

THE NEUROSCIENCE OF PLAY: HOW GAME-BASED LEARNING SHAPES THE BRAIN

Raximova Muslima Dilshodjon kizi

Student at Namangan State Institute of
Foreign Languages named after
Is'hokkhon Ibrat

Telephone number: +998912863521

E-mail: muslimaraximova53@gmail.com

Annotatsiya: Ushbu maqola o'yinlar orqali o'qitishning miya faoliyatiga va kognitiv rivojlanishga ta'sirini tahlil qiladi. Maqolada neyroplastiklik tushunchasi, ya'ni miyamizning yangi neyron bog'lanishlar hosil qilish qobiliyati, o'rganiladi va bu jarayon o'yinlar orqali qanday mustahkamlanishi ko'rib chiqiladi. Shuningdek, o'yinlar orqali o'rganish diqqatni jamlash, xotirani mustahkamlash va ijodiy fikrlash kabi kognitiv funksiyalarni rivojlantirishini tasvirlaydi. Maqolada shuningdek, ijtimoiy va hissiy o'rganish aspektlari ham yoritilgan: o'yinlar orqali o'zaro hamkorlik, ishonch, empatiya rivojlanadi, stress darajasi esa pasayadi. Xulosa qismida, o'yinlar orqali o'qitishning miyani qayta shakllantirishdagi kuchi qayd etilib, kelajakda virtual reallik, sun'iy intellekt va moslashuvchan o'yinlar yordamida o'rganishning yanada samarali bo'lishi mumkinligi ta'kidlanadi.

Kalit so'zlar: o'yin orqali o'qitish, neyroplastiklik, kognitiv rivojlanish, xotira, ta'lim, moslashuvchanlik, sun'iy intellekt, ta'sir, stress

Abstract: This article analyzes the impact of game-based learning on brain function and cognitive development. It explores the concept of neuroplasticity, that is, the brain's ability to form new neural connections, and examines how this process is reinforced through gameplay. The article also describes how learning through games enhances cognitive functions such as attention, memory, and creative thinking. Furthermore, social and emotional aspects of learning are highlighted: games promote collaboration, trust, and empathy, while reducing stress levels. In conclusion, the article emphasizes the brain-rewiring potential of game-based learning and suggests that future approaches using virtual reality, artificial intelligence, and adaptive games could make learning even more effective.

Keywords: game-based learning, neuroplasticity, cognitive development, memory, education, adaptive learning, artificial intelligence (AI), impact, stress

Аннотация: В данной статье анализируется влияние обучения через игры на работу мозга и когнитивное развитие. Рассматривается понятие нейропластичности, то есть способности мозга формировать новые нейронные связи, и исследуется, как этот процесс усиливается через игровые практики. Также описывается, как обучение с использованием игр способствует развитию когнитивных функций, таких как внимание, память и креативное мышление. Кроме того, выделяются социальные и эмоциональные аспекты обучения: игры способствуют сотрудничеству, доверию и эмпатии, а также снижают уровень

стресса. В заключение подчеркивается потенциал обучения через игры в перестройке мозга и предполагается, что в будущем использование виртуальной реальности, искусственного интеллекта и адаптивных игр может сделать обучение еще более эффективным.

Ключевые слова: обучение через игры, нейропластичность, когнитивное развитие, память, образование, адаптивное обучение, искусственный интеллект, влияние, стресс.

INTRODUCTION

Before talking about neuroscience of play we have to understand what is game-based learning actually. Game-Based Learning (GBL) is a pedagogical method that uses digital or non-digital games as a core element of instruction to promote active learning, problem-solving, collaboration, and deeper understanding of content. In GBL, teachers may use points, badges or different kind of game elements to usual contexts. In this approach teachers should not forget the thing is that play is not just entertainment for students, but it should serve as an educational approach. Here keeping the balance is very important. Play is often thought of as something lighthearted or just for fun—especially for children. But neuroscience tells a different story. Behind every game of make-believe or playful interaction, there's a lot happening in the brain. Research shows that play activates key areas involved in memory, decision-making, emotional regulation, and problem-solving. It's not just enjoyable; it's essential for healthy brain development. In fact, play helps shape the brain's architecture by strengthening connections between neurons and encouraging adaptability—what scientists call **neuroplasticity**. It also supports emotional and social growth, helping children (and adults) build empathy, creativity, and resilience. Far from being a break from learning, play is actually one of the brain's favorite ways to learn.

DISCUSSION

Play is more than just pleasure—it's a powerful tool of learning, especially when viewed through the lens of neuroscience. One of the key players in this process is dopamine, a chemical in the brain that's deeply involved in motivation and reward. When we play games—whether digital, physical, or imaginative—our brains often release dopamine. This release can happen when we complete a level, solve a problem, or even just anticipate a reward. Dopamine makes us feel good, but more importantly, it motivates us to keep going. It reinforces behavior, helping us remember what actions led to that rewarding feeling. In this way, games keep our brains engaged and ready to learn by creating a cycle of challenge, effort, and satisfaction. This is why game-based learning can be so effective. It naturally taps into the brain's reward system, encouraging persistence, focus, and a positive emotional connection to learning. But the kind of motivation that games create also matters—and this brings us to the difference between intrinsic and extrinsic motivation.

Intrinsic motivation comes from within. It's the drive to do something because it's interesting, enjoyable, or personally meaningful. Neuroscientific studies show that when we are intrinsically motivated, areas of the brain involved in curiosity, self-direction, and deeper thinking light up. Learning tends to be more lasting and meaningful when it's fueled by internal interest rather than external pressure. Extrinsic motivation, on the other hand, is driven by external rewards—things like grades, points, badges, or praise. These can also trigger dopamine release, but in a more short-term way. While extrinsic rewards can be effective in the moment, relying too heavily on them can backfire. If people start to associate learning only with rewards, they may lose interest in the task itself. This is known as the overjustification effect—when external incentives reduce our natural desire to engage with something we once enjoyed. So, when it comes to play and learning, the most powerful outcomes happen when we combine the brain's natural reward systems with intrinsic motivation. Games are a great tool for this because they offer challenge, feedback, exploration, and the freedom to fail and try again—all of which are rewarding in themselves. The goal is to design or choose learning experiences where the process is just as satisfying as the outcome.

Neuroplasticity allows the brain to strengthen pathways that are used often and prune away those that aren't. When we repeatedly practice a skill—whether it's learning a language, playing an instrument, or mastering a game—the neurons involved in that activity fire together more efficiently. Over time, this repetition reinforces those neural circuits, making it easier and faster for us to perform the same task in the future. Games, in particular, provide an engaging way to tap into this natural rewiring process. Each level, puzzle, or strategic challenge stimulates networks in the brain responsible for memory, attention, and problem-solving. Every time a player revisits similar challenges, the brain strengthens the related neural connections—a process that improves focus and helps store information more effectively.

Puzzle-based and strategy games are especially powerful examples. Games like *Sudoku*, *Chess*, or *StarCraft* push players to think critically, plan ahead, and adapt their tactics on the fly. These types of mental workouts engage the prefrontal cortex, the part of the brain involved in executive functions such as planning, decision-making, and self-control. The more these mental muscles are exercised, the stronger and more efficient they become.

Game-based learning goes beyond entertainment—it's a dynamic way to engage the mind and make learning more meaningful. Unlike traditional teaching methods, which often rely on listening and note-taking, games place learners directly in the center of the experience. This active involvement not only makes learning more enjoyable but also strengthens key cognitive functions such as attention, memory, and problem-solving. One of the most noticeable effects of game-based learning is the improvement in attention and focus. Games require players to stay alert, follow complex instructions, and adapt to changing situations. Whether it's keeping track of multiple tasks or reacting quickly to new challenges, this level of engagement helps

the brain build stronger concentration skills—skills that easily transfer to academic work and everyday activities.

Games also enhance memory retention by turning information into lived experiences. Instead of passively receiving facts, learners interact with concepts, make choices, and see the outcomes of their decisions. This kind of active learning helps create stronger neural connections, making it easier to recall information later. Simply put, what we experience and apply stays with us far longer than what we only hear or read. Another major benefit lies in problem-solving and creativity. Many games challenge players to think strategically, experiment with solutions, and learn from their mistakes. These activities activate the prefrontal cortex—the part of the brain responsible for reasoning, planning, and creative thinking. Over time, this kind of cognitive exercise can lead to better decision-making and greater mental flexibility. When comparing passive learning, such as traditional lectures, to active learning through games, the difference becomes clear. Passive learning can effectively deliver information, but it often lacks engagement. In contrast, active learning through gameplay invites curiosity, interaction, and exploration. Learners don't just absorb information—they use it, test it, and understand it on a deeper level.

Learning is never purely intellectual—it's also deeply emotional and social. The way we feel while learning shapes how well we remember, understand, and apply new information. Game-based learning takes advantage of this connection by creating experiences that are not only mentally stimulating but also emotionally rewarding and socially engaging. When people play, they often experience joy, curiosity, and excitement. These positive emotions have a powerful effect on the brain. They trigger the release of neurotransmitters such as dopamine, which enhances motivation and strengthens memory formation. In other words, when learning feels good, the brain is more likely to store and recall the information. This explains why lessons learned through play tend to stick with us longer than facts absorbed passively. Games that involve teamwork or collaboration also activate the brain's social systems. In cooperative or multiplayer settings, players rely on communication, trust, and empathy to succeed together. These interactions stimulate the release of oxytocin, often called the “bonding hormone,” which promotes feelings of connection and cooperation. Beyond improving teamwork, this sense of trust makes learners feel more supported and confident—key ingredients for meaningful learning. Another important benefit of playful learning is its ability to reduce anxiety and stress. When people are relaxed and enjoying themselves, the brain lowers its production of cortisol, the stress hormone that can interfere with focus and memory. Games create a safe environment where mistakes are part of the process, not something to fear. This lowers pressure, encourages experimentation, and helps learners approach challenges with a clearer, calmer mindset.

Case study

In a 2021 study led by Classcraft co-founder Shawn Young and researchers Silvia Sipone, Víctor Abella-García and Marta Rojo (published in the journal Sustainability), 75 students aged 10-11 at a primary school in Burgos, Spain

participated in a gamified intervention using Classcraft to explore sustainable mobility.

Over the course of three months, students worked in teams on a story-based platform where they completed quests and puzzles related to environmental, social and economic aspects of sustainable mobility. The study found a significant increase in students' awareness and knowledge of public transport, bike-sharing, and pedestrian zones after the gamified experience.

Teachers who use Classcraft have reported noticeable improvements in students' social skills and emotional well-being. Learners become more empathetic and supportive of one another, building trust and teamwork—traits linked to the release of oxytocin, the hormone responsible for social bonding. At the same time, the playful and low-pressure environment helps reduce anxiety by lowering cortisol levels, creating a calmer and more positive atmosphere for learning.

This example shows how incorporating play into education does more than make lessons fun—it taps into the brain's emotional and social systems to strengthen memory, motivation, and connection. By turning learning into a cooperative and rewarding experience, games like Classcraft demonstrate the real potential of game-based learning to nurture not just smarter students, but more confident and compassionate ones.

CONCLUSION

Neuroscience has made it increasingly clear that play is far more than just a pastime—it is a powerful tool for learning. Research shows that engaging in games can actively reshape the brain, strengthening neural pathways that support attention, memory, and problem-solving. When learners are immersed in playful, interactive environments, their brains are not just absorbing information—they are rewiring themselves for deeper focus, better recall, and more flexible thinking. Game-based learning demonstrates how education can move beyond passive lectures into dynamic experiences that engage both the mind and emotions. From collaborative multiplayer games that build social bonds to puzzle-based challenges that sharpen reasoning, play activates multiple cognitive and emotional systems simultaneously, making learning more effective and memorable. Looking ahead, the future of educational games is full of exciting possibilities. Emerging technologies such as virtual reality (VR), artificial intelligence (AI), and adaptive learning platforms offer the potential to create personalized, immersive experiences tailored to each learner's needs. Paired with brain-imaging studies, these innovations could reveal even more about how different types of play influence neural pathways, providing powerful insights into the ways we learn. In short, the evidence is clear: learning through play is not just fun—it is transformative. By embracing game-based learning, educators and learners alike can harness the brain's natural capacity for adaptation, making education more engaging, effective, and enduring than ever before.

References

1. Shaheen, A., Fotaris, P., & Whitehead, L. (2019). Neuroplastic reflective game design: A framework bridging neuroscience and game-based learning. *European Conference on Games Based Learning*. <https://doi.org/10.34190/ecgbl.19.2.4184>
2. Susanto, D., Pusporini, W., & Lestari, T. (2022). Traditional game-based learning model in early childhood education: A case study at TKIT Al-Hikmah. *Early Childhood Research Journal*, 5(1). <https://journals.ums.ac.id/ecrj/article/view/18669>
3. Al-Khayat, M. R., Gargash, M. U., & Atiq, A. F. (2023). The effectiveness of game-based learning in enhancing students' motivation and cognitive skills. *Journal of Education and Teaching Methods*. <https://gprjournals.org/journals/index.php/JETM/article/view/199>
4. Sipone, S., Abella-García, V., Rojo, M., & dell'Olio, L. (2021). Using ClassCraft to improve primary school students' knowledge and interest in sustainable mobility. *Sustainability*, 13(17), 9939.
5. Hasan, B., & Husein, M. (2024). Traditional games as a means of cognitive stimulation: An analysis of child development. *International Journal of Management, Accounting and Economics*, 7(10), 28. <https://www.ijmra.ijpbms.com/v7i10/28.php>