3. Developing the habit of completing what has been started, training for responsibility for work outcome. .	3.1. Choose the necessary musical accompaniment or sounds. 3.2. Think up hashtags, a name of the cartoon, characters' lines, comments and subtitles. 3.3. Edit cartoons in the InShot application. 3.4. Critically assess the work done (whether moral content of the cartoon is clear). 3.5. Conclude and analyze the goal achievement. Discussion.	

[3] ПОrder of the Ministry of Education of the Russian Federation No. 993 from November 16, 2022 "On approval of the basic federal educational program. general education", p. 101.

[4] Order of the Government of the Russian Federation No. 996-r from May 29, 2015 "On approval of the strategy of development of education in the Russian Federation for the period until 2025".

Besides misunderstanding the characters' feelings and misinterpreting the essence of the moral conflicts, the teenagers also consider some moral statements (words of wisdom) incomprehensible. For example, the quote "An idle life cannot be pure" by A.P. Chekhov confused the teenagers, as they believed that the word "idle" does not have a negative connotation. What is more, the teenagers believed that if people were resting 24/7 and enjoying pleasures, they were truly happy, though such way of living cannot be considered as meaningless or lead to harmful consequences for both individual and society. One more example of such mixing up the meanings is animated interpretation of Chehov's quote "Life is like a flower, growing luxuriantly in the field: a goat comes, eats it and there is no flower". Teenagers again saw it as an ability to live a life joyfully and fully rather than the fragility of life and brutality of actions that can take it away in a moment. After some analysis and discussions, the team of teenagers created a cartoon, showing a person's foot stepping on a flower, struggling to grow on the meadow under the sun, and totally destroys it. This plot, in their opinion, reveals carelessness towards the surrounding world, including living nature, though they reflected the idea of the quote quite directly and failed to recognize a metaphor. Interestingly, in the teenagers' team, worked on this quote, there were two competing leaders who could not agree with each other . However, another girl later joined them and since then all the team started working productively and managed to complete the cartoon. The situation suggests that the teenagers themselves were able to cope with instability themselves and emerge from it, showing friendliness and determination.

One more case of two boys S. and D., who used to stay apart from their classmates before the project, demonstrates the similar positive impact of participation in cartoon-making project on interpersonal communication. Their learned helplessness led to the fact that in the first session they even did not start working, as they had not had prepared for it properly, though they could not even ask for help or borrow craft materials from the classmates. They also did not dare to approach the teachers, it was difficult for them to form a request. Had discussed the problems in the second session, they finally chose the quote to work on. It was "There is no better reward than the peace paid with work", which they initially interpreted as the need to earn a lot of money to be able to relax and chill out. As a result, the boys came up with a plot about building a public bath/sauna, where after hard work on its construction not only the builder, but also other people could have a rest. However, during the work, it turned out that the boys did not get along with drawing and cutting out operations due to underdeveloped motor skills. They were very ashamed of their inability. With the teachers' help the boys explained the problem and asked the girl A. to join the team. Not only three of them completed the work but also became friends and now support relationships in free-of-school time.

Among other plots on a moral choice of cartoon characters in a problematic situation, the most striking one was the plot due to which teenagers help a young mother who does not have enough physical strength to drag the stroller with a newborn into the porch. This episode reflected the quote "While young, strong and full of life, do not stop doing good things". Another cartoon showed a story in which a pedestrian indifferently watches as a hooligan breaks a snowman, made by a child. As a punishment for indifference to the observed actions of bulling and injustice, the pedestrian turns into a huge black hole. The idea arose on the basis of the quote "Indifference is the paralysis of the soul and a premature death". Thus, *the analysis of some animated plots confirms that the cartoon project participants after discussions and team work in the sessions demonstrated*

a tendency to create social advertising, reflect on their experience, develop their own pro-social behavior, which resulted in decrease in conflicts in their daily school life as a whole. In addition, personal changes in the team members were noticed by both the project participants and even those teachers who did not take part in the project but continue teaching these teenagers. For instance, Mrs Hegai, a teacher of Russian Language and Literature, noted that "the teens, involved in the project, have become more confident in answering during her lessons, their motivation for learning and self-esteem increased as well".

Adolescents' perception of digital storytelling as a form of collaborative activity

Despite the fact that, when working on cartoons, the majority of teenagers in both subsamples experienced difficulties in joint activities and communication, by the end of the sessions the greatest dynamics in establishing relationships were observed among unmotivated teenagers. In their reflective diaries not once they noted that they learned to "work in a new company", "communicate normally with classmates", "negotiate and come to an agreement with other guys."

These changes were also confirmed by the empirical data. *Unmotivated teenagers to a greater extent saw in the cartoon creation activities an opportunity to make friends with classmates and unite* (23% of the unmotivated teenagers and only 6% of motivated teenagers) (Fig. 2). In their turn*, motivated teenagers saw more opportunities for development and personal growth*. Thus, they largely noted that they were able to discover new talents and interests in themselves (35% and 47% of unmotivated and motivated teenagers accordingly) and get acquainted with new creative activities (29% and 41% of unmotivated and motivated teenagers accordingly). The largest number of teenagers in both samples mentioned that, thanks to digital storytelling sessions, they were able to become better acquainted with works by Anton Chekhov (35% and 58% of unmotivated and motivated teenagers accordingly). This means that during sessions the largest number of teenagers paid attention specifically to the literary and semantic aspect of the activities.

Reflecting on the question whether animation experience would be useful in the future, unmotivated teenagers mostly answered "I don't know" or "it will be useful at work," while motivated teenagers thought about more realistic prospects. They as-

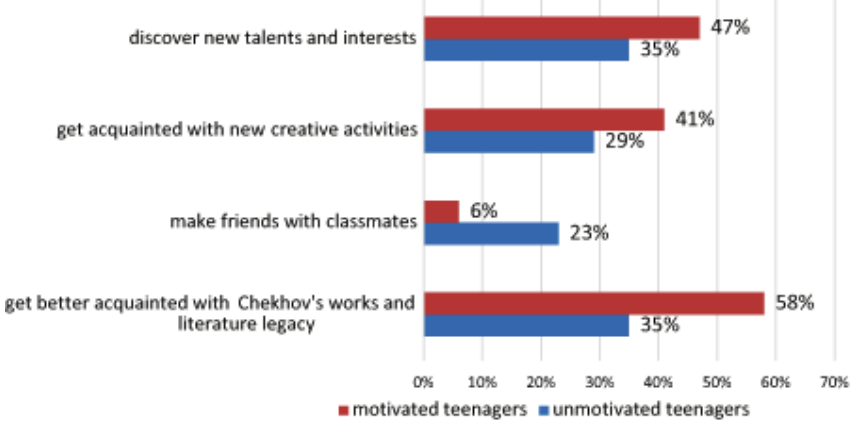


Fig. 2. The teenagers' assessment of the results and value of digital storytelling activities

sumed that they would be able to implement their obtained knowledge “in creating projects at school”, in such classes as “Technology and Fine Arts”, “in some other creative activity”, they would also be able to “help children in the future”, etc.

In both subsamples the empirical study demonstrated a difference in teenagers’ motives and in the assessment of their animation activities. A quarter of motivated teenagers noted that they achieved their goals and completed assignments in class, but not a single teenager from the subsample of unmotivated teenagers noted that they completed the work to the end. At the same time, the majority of unmotivated teenagers answered that they could produce cartoons (45% of the subsample) or were ready to try (22% of the subsample) (Fig. 3).

Interestingly, absolutely all motivated teenagers noted that they felt passionate while working on cartoons (100%), among unmotivated teenagers this number reached 71%. At the same time, 22% of unmotivated teenagers experienced frustration and dissatisfaction with themselves, 7% of unmotivated teenagers felt fear that they would not be able to cope with working on cartoons, that they would not succeed. Also, after digital storytelling sessions, 43% of unmotivated teenagers experienced fatigue, while none of such students were found among motivated ones. Also, among motivated teenagers, a significantly larger number of project participants perceived animation activities positively and would like to develop in this direction (75%), while only 36% of unmotivated teenagers would agree to continue producing cartoons (Fig. 4).

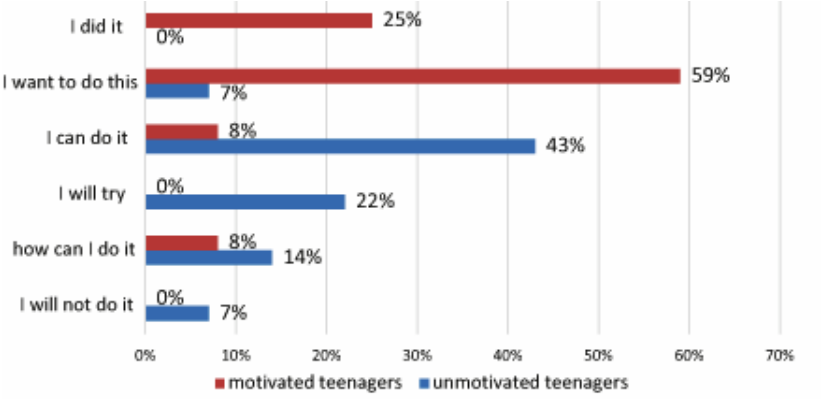
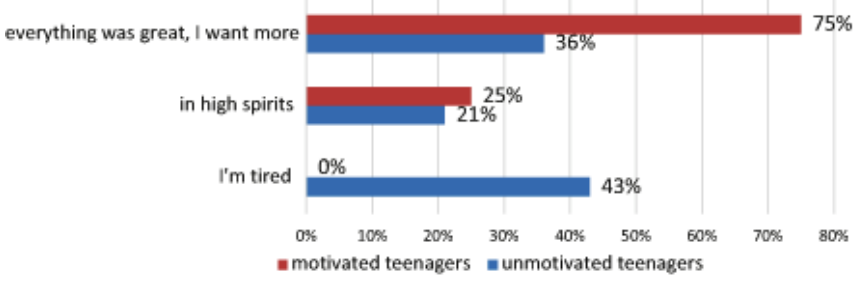


Fig. 3. Teenagers’ attitudes towards digital storytelling classes



Pic. 4. Emotional perception of activity on digital storytelling production

Conclusions

The received data shows that digital storytelling as a practice-oriented pedagogical technology allows to solve a wide range of tasks from establishing interpersonal relations to creative development of teenagers. The mechanism of creating digital stories not only helps to develop digital competencies, understand the moral essence of classic literature, express one's opinion and attitude towards the studied problem, but also offers a range of opportunities to reduce conflicts among peers, instill moral traits in them and make teenagers confident in their abilities. While working on digital stories, based on literary material, regardless of team cohesion and motivation, such experience contributes to the formation of spiritual and moral standards of teenage behavior and the development of their pro-social active positions. Also cartoon creation activities increase discipline in a team as well as form such personal qualities as responsibility, goodwill, sociability and meaningfulness, etc. In addition, this pedagogical technology is perceived positively by teenagers, since teenagers promote its practical application in their school and extracurricular life, using skills of digital storytelling for personal purposes (for example, for promoting themselves and their products on the Internet, developing relationships with peers, etc.). Thus, digital storytelling meets the needs of the society (for the purpose of spiritual and moral education of youth), the state (as a new pedagogical technology), and teenagers themselves (as a way of socialization and solving psychological problems specific to their age and developmental stage).

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Man of Activity

To the 75th Anniversary of Vitaly Vladimirovich Rubtsov

On October 20th, Dr. Vitaliy V. Rubtsov celebrates his 75th anniversary. Dr. Rubtsov is a founder, the first dean, the president of MSUPE, and the head of the International UNESCO Chair on “Cultural-historical Psychology of Childhood” (MSUPE). Vitaly Rubtsov is a leading scientist, a specialist in general psychology, pedagogical and age psychology, an academician of RAO Rubtsov began, under the guidance of Dr. Vasiliy Davydov, to study the problem of cooperativeness in solving physical tasks and created a new scientific direction in sociogenetic psychology. He investigated the determination of developmental processes in learning by social relationships between children and adults, he created a concept of new forms of child-adult sociality in education. He investigated the formation of the individual subject within the collective subject, investigated the correlation between the transformation of the collective subject and rising learning independence, initiative, arbitrariness, and freedom among other students. The traditional school tries to make the content and form of learning accessible for children's (and adults') minds, and cultivates "delayed" development; the school is not ready to change. Such a conclusion is made by Vasily Davydova. A school (class, group) that sees itself as a place for the transfer of knowledge, skills and abilities, rather than as a potential collective subject that seeks, tries, and transforms, full of initiative from children and adults. Such a school cannot become a child-adult community. This is a conclusion from the works of Dr. Rubtsov in continuation of Vasily Davydov's ideas. How to create a developing learning community of children and adults as individuals within schools — it's the main problem that solves Rubtsov and his followers.

Starting in the late 1980s, Vitaly Rubtsov initiated and developed many educational projects, from the informatization of education to the creation of educational standards for teacher training.

For the first time, a wide range of psychologists who had previously been assigned to "service" functions (diagnosis, counseling, etc.) were recruited for this work. These were the psychologists from the Psychological Institute of the Russian Academy of Education, which Rubtsov headed for more than 20 years, and the MSUPE "on the shoulders of the scientific schools of the Institute" (Rubtsov's expression). The dispute about which approach is better — the activity or non-activity approach — was resolved in the practical sphere, where Rubtsov's team designed educational programs. Rubtsov developed educational practices in learning, games, and other types of activities. In order to transform social practices, it is necessary to develop these practices as a transforming activity. It is pointless to "transform" anything from the outside. If we wish to achieve the developmental effects of education, then the models of education themselves should be constructed as "development of activity" (V.V. Davydov). Following this logic, Dr. Rubtsov conceived and created our university, MSUPE, and continues to work on it. MSUPE is a peculiar world of activities. Students get introduced to it from the very beginning, and the more they learn, the more they understand how activities are organized. According to the idea of Dr. Rubtsov, there should be no borders between fundamental knowledge (theoretical thinking), "application of knowledge" (theoretical thinking in order to obtain new knowledge), designing (the project is a theoretical way of transforming reality), and organization of activity (it is a cooperation of the actions of participants; "understanding of the essence of the matter" is a component of theoretical design). As far as we know, such a model of university education has no analogues. A few years ago, Vitaly Rubtsov gave an interview for the MSUPE video project "Psychologist-and-Me: Living Stories". When he was asked, what his dream was, he answered: “I dream of building a school. I dream about it, because I know how to do it. I know how to teach children to learn. That's what schools are for”. There was the wisdom of a scientist who, having created a scientific school and the university, came to the most difficult task: to be a school teacher.

He, in the words of Martin Heidegger, "must have the capacity to be more teachable than the students. The teacher is much less certain of his rationale than those who learn. If the relations between the teacher and his subject are healthy, then there is no room for the authority of omniscience or a personal authoritarian position. In such a case, becoming a teacher is a sublime vocation, which is in some ways quite different from becoming a famous professor. But this can be deeply understood only by the "famous professor," i.e., the scholar. As he realizes himself to be a teacher he, at the same time, is able to assume the changing position of the student in teaching. It is difficult to answer the question of who has it harder. We can only give an example of the "coincidence of positions" of scientist, teacher and student, as Vitaly Rubtsov does, following the ideas of his teacher Vasily Davydov. He could work in there positions cheerfully, energetically, and youthfully; it's a gift and a condition for new accomplishments. A gift is always a burden, which you can't share with others, although, in the end, this gift is meant for them. And it is a lucky vocation.

We congratulate Vitaly Rubtsov on his anniversary and wish him many years, good health, strength, and the mood to follow his vocation.

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