7th International Scientific Conference
Technics and Informatics in Education
Faculty of Technical Sciences, Čačak, Serbia, 25-27th May 2018

Session 1: Technics, Technology and Informatics in Education UDC: 621.39:004

Video Games - Influence on Children's Cognitive Abilities

Branka Arsovic [1*], Lidija Zlatic [1]
[1] University of Kragujevac, Faculty of Education, Uzice, Serbia
[*] arsovic@pfu.kg.ac.rs

Abstract: *The purposes and functions of play in children's development have been researched for well over a century by scientists of different disciplines. Like everything else, the play itself is experiencing transformations in the contemporary, digital age. Children spend more time with computers and other smart gadgets, both at home and at school. The question that arises is how the use of information and communication technologies and especially playing video games can affect and change children's lives – from educational and learning aid, to the emergence of depression and the promotion of violent behaviour. The paper reviews the conclusions of the research concerned with each of the five main types of play in which children engage; and highlighting the benefits of playing video games for the development of children and their skills. Article provides an overview of the limited research on the effects of using information and communication technologies on the cognitive and social development of children. The influence of playing video games on the development of cognitive abilities in children is analyzed in particular. In conclusion, the guidelines and tips for possible further research of the effects of playing video games on the children development are provided.*

Keywords: *video games; cognitive skills; ICT; play; children*

1. INTRODUCTION

Psychologists, anthropologists, sociologists, pedagogues and many others experts have been researching and theorising about play and its role in human development, for well over a century. 'Play' is sometimes contrasted with 'work' and characterised as a type of activity which is essentially negligible, trivial and deficient in any serious purpose and intention. As such, it is seen as something that children do because they are immature, and as something they will grow out of as they become adults. Numerous studies have exposed this attitude and this view as incorrect. Play, in all its forms, is among the top achievements of the human species, beside language, culture and technology [1]. Definitely, without play, none of these other achievements would be possible. The importance of play is increasingly recognised by researchers, for adults as well as children, as the evidence mounts of its relationship with intellectual achievement and emotional well-being [1]. The evolutionary and psychological proof points to the essential contribution of play in humans to our success as a very adjustable species [2]. Playfulness is strongly related to cognitive development and emotional well-being. The mechanisms underlying these relationships appear to involve play's role in the development of linguistic and other representational abilities, and its support for the development of metacognitive and self-regulatory abilities [2].

It has recognized five fundamental types of children play by psychological research. Those games types can commonly be classified as: physical play, play with objects, symbolic play, pretence or socio-dramatic play, and games with rules [1]. All five types of play are found in different manifestations, depending on available technology, in all cultures. Each of them supports a range of cognitive and emotional developments. Therefore, a good balance of various play experience is considered as a healthy play diet for children. Some types of play are more fully researched than others, while much more of them remains to be understood relating the underlying psychological processes involved.

The most important benefits for children, considering each of the above types of games, can be highlighted:

- Physical play – since this play type includes active exercise (jumping, running, cycling, wrestling with friends, ball playing, various fine-motor practice…), it is associated with the development of the entire body of children and hand-eye coordination. Also, it is significant in building strength and endurance [3].
- Play with object – it begins as soon as infants can grab and hold some object; early investigative behaviours include mouthing/biting, rotating while looking, rubbing/stroking, hitting and dropping.

This might be described as 'sensory-motor' play when the child is exploring how objects and materials feel and behave. And in the older age children begin to arrange objects, also building and constructing things of them, which progressively develops into sorting, organization and classifying activities. When playing with objects, children maintain their attention, developing problem-solving skills and competencies, as well as self-regulation [4].

- Symbolic play – humans have and use a wide variety of symbolic systems (spoken language, reading, writing, numbers, various visual media, music etc). This type of play supports children to develop their technical abilities to express and reflect upon their experiences, ideas and emotions [5].
- Pretence/socio-dramatic play – this type of play has repeatedly been shown to be very strongly related with the development of cognitive, social and academic abilities. It strongly influence on narrative skills, as well as on deductive reasoning and social competence [6]. This kind of play makes some of the greatest demands on children's self-discipline, or self-regulation, because children are obliged to follow the social rules according to the character and role they play.
- Games with rules – children tend to give meaning to their world and therefore they are very motivated to establish rules. As a consequence, from a very young age, they enjoy games with rules, and frequently invent their own. In addition to helping children to develop their understanding of the rules, the main developmental contribution of playing these games arises from their essential social nature. While playing games with their friends, relatives and peers, children are learning a whole range of social skills related to exchanging, sharing, taking change, understanding the perspective of others etc [7].

From the presented it can be seen that the play is not irrelevant at all, and its influence on the development of the young beings is very significant. International bodies, such as the United Nations and the European Union, have begun to consider and develop policies concerned with children's right to play, with the educational and societal benefits of play provision, and with the implications of this for educational institutions and educational programs.

2. PLAY IN A CONTEMPORARY ENVIRONMENT

The play, like everything else, is susceptible to change (social, technological, scientific...). The appearance of personal computers and other ICT (Information and communication technologies), in the first place of the Internet, had a big impact on the play form transformation. The play was evolving in the 21st century, from outdoors play and games to computer, video games.

It can freely be said that the electronic age produces an entirely new sort of individuals. But what kind of an effect will such an age have on them, primarily on children? Actually, many begin to call these new, technological natives' generations "Generation M" (M stands for media). The world that they are growing up in is totally different from their parents' world. Contemporary world and society are under the influence of the media and technologies of various types. With the greater role of personal computers and other smart, mobile, handy gadgets in children's lives, has come increased concern about how children may be affected. The growing amount of time children are spending with computers, at home and school, has raised questions about how the use of computer technology may make a difference in their lives – from helping with learning and homework, to causing depression and to encouraging violent behaviour. Time spent on computers and using ICT may displace other activities (other type of play), that have more developmental value. So, the advantage of the computer-based activities has also been questioned. The daily use of ICT has enforced many questions about the impact on children (in terms of health, education, psychological impact, social impact etc.). The overall ICT impact on children is a complex issue and requires numerous, extensive research, which would approach to this problem from a various aspects. It is necessary to explore different types of impacts of different types of ICT. In this article we will try to present some of the posture how new forms of technology-assisted play can affects children's development and education.

During previous decades computer video games became a significant source of entertainment for young people (i.e. children and young adults). Nowadays such games can be played on relatively low specification technology gaming platforms, including mobile devices and other smart gadgets. This makes the video games accessible even to those who may not own personal computer; as a consequence, we have many children spend a significant amount of free time playing computer games. Video games have quickly become a general aspect of child development [8], and their rapid rise to importance has stimulated scientific inquiry and public concern [9]. Researchers emphasize that children may be particularly vulnerable to the effects of playing video games [10] [11], the effects of video games on children's psychosocial development remains highly debated.

Like any medium, video games are communication channels whose effects vary greatly depending on their content. Thus video games are in general studied as a possible cause of aggressive knowledge, cognitions and behaviour [12], emotional problems such as depression [13], and

hyperactivity and lack of concentration [14]. In some research works, video games are described as an overwhelming entertainment medium whose wisely use of feedback loops and positive back up schedules train unhealthy habits of mind [15]. Experimental, longitudinal and meta-analytic data show that playing violent video games increases aggression, hostility and aggressive thoughts [12] [10] [16].

On the contrary, researchers have recently begun looking at video games as a domain for training healthy habits and positive cognitions and behaviour [17] [18]. From this point of view, many video games recompense communication and cooperation as well as resolving negative emotions such as frustration. In addition, it's obvious that video games provide a context for fulfilling self-deterministic needs, thus contributing positively to the psychological, mental well-being [19]. Games with positive content show positive effects. For illustration, playing a dancing video game can help children lose weight [20].

3. VIDEO GAMES AND COGNITIVE SKILLS

When it comes to certain cognitive skills, researchers have found that ICT, especially video games, can improve visual spatial skills (such as visual tracking, mental rotation and targeted localization). Computer games can also advance children's problem solving skills. Researchers still need to fully understand the issue of learning transfer via electronic media. Studies suggest that, in some circumstances, children can transfer what they learn through ICT (and video games) to other applications, but it is still not certainly known how this transmission takes place [21].

Research was carried out, aimed at determining whether learning through ICT (which affects both the auditory and the visual system) is more or less effective than learning only through the symbolic system. Several studies Kozma [22] conducted compare the learning achievements through combined audio-visual presentations with learning outcomes only to audio or visual media. It turned out to be an advantage on the side of audiovisual presentations. The subjects are more familiar with what they hear and see together, than with what they only see or just hear. One study found benefits of video gaming for visual attention, including greater attention capacity, faster attention deployment, and faster processing [18] [21] [22].

According to Salomon [23], different media forms engage, and develop, different cognitive processes. He demonstrates that repeated exposure to cinematic codes presented on film, such as the zoom technique, leads children to essential adoption of these codes [23]. Salomon's research also provides confirmation that educational programs can enhance particular cognitive abilities [24] [25]. Analysts have conducted many researches on video games. Several studies imply that video game may improve spatial reasoning skills in children. These studies suggest that video games may positively affect a variety of visual spatial skills (video game players, for example, have better hand-eye coordination than nonplayers) [24] [25]. Children's previous video game experience has also been associated with shorter reaction times on colour and shape discrimination and stimulus anticipation tasks [21] [24] [25].

Video games might also improve children's problem-solving skills. The long-term positive benefits of video games depend, in large part, on whether children can learn abstract knowledge or problem-solving skills and transfer them to new situations [17] [18] [21]. Video games provide informal training in inductive discovery – as play went on players induced the set of rules and strategies inherent to the game.

Children growing up in the digital era are far more practiced and capable at processing information rapidly than were their predecessors and are bored if they have to 'slow down' at educational environment [26] [27]. Regardless of the existing theories of learning and cognitive abilities, we must be aware and recognize the existing changes that are caused by ICT. In childhood, the use of ICT is mostly reflected in the playing of computer games. Changes in the cognitive skills of digital natives are evident, and this can only be ascribed to the daily use of ICT in all life aspects. Ten main cognitive style changes have been observed in the 'video games generation' [27]:

- twitch speed versus conventional speed
- parallel processing versus linear processing
- graphics first versus text first
- random access versus step by step
- connected versus standalone
- active versus passive
- play versus work
- payoff versus patience
- fantasy versus reality
- technology-as-friend versus technology-as-foe.

These changes pose considerable challenges for the educators who wish to promote literacy skills. All the games make use of the visual, but they always make use of much more: there is a musical score, elementary, simply dialogue, and there is writing – usually as in comic strips, in a box above the rest of the visually saturated screen. It's exactly this kind of video games multi-layered layout that makes them an essential medium for developing the cognitive skills of children. Their general acceptance and informality is only an advantage over traditional, sophisticated systems. Children more easily and quickly accept activities that are

closer to the play; they are more dedicated and devoted and are more motivated to take part.

4. CONCLUSION

Like most things in life, there are two sides to the video game discuss. Researchers have found many negative effects, mainly from violent games, while positive effects have also been seen – mostly in the more effective learning that occurs in interactive games. In brief, it seems that the moderate amount of the video game is not harmful to the development of children. In fact, playing of video games may produce critical thinking, healthy exploration, and skills development in children. However, an excessive amount could obstruct exercise, learning or social activities. While violent video games may lead children to more at-risk behaviours. A number of issues have been highlighted about the use of ICT and video games for education by children. Researches' findings often conflict in their outcomes, so longitudinal studies are needed. In reviewing the literature, particular areas of investigation are raised. Some directions of future research may be:

- the cognitive and social effects of the newer video games generation and other software, especially the multi-user games available on the Internet
- the long-term cumulative impact of interactive video games on cognition and academic achievement
- more completely investigation on the relation between violent games and children's aggression
- simulation and simulated world impact on children's developing identities and sense of reality
- how video games can be used more adequately as a valuable educational and instructional tool.

So far, very few studies have been conducted, in our country, on children using ICT and video games (which can have literacy, computing or other basic skills requirements). Consequently, there is little reporting on the social needs, social and behavioural issues in children's age that relate to the education.

REFERENCES

[1] Whitebread, D. & Coltman, P. (Eds.) (2015). Teaching and Learning in the Early Years, *4th Ed., Routledge*.

[2] Whitebread, D. (2012). Developmental Psychology and Early Childhood Education. London: Sage.

[3] Pellegrini, A.D, and Smith, P.K. (1998). Physical Activity Play: The Nature and Function of a Neglected Aspect of Play. Child Development, 69(3). 577-598.

[4] Pellegrini, A. D., and Gustafson, K. (2005). Boys' and girls' uses of objects for exploration, play and tools in early childhood. In A. D. Pellegrini, and P.K. Smith (Eds.). The nature of play: Great apes and humans.(pp. 113-135). New York: Guilford Press.

[5] Matthews, J. (2011). Starting from scratch: The origin and development of expression, representation and symbolism in human and non-human primates. Hove, E. Sussex, UK: Psychology Press.

[6] Whitebread, D., and Jameson, H. (2010). Play beyond the Foundation Stage: story-telling, creative writing and self-regulation in able 6-7 year olds. In J. Moyles (Ed.), *The Excellence of Play, 3rd Ed.* (pp. 95-107). Maidenhead: Open University Press.

[7] DeVries, R. (2006) Games with Rules. In D.P. Fromberg and D. Bergen (Eds) Play from Birth to Twelve, *2nd Ed. Abingdon*, Oxon: Routledge.

[8] Lenhart, A., Kahne, J., Middaugh, E., Macgill, A., Evans, C., & Vitak, J. (2008). Teens, video games, and civics. Washington D.C.: *Pew Internet & American Life Project.*

[9] Ferguson, C. J. (2013). Violent video games and the Supreme Court: Lessons for the scientific community in the wake of Brown v. Entertainment merchants association. American Psychologist, 68, 57–74.

[10] Bushman, B. J., & Huesmann, L. R. (2006). Short-term and long-term effects of violent media on aggression in children and adults. *Archives of Pediatrics and Adolescent Medicine*, 160, 348–352.

[11] Lobel, A., Granic, I., & Engels, R. C. (2014a). Associations between children's video game playing and psychosocial health: Information from both parent and child reports. Cyberpsychology, *Behavior and Social Networking*, 17, 639–643

[12] Anderson, C. A., Shibuya, A., Ihori, N., Swing, E. L., Bushman, B. J., & Sakamoto, A., et al. (2010). Violent video game effects on aggression, empathy, and prosocial behavior in Eastern and Western countries: A meta-analytic review. *Psychological Bulletin*, 136, 151–173.

[13] Tortolero, S., Peskin, M., Baumler, E., Cuccaro, P. M., Elliott, M. N., & Davies, S. L., et al. (2014). Daily violent video game playing and depression in preadolescent youth. *Cyberpsychology, Behavior, and Social Networking*, 17, 609–615.

[14] Gentile, D., Swing, E., Lim, C., & Khoo, A. (2012). Video game playing, attention problems and impulsiveness: Evidence of bidirectional causality. *Psychology of Popular Media and Culture*, 1, 62–70.

[15] Gentile, D. A., & Gentile, J. R. (2008). Violent video games as exemplary teachers: A conceptual analysis. *Journal of Youth and Adolescence*, 37, 127–141.

[16] Carnagey, N. L., & Anderson, C. A. (2004). Violent video game exposure and aggression. *Minerva Psichiatrica*, 45, 1–18.

[17] Adachi, P. J., & Willoughby, T. (2012). Do video games promote positive youth development? *Journal of Adolescent Research*, 28, 155–165.

[18]Granic, I., Lobel, A., & Engels, R. C. M. E. (2014). The benefits of playing video games. *American Psychologist*, 69, 66–78.
[19]Ryan, R. M., Rigby, C. S., & Przybylski, A. (2006). The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion*, 30, 344–360.
[20]Epstein, L. H, Beecher, M. D., Graf, J. L., & Roemmich, J. L. (2007). Choice of interactive dance and bicycle games in overweight and non-overweight youth, *Annals of Behavioral Medicine*, 33(2), 124-131.
[21]Przybylski, A. K., & Mishkin, A. F. (2016). How the quantity and quality of electronic gaming relates to adolescents' academic engagement and psychosocial adjustment. *Psychology of Popular Media Culture*, 5, 145.
[22]Kozma, R. B. (1991). Learning with Media, *Review of Educational Research*, 61, 179–211.
[23]Salomon, G. (1979). Interaction of Media, Cognition, and Learning, *San Francisco: Jossey-Bass*
[24]Chatters, L. B. (1984). An Assessment of the Effects of Video Game Practice on the Visual Motor Perceptual Skills of Sixth-Grade Children, *University of Toledo*
[25]Miller, G. G., Kapel, D. E. (1985). Can Non-Verbal, Puzzle Type Microcomputer Software Affect Spatial Discrimination and Sequential Thinking of Skills of 7th and 8th Graders? , *Education 106*, 160–67.
[26]Mumtaz S (2001). Children's enjoyment and perception of computer use in the home and the school. *Computers and Education*, 36(4), 347–362.
[27]Prensky M (2001). Digital game-based learning. *New York: McGraw-Hill*.