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Article

Serious Video Games: Tools for Learning, Behaviour and Health

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Definition

Serious video games are digital games designed with purposes beyond entertainment, typically to support education, training, health, or behaviour change. They integrate game mechanics with psychological and pedagogical principles to create interactive environments that promote learning, skill development, and engagement. Within cyberpsychology, serious video games offer controlled settings for examining how digital technologies influence cognition, emotion, motivation, and behaviour.

Abstract

Serious video games are digital games designed with purposes beyond entertainment, commonly used to support education, training, health interventions, and behaviour change. Within cyberpsychology, they offer controlled interactive environments for examining how digital technologies influence cognition, emotion, motivation, and behaviour. This entry outlines the historical development of serious video games, from early non-digital simulations to contemporary applications incorporating online platforms, artificial intelligence, and immersive technologies. It summarises key psychological theories underpinning their design, including self-determination theory, flow theory, learning theories, and social and emotional frameworks. The entry reviews major application areas such as education, healthcare, professional training, cybersecurity, and environmental education, alongside evidence regarding their effectiveness. Ethical, cultural, and accessibility considerations are discussed, particularly in relation to inclusivity, data privacy, and manipulative design. The entry concludes by highlighting future directions for research and development, emphasising the need for longitudinal evaluation, ethical design, and inclusive approaches as serious video games continue to evolve.

Keywords: serious games; cyberpsychology; education; mental health; behaviour change; motivation; learning technologies

1. Introduction and History

Serious video games are digital games designed for purposes beyond pure entertainment, often incorporating educational, training, or behavioural change objectives. They are used in a range of domains such as education, healthcare, defence, cybersecurity, and public policy.

Serious video games are a broad category of game-based activities developed with a purpose beyond entertainment, often designed to educate, train, or help users develop new skills. Clark Abt, who first introduced the term in the 1970s, highlighted that serious games are created with explicit and carefully defined educational or social goals rather than for amusement. Zyda later refined this definition by describing serious video games as a mental contest, played with a computer in accordance with specific rules, that uses entertainment to further training, education, health, public policy, and strategic communication objectives [1]. These games are increasingly used in emerging fields such as defence, environmental sustainability education, and cybersecurity, where their interactive nature can enhance engagement and learning outcomes. Within cyberpsychology, which

examines how digital technologies influence cognition, emotion, and behaviour, serious video games have become a growing area of interest. They provide controlled, interactive environments in which motivation, learning, decision making, and emotional regulation can be studied and applied. This entry situates serious video games within cyberpsychology, traces their development, outlines key psychological foundations, reviews major applications, examines evidence of effectiveness, discusses ethical and cultural considerations, and highlights future directions.

2. Historical Development

Early examples of serious games were largely non-digital, such as role-play activities where students acted as diplomats in mock international negotiations. By the 1980s, flight simulators and military training programmes became among the first large-scale digital applications, using interactive technologies to replicate complex and high-stakes environments in a safe setting for learning and skill development. Educational software such as *The Oregon Trail* demonstrated the potential of game-based learning within school contexts.

By the early 2000s, advances in internet connectivity and graphics expanded the accessibility and sophistication of serious video games. The concept of gamification, where game elements are integrated into non-game contexts, became widely adopted in education, health, and corporate training. More recently, virtual and augmented reality technologies have enabled immersive learning and therapeutic interventions, such as virtual surgery simulations. Serious games have also become more mainstream and publicly accessible, for example *Foldit*, a protein folding game that has contributed to scientific discoveries. These developments reflect the convergence of technology, psychology, and pedagogy that continues to shape the field.

3. Psychological Foundations

Serious video games draw heavily on psychological theories that explain how people learn, stay motivated, and regulate their emotions in interactive environments. They commonly incorporate meaningful choices, progressively challenging tasks, and opportunities for social connection. These theories guide design so that games support engagement while fostering skill development and behaviour change.

Self-Determination Theory and Cognitive Evaluation Theory emphasise the importance of autonomy, competence, and relatedness for sustained motivation [2,3]. Research on player engagement supports the relevance of these principles within digital games [4]. Flow theory explains how games sustain deep engagement by balancing challenge and skill level [5]. Behaviourist principles such as operant conditioning also underpin features such as points, levels, and rewards, reinforcing desired behaviours.

Learning theories further inform serious game design. Constructivist perspectives highlight the value of active problem solving, exploration, and immediate feedback. Cognitive load theory emphasises the need to balance complexity and support to prevent overload [6]. Repetition within game mechanics can support memory consolidation and skill retention.

Social and emotional theories also play a role. Social Learning Theory demonstrates how observing others, including avatars or other players, can promote skill acquisition and pro-social behaviour [7]. Serious games can support resilience, emotional regulation, and self-efficacy by allowing users to experiment, fail, and succeed without real-world consequences [8,9].

4. Applications

Serious video games are used across a wide range of domains where interactive experiences can enhance learning, skill development, and behaviour change. In education, they support subjects such as science, mathematics, and languages through simulations and adaptive challenges. Tools such as *DragonBox* and *Duolingo* demonstrate how personalised feedback and progression can improve learning outcomes.

In healthcare and mental health, serious games support physical rehabilitation, cognitive training, and psychological interventions [10]. Motion-controlled games can aid motor recovery, while cognitive training games target memory, attention, and executive functioning. Mental health interventions such as Silver for adolescents with depression have shown potential to reduce symptoms and increase engagement [11].

Professional training represents another major application area. In military, defence, and emergency services, simulations allow individuals to practise decision making and coordination in high-risk scenarios [12]. Cybersecurity training increasingly uses gamified simulations to improve threat recognition and digital literacy among professionals and the public.

Environmental and climate change education is an emerging application. Interactive simulations allow players to explore the consequences of decisions related to ecosystems, energy use, and policy. Decision-based simulations, such as those developed for climate strategy education, promote systems thinking and understanding of complex global challenges.

5. Ethical and Cultural Issues

The effectiveness of serious games depends on careful consideration of user diversity. Accessibility is a key concern for neurodivergent individuals, those with language barriers, and users with varying levels of digital fluency. Games lacking flexible interfaces or customisation options may unintentionally exclude some users. Adjustable pacing, multimodal content, and clear visual design can help address these challenges [13].

Ethical issues also include privacy and data security, particularly in health and psychological contexts where sensitive data may be collected. Cultural sensitivity is essential, as games developed within specific cultural contexts may not translate effectively across regions or populations.

There are additional concerns around manipulative design. Gamified reward systems can exploit psychological vulnerabilities if poorly implemented, leading to compulsive engagement rather than meaningful learning [14]. Addressing these issues requires user-centred, transparent design and ongoing evaluation.

6. Evidence of Effectiveness

Research generally indicates that serious games can improve learning, skills, and engagement, although outcomes vary depending on design quality and context. Systematic reviews in education suggest improvements in knowledge and skills, though motivational effects are inconsistent [15]. In healthcare and professional training, serious games are associated with improved learning and engagement, particularly when aligned with psychological principles.

Evidence for long-term impact remains limited. Many studies assess outcomes immediately after gameplay, with fewer examining sustained effects [16]. Some interventions, such as Re-Mission for young people with cancer, demonstrate benefits maintained over several months [17,18]. However, more longitudinal research is needed to assess real-world transfer and durability of outcomes.

7. Conclusions and Future Directions

Future developments in serious video games are likely to involve greater integration of artificial intelligence and immersive technologies such as virtual reality. AI-driven systems can adapt content, pacing, and feedback in real time, while VR can provide realistic environments for practising complex skills. These technologies may enhance autonomy, competence, and engagement [19].

Learning analytics and adaptive frameworks offer opportunities for personalised learning paths that respond to cognitive load and engagement [20]. Emerging evidence suggests AI-enhanced serious games may support meta-skills such as self-regulation and resilience, particularly for diverse and neurodiverse populations [21].

Challenges remain, including the lack of longitudinal evidence, ethical concerns related to data use and algorithmic bias, and the need for inclusive design across cultures and learning styles. Continued multidisciplinary research is required to ensure serious games achieve lasting benefits while remaining ethical and accessible.

Supplementary Materials: The following supporting information can be downloaded at the website of this paper posted on Preprints.org. The following games have been referred to in text: <https://oregontrail.ws/the-oregon-trail-game/>. <https://fold.it/>. <https://ig.ft.com/climate-game/>. <https://dragonbox.com/>. <https://www.duolingo.com/>.

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