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PSYCHOLOGICAL ASPECTS OF HYPERSTIMULATION AND REDUCED COGNITIVE FLEXIBILITY IN DIGITALLY DEPENDENT CHILDREN

Abstract

The present article reveals the problems of hyperstimulation and reduced cognitive flexibility in elementary school children, arising in them as a result of digital addiction, and presenting serious challenges for the individual and society as a whole. The key concepts of "hyperstimulation", "cognitive flexibility" and "digital addiction" are defined from the point of view of psychology and pedagogical psychology, which allowed to form a structural basis for a deep understanding of this problem. The factors influencing the occurrence of digitalization-induced hyperstimulation in children and reducing their cognitive flexibility are disclosed. The main mechanisms of influence of digital environment on children's cognitive functions are described and the most important psychological consequences are established. It is established that children are significantly involved in the digital environment in their free time from school classes. It was revealed that the main reactions to the restriction of access to digital devices were slight dissatisfaction or indifference and only 4% of children could immediately agree not to use a gadget. The conducted experimental study confirms the need to develop and implement special programs and activities aimed at reducing hyperstimulation and increasing cognitive flexibility in digitally dependent children. Some directions for further work and specific recommendations are proposed.

Keywords: hyperstimulation, cognitive flexibility, digital addiction, elementary school students, digital devices.

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САНДЫҚ ТӘУЕЛДІЛІК ЖАҒДАЙЫНДА БАЛАЛАРДАҒЫ ГИПЕРСТИМУЛЯЦИЯ ЖӘНЕ КОГНИТИВТІ ІКЕМДІЛІКТІҢ ТӨМЕНДЕУ ПСИХОЛОГИЯЛЫҚ АСПЕКТІЛЕРІ

Аңдатпа

Бұл мақалада бастауыш мектеп жасындағы балалардағы гиперстимуляция және когнитивті икемділіктің төмендеуі, олардың цифрлық тәуелділіктен туындайтын және тұлға мен жалпы қоғам үшін үлкен қиындықтар туғызатын проблемалары ашылады. «Гиперстимуляция», «когнитивті икемділік» және «цифрлық тәуелділік» негізгі ұғымдары психология және педагогикалық психология тұрғысынан анықталған, бұл осы мәселені терең түсінудің құрылымдық негізін қалыптастыруға мүмкіндік берді. Балаларда цифрландырудан туындаған гиперстимуляцияның пайда болуына және олардың когнитивті икемділігінің төмендеуіне әсер ететін факторлар анықталды. Цифрлық ортаның балалардың танымдық функцияларына әсер етуінің негізгі механизмдері сипатталған және ең маңызды психологиялық салдары анықталған. Балалардың мектептен бос уақытында цифрлық ортаға айтарлықтай қатысатыны анықталды. Сандық құрылғыларға қол жеткізуді шектеудің негізгі реакциялары жеңіл наразылық немесе немқұрайлылық екені анықталды және балалардың тек 4%-ы гаджетті пайдаланбауға бірден келісе алады.

Жүргізілген эксперименттік зерттеу гиперстимуляцияны төмендетуге және сандық тәуелді балалардағы когнитивті икемділікті арттыруға бағытталған арнайы бағдарламалар мен іс-шараларды әзірлеу және енгізу қажеттілігін растайды. Әрі қарайғы жұмыстың кейбір бағыттары мен нақты ұсыныстар ұсынылады.

Түйін сөздер: гиперстимуляция, когнитивті икемділік, сандық тәуелділік, бастауыш сынып оқушылары, сандық құрылғылар.

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ПСИХОЛОГИЧЕСКИЕ АСПЕКТЫ ГИПЕРСТИМУЛЯЦИИ И СНИЖЕНИЕ КОГНИТИВНОЙ ГИБКОСТИ У ДЕТЕЙ В УСЛОВИЯХ ЦИФРОВОЙ ЗАВИСИМОСТИ

Аннотация

В данной статье раскрываются проблемы гиперстимуляции и снижения когнитивной гибкости у детей младшего школьного возраста, возникающие у них в результате цифровой зависимости и представляющие серьезные вызовы для личности и общества в целом. Ключевые понятия «гиперстимуляция», «когнитивная гибкость» и «цифровая зависимость» определены с точки зрения психологии и педагогической психологии, что позволило сформировать структурную основу для глубокого понимания данной проблемы. Раскрыты факторы, влияющие на возникновение у детей гиперстимуляции, вызванной цифровизацией, и снижение их когнитивной гибкости. Описаны основные механизмы влияния цифровой среды на когнитивные функции детей и установлены наиболее важные психологические последствия. Установлено, что дети значительно вовлечены в цифровую среду в свободное от школьных занятий время. Выявлено, что основными реакциями на ограничение доступа к цифровым устройствам являются легкое недовольство или безразличие, и только 4 % детей могут сразу согласиться не пользоваться гаджетом. Проведенное экспериментальное исследование подтверждает необходимость разработки и внедрения специальных программ и мероприятий, направленных на снижение гиперстимуляции и повышение когнитивной гибкости у дигитально зависимых детей. Предлагаются некоторые направления дальнейшей работы и конкретные рекомендации.

Ключевые слова: гиперстимуляция, когнитивная гибкость, цифровая зависимость, учащиеся начальной школы, цифровые устройства.

INTRODUCTION. In the context of the development of modern digital society, the issues of hyperstimulation and reduced cognitive flexibility in children resulting from digital addiction are very important. It is determined by the fact that the development of digitalization has led to the fact that children are allowed from an early age to enter the Internet and immerse themselves in this world, with the help of various kinds of gadgets. In addition, they spend a lot of time on the Internet, sitting for hours at the screens of computers, tablets and smartphones. This situation is starting to cause concern among psychologists and educators, as well as many parents, as the impact of using digital devices in large time frames on both the physical and psychological development of children remains insufficiently researched.

The relevance of the research topic is due to the fact that digitalization is an uncontrollable process, as it penetrates into all spheres of society, is actively used in the education system and in the usual entertainment provided to children, and that many aspects of the impact of digital technologies on the development of children remain still unclear, as there has been no time to study them in detail.

The extent of research on this topic is still in its infancy, with growing interest in hyperstimulation and reduced cognitive flexibility in children as a result of digital addiction. There is a relatively small

number of research papers addressing this issue. Comprehensive approaches to solving psychological and pedagogical problems that are associated with modern forms of hyperstimulation and reduced cognitive flexibility in children have not yet been developed. Most often the issues are considered, on the study of the general influence of time spent in front of screens on the emotional state of children. To some extent, some links between digital technologies and individual cognitive processes have been highlighted. So far there are no unambiguous answers regarding the influence of digital addiction on the formation of such cognitive, emotional and social disorders as attention problems, depressive symptoms and deterioration of interpersonal relationships. It also concerns the impact on the development of critical thinking, self-esteem and self-control.

The aim of the study is to identify the specifics of the impact of digitalization on the processes of hyperstimulation and reduced cognitive flexibility in modern children aged 6 to 8 years, as well as to determine the key factors contributing to these changes in their cognitive and behavioral development.

The object of the study is modern children aged 6 to 8 years old.

The subject of the study is the processes of hyperstimulation and reduction of cognitive flexibility, as a result of the influence of digitalization.

Objectives:

1. Reviewing research findings on the topic of digital addiction and its impact on children's mental health;
2. Assessing risk factors and levels of hyperstimulation formation and reduced cognitive flexibility under the influence of digital technologies;
3. Developing interventions to reduce digital addiction in children.

The hypothesis of the study is that if we reduce the overuse of digital devices leading to hyperstimulation of the nervous system and reduced cognitive flexibility in children, it is possible to improve their learning and social adjustment abilities.

Theoretical significance is to expand knowledge about the impact of digital technologies on children's mental development and to develop new approaches to the study of this phenomenon.

Practical significance lies in the possibility of applying the results of the study for the prevention of childhood education aimed at reducing digital dependence and for further research.

MAIN POINTS. The article discusses important issues related to the impact of the digital environment on primary school children. The main focus is on hyperstimulation and reduced cognitive flexibility, which result from digital addiction and pose serious challenges to both the child's personality and society as a whole.

The key concepts of the article are 'hyperstimulation', 'cognitive flexibility' and 'digital addiction'. Each of these concepts is explored from the perspective of psychology and educational psychology, which helps to further understand the mechanisms of their emergence and impact on children's development.

The article highlights several factors that contribute to the emergence of hyperstimulation in children. A particularly significant role is played by the features of the digital environment that create conditions for excessive stimulation of the nervous system, which disrupts the normal process of perception and processing of information. It is important to note that a decrease in cognitive flexibility, i.e. the ability to adapt, solve new tasks and switch between activities, is closely related to prolonged and intensive exposure of children to digital technologies.

The mechanisms of the impact of the digital environment on children's cognitive functions have been revealed in the context of excessive activity and rest deficit. The psychological consequences of this exposure can manifest as impairments in memory, attention, concentration ability, and emotional and social impairments.

In addition, the study found that children are actively involved in digital environments during their free time from school, which increases the impact of technology on their mental and cognitive development. Interestingly, in response to the restriction of access to digital devices, children tend to show only mild resentment or indifference. Only a small percentage of children (about 4%) are willing to stop using gadgets immediately, which emphasizes the extent of their dependence on digital technologies.

In conclusion, the article confirms the need to develop and implement special programs and interventions aimed at reducing hyperstimulation and increasing cognitive flexibility in children with digital dependence. The authors offer recommendations for further work in this area, including the creation of more balanced learning and entertainment environments, which should contribute to the harmonious development of children in the conditions of digital reality.

MATERIALS AND METHODS. Monographs, scientific articles and other publications on the topic of the study became the materials of the research. Protocols and summary sheets on the results of the research were used as research materials.

The research methods chosen were literature analysis, surveys of parents and teachers, observation of children's behavior, experiment, methods of analytical and statistical analysis

At the first stage of the work, an assessment of risk factors in the form of observation was carried out. A group of second grade children was selected for this purpose. There are 48 people in the group in total; the observation was conducted in the classroom, where in their free time, use their phones and tablets; the duration of the observation was one hour (60 minutes) during the school week (for a total of five days); the content used by the student (social networks, games, videos and other).

The observation parameters were:

1. Start and end times for each student's use of the digital device.
2. Student response to restriction (teacher's request) of access to a digital device.

In the second stage, the ADHD-Rating Scale IV method is used, which aims to assess the level of hyperstimulation and cognitive abilities (attentiveness) in children. The result of this method is expressed in scores, provided that the higher the score, the stronger the symptoms of hyperstimulation and inattention are in the person.

Also at this stage, cognitive flexibility and the ability to switch between tasks are tested using the Stroop Scale. In this method, the result is evaluated in terms of the time (in seconds) it takes to complete all test items. Time criteria: the longer the time it takes to complete the test, the lower the person's cognitive flexibility.

These methods are conducted within the framework of the experiment: second grade students in the number of 48 people are divided into two groups of 24 people (experimental and control group). Diagnostics is carried out in two stages: the ascertaining and control experiment.

RESULTS AND DISCUSSION. Analytical and statistical analysis summarized the results obtained and interpreted.

In the course of the literature analysis of the issues related to the problem of hyperstimulation and reduced cognitive flexibility in children under conditions of digital dependence, the following statements were established, which help to form a structural basis for a deep understanding of this problem. The key concepts of "hyperstimulation", "cognitive flexibility" and "digital dependence" are defined in terms of psychology and educational psychology.

According to Z. Freud, hyperstimulation **in psychoanalysis is a person's overload of information**, in its conditions of which it is almost impossible or difficult to process the received information (**Freud, 2020**). **While in pedagogical psychology it is an overload of the student with information received audio or visual**, which can lead to slowing down or stopping children's ability to learn (Yang, 2023).

There is no generally accepted definition of cognitive flexibility. It comes from the English word combination "cognitive flexibility" and is usually denoted as a person's mental ability expressed in the ability to quickly switch from one thought to another, as well as the ability to simultaneously think about several subjects (Stad, 2019). Cognitive flexibility is also considered as a separate characteristic of human cognition, helping it to adapt to changing or new circumstances with the help of strengthening cognitive resources. It gets its development in preschool age, being a precursor of children's future successes, both social and academic (Beraksa, 2023).

Digital addiction, derived from the term "addiction", which always has a negative connotation, which is characterized in general as a form of deviant behavior. It is usually understood as the state of a person who feels an uncharacteristic need to constantly use online resources and digital devices, despite the fact that they have many negative consequences for his life (Blackwell, 2021).

Factors influencing the occurrence of digitalization-induced hyperstimulation in children and the decline in their cognitive flexibility encompass both internal characteristics and external conditions (Amedee, 2022), J. Anderson, S. Wagovich, L. Ofoe (2020), V. Arán-Filippetti, M.B. López (2016), M. Paphiti, K. Eggers (2022), M.S. Ashilova, A.S. Begalinov, K.K. Begalinova (2019), J.S. Battalova A. Yergenbolatkyzy (2023), A.S. Kurmashova, L.O. Baimoldina (2021): excessive duration of children's use of digital devices leads to overload of their nervous system; the type of digital content is predominantly aggressively entertaining and playful, with rapid frame changes, which causes strong excitation of the CNS, making it difficult for subsequent concentration to solve subsequent intellectual tasks; early age of the beginning of active use of gadgets, when the child's brain is particularly susceptible to external stimuli, can disrupt the normal development of the cognitive functions required by the child; family

According to a number of Kazakh scientists such as M.S. Ashilova, A.S. Begalinov, K.K. Begalinova. Begalinova the main mechanisms of the impact of the digital environment on cognitive functions in children: overload with sensory devices; changes in the structure of the brain; impaired regulation of attention, needed to focus on a single task; reduced depth of information processing; decreased creativity and critical thinking; increased emotional instability, expressed stress and anxiety (10, p.45). All these mechanisms lead to excessive activation of the nervous system and a decrease in cognitive flexibility, which makes it difficult for children to get used to performing complex intellectual tasks in changing conditions.

Psychological consequences of digital addiction: depression and increased anxiety; aggression and irritability; decreased motivation for activity, including learning; chronic sleep deprivation and fatigue; addictive behavior similar to food or drug addictions; social isolation, leads to difficulties in establishing friendships in real life. These consequences affect negatively the main indicators of psychological and emotional state in children, also hinder the full development of intellectual personality and impede its socialization (Arykbayev, 2021; Eichorn, 2021).

The following methods are used to diagnose hyperstimulation and decreased cognitive flexibility in children:

— traditional neuropsychological diagnostics, which utilize surveys, interviews, and form-based techniques

— methods, with the use of digital tools, which makes it possible to unify the whole procedure and process the diagnostic results faster, and also increases children's motivation. But it is required to conduct a traditional assessment of psychometric properties beforehand.

The results of the observation of the time of use of the digital device by each student and on the student's reaction to the restriction (teacher's request) of access to the digital device, are shown in Table 1 and 2.

Table - 1. Results of time of gadgets use by pupils

Parameter	total	0 minutes	10 minutes	20 minutes	30 minutes	40 minutes	50 minutes	60 minutes
Total utilization time	48 people	0	5 people	13 people	15 people	10 persons	5 people	0
Share of the total number of people, %	100	0	10,4	27,1	31,3	20,8	10,4	

Formula for finding the average time of using gadgets (1):

$$\text{Average time} = \sum (\text{Time} \times \text{Number of students}) / \text{Total number of students (1)}$$

$$\text{Average time} = (10 \times 5) + (20 \times 13) + (30 \times 15) + (40 \times 10) + (50 \times 5) / 48 = 1410 / 48 = 29.37 \text{ minutes.}$$

We round up and get the average time children use phones in their free time approximately 30 minutes or 50% of all free time. All children used phones in their free time, the smallest number of five children or 10.4% used phones for 10 minutes and 50 minutes. The largest number of children (15 or 31.3%) used 30 minutes, 20 minutes was used by 13 or about a third of children and 40 minutes was used by 20 or 20.8%. The obtained data indicate a significant involvement of children in the digital environment in their free time from school hours.

Table 2. Results of pupils' reactions to restriction (teacher's request) of access to digital device

Type of reaction	Number of students	Percentage
Slight resentment	20	42%
Indifference	18	38%
Strong negative reaction	8	17%
Quick agreement	2	4%

The findings show that the main reactions to restricting access to digital devices were mild dissatisfaction (42%) or indifference (38%), while a strong negative reaction was seen in fewer students (17%). Only 4% percent of children agreed that there was no need to use a gadget.

The results of the ADHD-Rating Scale IV test at the beginning of the experiment are reflected according to Figure 1.

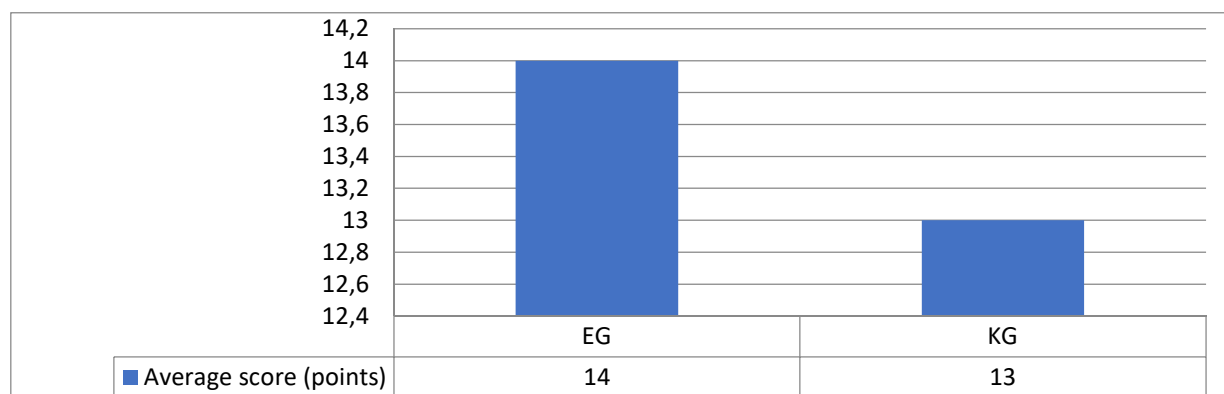


Figure 1 - Results of the ADHD-Rating Scale IV cognitive hyperstimulation level at baseline

Pupils in the experimental group showed an average score of 14 points, which indicates a moderately high level of hyperstimulation and inattention in schoolchildren. Such data usually indicate that children have some difficulties in controlling their impulsive behavior and the need to concentrate. The control group also received a mean score of 13 points, which is close to the experimental group. A difference of 1 point is not statistically significant and can be used as a sample.

The results of the Stroop Scale test at the beginning of the experiment are reflected according to Figure 2.

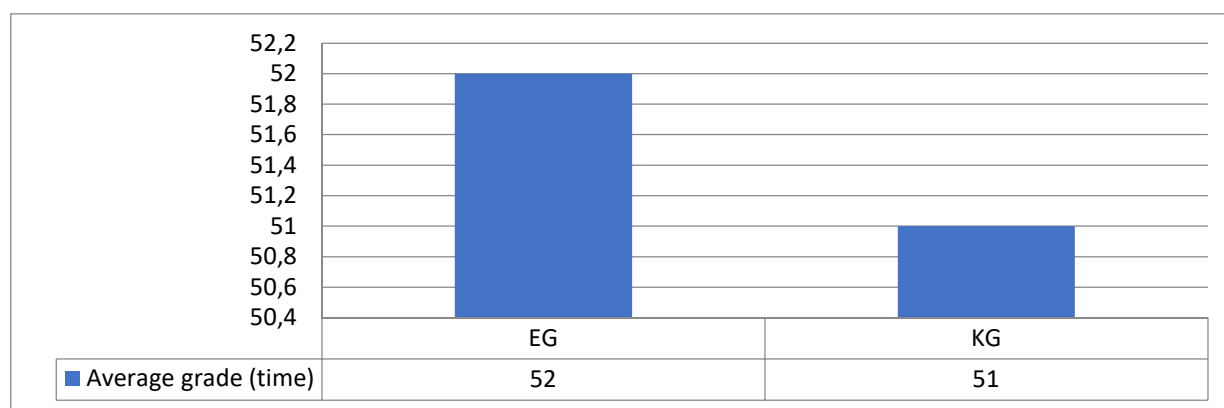


Figure 2 - Results of the level of cognitive flexibility on the Stroop Scale

Normative indicators: for junior schoolchildren within 50-60 seconds. Pupils of both groups completed the test on average in 42 seconds (EG) and 41 seconds (CG), which are almost identical, as they indicate comparable cognitive flexibility and ability to switch between tasks. Differences of 1 second are not statistically significant.

The results indicate that cognitive flexibility in students from both groups is at a comparable level, as the results in both groups are within the normal range for elementary school students (50-60 seconds).

As part of the experiment, continuous monitoring of the use of digital devices was conducted in the experimental group:

- set time limits for children to use digital devices in the experimental group up to one hour per day (no limits were set in the control group);
- all parents have been informed of the restrictions;
- Teachers and parents monitor the use of digital devices;
- organized alternative activities for EG children in order to distract them from gadgets (sports clubs, creative circles, group classes);
- Specialized sessions were held to develop cognitive flexibility (on switching between tasks, puzzle solving, role-playing, creative imagination projects, attention and concentration training).

All of these activities promote cognitive flexibility as they help children learn how to quickly switch between tasks, improve their concentration, and think creatively about problem solving.

The results of the control diagnostics are reflected in Table 3 and 4, which made it possible to compare after the end of the experiment the scores of the contating and control stages of cognitive flexibility and hyperstimulation.

Table – 3. Results of comparative analysis of the level of hyperstimulation and cognitive abilities by ADHD-Rating Scale IV method

Group	Average score (points)		Difference
	At the beginning of	At the end of	
EG	14	10	-4
KG	13	12	-1

In the experimental group there is a significant decrease in the level of hyperstimulation, as the average score decreased from 14 to 10 points, which is a difference of -4 points. The obtained data indicate a positive effect of the conducted interventions on the reduction of hyperstimulation and cognitive abilities in children. While in the control group there is a slight decrease, as the mean score decreased by 1 point, indicating the lack of specialized measures used in the EG.

Table 4. Results of the level of cognitive flexibility on the Stroop Scale

Group	Average grade (time)		Difference
	At the beginning of	At the end of	
EG	52	39	-13
KG	51	49	-2

In the experimental group on the Stroop Scale, there is also a marked improvement in cognitive flexibility, as the average time to complete the task decreased from 52 to 39 seconds, by 13 seconds, indicating a positive impact of the measures taken on children's cognitive abilities. And in the control group the average changes are minimal by 2 seconds. Such results indicate that the level of cognitive flexibility remained almost at the same level in the CG.

Earlier studies have also indicated a relationship between time spent with gadgets and cognitive development. Some of them concluded that excessive use of digital devices may lead to a decrease in cognitive flexibility and an increase in hyperstimulation (Ignatova, 2022). Our study supports previous hypotheses, and confirms experimentally that limiting the time of gadget use can have a positive effect on cognitive function in elementary school children. In addition, this study is interim and suggests other more in-depth and long-term studies to evaluate the effectiveness of different types of strategic interventions in more detail.

CONCLUSIONS. The obtained data indicate a significant involvement of children in the digital environment even during their free time from school. Since the average time of gadgets use by pupils was about 30 minutes, which is equivalent to 50% of the total free time. The majority of students (68.8%) spent between 20 and 40 minutes with gadgets, with 31.3% of students using devices for 30 minutes. There were significant negative reactions of pupils to restriction (teacher's request) of access to digital device.

The conducted experimental study, using two diagnostic methods and practical measures, showed that children from the experimental group showed a more significant reduction in hyperstimulation and improvement in cognitive flexibility under conditions of digital addiction compared to the control group. The test results confirm the need to develop and implement special programs and interventions aimed at reducing hyperstimulation and improving cognitive flexibility in digitally dependent children.

Some suggested directions for future work are: conduct in-depth and time-consuming research to establish more sustainable outcomes; create comprehensive integrated support programs to reduce hyperstimulation and improve cognitive flexibility; make changes in teaching methods and curricula to minimize the negative impact of digitalization; provide parents and educators with tools to monitor and adjust children's behavior regarding hyperstimulation; support and encourage more altered cognitive performance; and provide more effective interventions to improve children's cognitive functioning. Developing these effective interventions will minimize the negative impact of digital devices on children's cognitive functions and provide a better understanding of the problem at hand.

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