

# The Impact of Computer Games on Preschool Children's Cognitive Skills

Dolores Kamenar Čokor, Andrija Bernik

University North, Ul. 104. brigade 3, 42000, Varazdin, Croatia

dokamenarcokor@unin.hr, abernik@unin.hr

**Abstract.** The aim of this paper is to investigate how computer games affect the preschool population from 3 to 6 years of age. As the popularity of computer games in children of that age increases, the extent to which their influence on behavior and cognitive development and early learning will be explored. The role of parents (N=167) and their control over the content and timing of playing computer games will be described in this paper within 5 hypotheses. The results obtained with the use of survey questionnaire (30 closed type questions) will show that the content of the computer game affects the child's behavior, while time spent playing computer games has effect on cognitive development.

**Keywords:** Behavior, Cognitive Development, Computer Games, Parents, Preschool age

## 1 Introduction and research focus

"Toys and playgrounds" of the modern age, for younger children are computer games, regardless of which device they are using. [1] Computer games differ from other children's games because they contain programmed rules. Thus, the computer is always a consistent player and teammate who uses strictly algorithmic rules consistently, and without exception. [2] The rules, challenges and feedback of computer games can create interesting experiences that can be useful but also harmful and teach children at an early age desirable or undesirable behaviours. An increasing number of computer games are available to children aged 3 to 6, while at the same time very little is explored about how they affect their cognitive skills, emotional and psychological development, and physical abilities. [3] Preschool children cannot properly distinguish the world of imagination and fantasy from the real world as older children and adults can. To them, animated characters and magical superhuman powers may seem real, even though the same is impossible to achieve in the real world. This is especially true for the younger preschool population because they focus on one of the most prominent attributes of the character, rather than looking at the whole. [4] They are likely to imitate what they see, without recognizing behaviours that may be dangerous or socially inappropriate. [5] Consequently, the amount of time a child spends playing computer games at such an early age is extremely important, especially because there are other ways that help child to build, such as physical activity, social interaction, etc. [3]

Since the development of technology, children are starting to use various media earlier than expected, it is necessary to monitor the frequency of playing computer games, as well as the use of other media. The research [6] on media consumption from 2011 from the Finnish Society on Media Education for children aged 0 to 8 stands out. According to this research, the use of different media begins at a very early age. Most children aged 0-2 listen to books, radio and audio recordings. Even children under the 12 months play computer games, use the Internet and mobile phones. According to the study, one-year-olds watch media content on a daily basis, mainly in the presence of a parent or other adult. The use of media content by children between the ages of 3 and 4 is more diverse than that of younger children, and individual desires and motives begin to develop. Also, they mostly use the media in the company of parents and friends, but do not use them on a daily basis. So boys start using the Internet and playing computer games a little earlier than girls, and they prefer arcade games as opposed to girls who prefer educational games. Older preschoolers between the ages of 5 and 6 start using computer games and the Internet regularly. Girls preferred educational and arcade games, and boy's games that include driving a car, various sports and adventure games. [6] A recent survey by the UK Communications Agency shows that 20% of children aged 3 to 4 own their own smartphone or tablet. 96% of children of that age watch television 14 hours a week, and 36% play computer games more than 6 hours a week, at the same time more than half of children use the Internet more than 9 hours a week, for various activities. How much the use of the media oscillates among older preschool children aged 5 to 7 in this study is shown by the fact that 47% of them own their own smartphone or tablet. They spend half an hour a week in front of a television program than 3rd and 4th year olds, but that is why 63% of them play computer games 7.5 hours a week, and 82% of children spend 9.5 hours a week online. [7] If we take into account that the frequency of playing computer games in preschool children in recent years is rapidly increasing, which is confirmed by the data of the Eurostat survey for 2018 which shows that there is a big difference in household access to the Internet. The survey was conducted for EU members, while an interesting figure for Croatia, where in 2013 65% of households had access to the Internet and in 2018 the number climbed to 82%, [8] and the 2016 recommendations of the American Pediatric Academy (APA) have tightened the time that children aged 2 to 5 can spend in front of screens for less than 1 hour a day, [9] we come to the question at what way we can reduce the frequency of playing computer games. Majority of parents today, think about the correctness of their decisions when it comes to children and their time spent at the computer. Many parents wonder if they should even allow their child to play computer games, how to limit the time, at what age to start using it, and what are the consequences of using it. [10] According to the authors [11], children should be monitored while using a computer, and this is especially true for preschool children. Parental attention to computer use at that age should be constant, and the child should not be allowed to using it for more than twenty minutes a day. [11] It is very important that parents are actively involved in the selection of appropriate video games, the content of which should be positive (without violence, blackmail, murder, pornography, etc.), preferably games from which the child could learn something instructive. By using educational computer games, parents can teach their child without force and pressure, with play. Thus, parents together with their children will enjoy learning, acquiring

knowledge and language, mathematics, geographical features and others important knowledge. In this way, parents help their children to become computer literate. [10] Also one of the important roles is played by the attitude of educators in kindergartens who during the parent's absence can contribute to how the child will accept computer games. Some kindergarten teachers often find a game based on computer or other media (such as a mobile phone) inappropriate or disturbing because of the content often found in such games. Considering that such forms of play, due to their repetitive nature, are harmful to the development of children's imagination, as well as restrictive for the same. [12-13] It is important for parents and kindergarten teachers to understand the virtual world in which children spend their time, also to talk openly with their children, and to be interested in the content of the game, story and characters, rules and arrangements about time and place for playing computer games. In addition, it is good to know that children love to play video games with their parents and playing together gives parents the opportunity to learn something their child is interested in. By including video games in everyday life and creating a new form of media culture together with the child, parents get to know the media reality with their children and analyse it in a completely new way. [1].

As it can be seen from above, it is important to investigate how playing computer games affects the age group from 3 to 6 years. The reason why children under the age of three are not included in this study is that, as recommended by the APA, the interaction of such young children with their parents is crucial, and there is still insufficient evidence of media benefits to children of that age. [9, 13] According to the hypothesis that one activity can replace another (displacement hypothesis), it was in [14] investigated how the fact that younger boys own a game console and computer games affects their school success and behavior. The experiment showed that computer games can replace extracurricular activities that have educational value and can interfere with the development of reading and writing skills in some children. [14] It remains to see whether playing computer games in excessive quantities will replace other activities necessary for proper development, and how much educational computer games will improve children's learning to a greater or lesser extent. Our research will be conducted by the research concept of [15], whose results were conducted among parents of children from 6 to 10 years, this study confirm that computer game time and content, have effects on child's behavior and learning. The results revealed that time spent playing computer games was positively associated with aggression and negatively with school success or learning. Violent computer games caused attention problems, while educational computer games increased attention and concentration, as well as better school performance. The results of a study by [15] suggest that violent computer games and frequent playing of computer games are associated with problematic behavior and poorer learning, with the exception of educational computer games, which positively affected behavior and learning. However, in different studies like [16-18] computer games can indicate positive changes in child's cognitive skills where the need for the new curriculum is offered. The idea is to adopt new technologies and help children to learn while playing with the help of ICT and serious and educative games.

Our research aims to contribute to a better understanding of how computer games affects children of preschool age, with the use of survey questionnaire on their parents, because in preschool children we cannot measure school success, but only possible indicators of cognitive development i.e. learning.

## **2 Research details and methodology**

### **2.1 Defining hypotheses**

There is still much controversy as to whether preschool children should be allowed to use media technology at all, and thus play computer games. Also, do parents think that computer games in some way influenced behavior, such as attention, aggression, concentration and the learning of preschool children. In addition to the above, it is important to examine the percentage of parents who doesn't allow their children to play computer games, and what is their reason for that. For this purpose, two main hypotheses were created as well as their variants:

**H1a:** The content of playing violent games will have a bad effect on the behavior of the preschool population.

**H1b:** The amount of time playing games will have a bad effect on early learning, i.e. cognitive development.

**H1c:** Educational games will have a positive effect on early learning and behavior.

**H2a:** Greater parental control will reduce addiction and behavioral problems.

**H2b:** Greater parental supervision will improve the cognitive development of the preschool child.

### **2.2 Measuring instrument**

The goal is to conduct the survey on as many respondents as possible, so the survey questionnaire will be available online for two weeks, and in printed form for parents who do not have access to the Internet. Completing the survey questionnaire will take up to 5 minutes and will be completely anonymous. The survey questionnaire was made referring to the work of [15], which is also based on already established scientific paper [20]. The questionnaire will consist of 30 questions with clearly defined answers and all of them will be the closed type. Google Forms application will be used to create it, through which the survey will be available online, with the possibility of printing it. The questionnaire has three categories.

**The first part** contains demographic questions (age and gender, both child and parent) which makes a total of 4 questions. To continue the survey, the question of whether a parent allows a child to play computer games or not was important. If the answer is no, the parent should state a reason and the survey would have ended for the respondent. The same is regulated by a written explanation on a printed questionnaire.

**The second part** of the survey questionnaire consists of questions related to the frequency of playing computer games, on which media device the child plays computer games the most, whether child has his/her own device and how many games

on the devices the child owns. Also, it is important to find out how much time a child spends a week playing computer games, and how often a child spends daily playing computer games along with other activities such as watching TV, playing outside, learning new concepts, organized activities such as sports, etc. Parents for each activity chose a certain number of min / h per activity on daily basis. According to the Likert scale (1 to 5), parents had to determine how often a particular computer game by type (action, educational, shooter game, arcade) was often played by a child. In doing so, action games are explained in the survey as enemy defence games, according to [15] they belong to non-human violence games, but have, for example, elements of defence against aliens or animals. As an example in research [11], the games Pacman and Super Mario are mentioned, which contains elements of violent scenes, i.e. this game is marginally suitable for children aged 3 to 6, because game is classified for children from 7 years, according to Common Sense Media. [21] In this study, arcade, action, and shooter games will be considered as a variable to measure total exposure to violence when playing computer games, according to the before mentioned study. Among other things, the second part will measure the social context of playing computer games in terms of examining who chooses computer games for the child, and whether the child plays computer games alone or with a parent because the same applies to parental control of content and time. Parental content control and time control [22-23], will be measured according to the Likert scale (1 to 3). Monitoring will also be measured regardless of the type of computer game (Likert scale, 1 to 5). This part of the questionnaire also covers questions related to the amount of time a child spends per week playing computer games, and how often a child spends daily playing computer games along with other activities such as watching TV, playing outside, learning new concepts, organized activities such as sports, etc. For each activity, parents chose a certain number of min / h per activity on daily basis.

**The third part** of the survey questionnaire, the last question was divided into 13 statements that had to be answered with "Yes" / "No". This section contains claims according for measuring potential addiction according to [24]. For each variable (attention, aggression, concentration) 3 statements are valid, of which some statements overlap with several variables simultaneously, while the addiction variable has three statements that do not overlap with the others.

Questionnaires were sent to parents in print and online in 3 kindergartens in Varaždin County, with the consent of the principal, as well as in two Facebook groups of parents in the county with the consent of the group administrator. Total number of respondents were 167, of which 3 to 4-year old was 45.5%, while children aged 5-6 was 54.5%. A girl aged 3-4 was 43%, while boys are 57%. Looking at the older group of preschool children aged 5 to 6, the gender difference is significant, with as many as 64% of boys and 36% of girls. In any case, both age groups are dominated by boys. The demographic structure of parents shows that out of 167 respondents, 87.4% are females, while only 12.6% are males. According to the [19] when researching a child's behavior, the most important source of information is the parents, because they are closely related to the child and have direct insight into the overall behavior so we can get credible and reliable data especially from mothers.

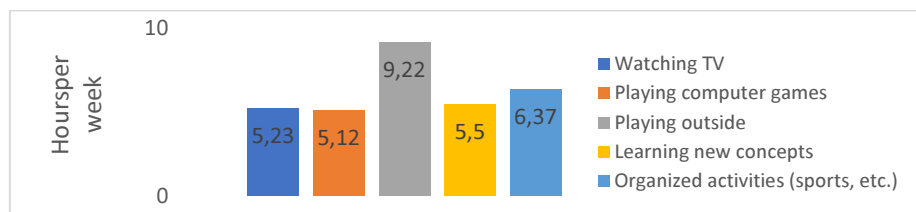
### 3 Collected data

Descriptive statistics, numerical values mostly in percentages, and Pearson's (r) correlation coefficient were used to obtain results. A special variable was used to measure a total exposure to violent content of computer games, by taking the average percentage of exposure for all types of computer games (action, arcade, shooters) in which all were considered to have some form of violent content other than educational. [15] As explained earlier, the survey was attended by a total of 167 respondents, of which 3-4 were children. 45.5% (91), while children aged 5-6.g 54.5% (76). Both age groups were statistically dominated by boys (57% and 64%), while parents were dominated by females 87.4%. To continue the research, it was important for the parent to define whether they allow their child to play computer games, the total number of respondents who allow was 118. If the answer is no, the survey ends immediately after the respondent states one of the reasons why he/she doesn't allow playing computer games 29.3% (49) respondents. Parents of younger preschool age equally allow or don't allow playing computer games. In the larger age group of preschool population 5 to 6 years the majority of parents allow their children to play computer games. Also, the majority of parents 53,1% who don't allow playing computer games, believe that preschool children don't need computer games at all or 30.6% that child is not yet mature enough.

According to the survey data, 73 respondents (61.9%) stated that a child most often plays computer games on a mobile phone, followed by a tablet with 24.6% (29 respondents), 4.2% of them play most often on a personal computer, 8.5 % on a game console like the Playstation, and 1 respondent on a laptop 0.8%. Out of a total of 73 respondents who play computer games, 26 of them, male and female, are most often on their mobile phones, aged 3-4, and 47 of them, aged 5-6, in both sexes. When it comes to owning a device, most parents answered that the child does not own their own tablet or mobile phone, 58.5%, ie 69 respondents. The vast majority of respondents 87.3% (out of N = 118) answered that they think that their child owns a small number of computer games from 1-3, while 11.9% or 14 of them answered that they own from 10 to 20 computer games, and only one respondent (0.8%) answered that a child owns more than 20 computer games. Parents (118 respondents) stated in most of the answers that a child often 37.3% (3 times a week) plays computer games, regularly 13.6% (4-5 days a week), and even 18.6% every day. 36 respondents 30.5% answered that a child rarely plays computer games during the week. When we add up the total number of respondents who play 3 to 7 times a week we come to an incredible 69.5% of respondents. Accordingly, the parents also stated the daily duration of playing computer games. 26 of them (22%) stated that the child plays computer games for 10 - 15 minutes a day, 44 that they play 30 minutes a day (37.3%), 1 hour 33 of them (28%), 1 hour and 30 minutes 5 respondents (4 , 2%), and 10 respondents that a child plays 2 hours or more a day (8.5%). The number of hours children spend playing computer games is correlated using the Pearson coefficient (r) with the number of hours children spend engaging in other listed activities. For watching TV (r) is 0.46, organized activities 0.02, playing outside -0.52, learning terms 0.27.

Which means that the time of playing computer games is insignificant or not at all related to the time spent on other activities, so it is not possible to confirm the thesis that the child will replace one activity with another.

Figure 1 shows a graphical representation of the average time of playing computer games in relation to other activities, so as a result, children spend the most time a week playing outside for an average of 9.22 hours, for sports activities 6.37 hours, followed by learning new concepts from 5.50 hours. Interestingly, the number of hours is almost equal with a slight difference in minutes when it comes to watching TV (5.23), learning new concepts and playing computer games. But regardless of the same, physical activities are at the forefront of the way we spend our time.



**Fig. 1.** Average playing time in connection with other activities

More than half of the parents (60 respondents) answered that 50.8% choose computer games in cooperation with their children, while 36 respondents (30.5%) stated that they choose the computer game that the child will play. A small number of respondents answered that a child by himself chooses a computer game to be played by 18.6%. 28% of children play computer games independently, which is similar to the above percentage of parents who choose a computer game to play. The majority of parents claim that they occasionally play computer games with their children (65.3%), while 8 of them (6.8%) claim that they always play computer games together with their children, which shows that parents are more careful about which games the child uses or downloads, by playing games with their own children, they have more control over playing computer games. More than half of children never play action games 53.4%, shooter games never play a slightly higher number of respondents 69.5%, and a slightly smaller number of respondents who never play arcade like games 39.0%. Occasionally an equal number of respondents play both action and educational computer games 32.2%, followed by arcade games with 30.5% and the least shooters games 21.2%. Computer games that respondents often use are educational 50.8%, while the smallest number of those who often play shooter games is 7.6% or only 9 respondents out of 118 in total. Action games are often played by only 10.2% of respondents, and arcade games by 26.3%. Very often, respondents play educational computer games 11%, action and arcade games in equal numbers 3.4%, and only one respondent who plays shooter games very often. Every day, only one respondent plays action, arcade, shooters 0.8%, while educational plays 5 respondents or 4.2%. Overall, most children play educational games, followed by arcade games, action computer games and shooter games at least.

Calculating the total percentage of frequency of use for all games that contain some form of violence (arcade, action, shooter games) we come to the average percentage of children who are exposed or not, to violent content. Data shows that on average more than half of the children were never exposed to violent content by 63 respondents or 53%, occasionally 27.96% and 33 children, and often 17 children, ie 14.7%. Every day only 1 child, and very often three children 2.53%.

The vast majority of parents have complete control over the content of computer games that their children play. Action games (9.3%) and shooters (10.2%) leave the least number of parents unattended, while they are completely supervised by the most respondents. Thus, 62.7% of parents completely control the action, and 68.6% of the shooters. It is interesting to note that in relation to the type of game, parents are mostly partially controlled by educational games 33.1%, followed by action games with 28%, but regardless of the same, educational games parents are somewhat less fully controlled by 46.6%. Arcade games are completely controlled by more than half of parents by 56.8%, while they are not controlled by 16.9%. Regarding time control, the largest number of respondents constantly follow the play of shooters 51.7%, followed by action games with 45.8%, and arcade games with 42.4%. That parents are not inclined to constantly monitor educational computer games is shown by the fact that only 28.8% do so, but that is why 55.9% most occasionally follow the management of this type of game. Of the respondents, the largest number of them never follow the play of arcade games 21.2%, and a small number of parents who never follow the play of shooter game and action games. The Pearson correlation coefficient between content control by game type and parental time control was calculated. The coefficients obtained for each of the computer games show that there is a strong correlation between content control and time when it comes to all violent content games. The more violent the game, the higher the time of parental supervision ( $r = 0.91$  shooters,  $0.82$  action,  $0.85$  arcade,  $0.30$  educational), the relatively weak correlation is valid only for educational computer, so it can be concluded that parents don't need to supervise educational computer games in such extent.

Parental control was examined regardless of the type of game, according to Likert's scale from (1) -I completely disagree to (5) -I completely agree. Thus, 48.3% of parents fully agree to closely monitor how long a child plays computer games, 39.8% completely limit playing computer games for a certain period of time, while the above also applies to careful monitoring of content 50.8%. Almost half of the respondents, 48.3%, would not approve of a child buying or receiving as a gift any type of computer game. So it can be concluded that most parents fully or partially agree to control the time and content of computer games. When we talk about the impact of computer games on the behavior, variable aggression is not confirmed in most, but 70.3% of them agree that when they take the child device (on which it plays a computer game) the child can be angry, grimace or cry. Many parents 39.8% or 47 respondents believe that after a child plays a violent game, child often played that he is the hero of that game, and 60.2% think the opposite. The relationship between frequent time spent playing computer games and the impact on aggression was measured by taking into account all children who play frequently (3 times a week), regularly (4-5 times a week) and daily, and all those who affirmatively polls responded to all three allegations of aggression. According to the above, it was confirmed that the time of playing computer games affects aggressive behavior, but



this only applies to a small group of children, a total of 11 of 118 respondents, which is about 10% of respondents.

When it comes to addiction, parents don't think that their children are addicted to computer games 59.3% (average of three statements / negations), but therefore a relatively high percentage of 61.9%, those who confirm that their child sometimes does not want to complete tasks because child wants to continue playing computer games, which according to [24] and [25] is interpreted as a continuation of play despite a ban by the parents. Only 20.3% of parents stated that a child sometimes hides from them that he played a violent game because they were not allowed to play it. Also, as many as 39.8% of children think that their parent gives them too little time to play computer games, which means that children would extend their playing time if they could. But regardless of the above, we have already examined that 69.5% of children play from (3 to 7 times a week), ie 44.4 minutes a day almost the same as watching TV (a total of about 90 minutes), which is definitely too much time children spend in front of a screen given the recommendations (less than 1 hour) of APA [9].

Attention and concentration were measured separately. The reason why this is so is that concentration refers to the focus of the mind on a particular subject and is crucial for mechanical and technical learning (such as learning a new programming language). Attention, on the other hand, is all-encompassing and it does not exclude anything, ie anything can distract it. [26] Among other things, children's attention is badly affected by environmental conditions, such as noise, which is why children like permanence and predictability when it comes to attention because it gives them a sense of security. [27] Consequently, in the attention variable, parents were asked to indicate whether the child is sometimes afraid of new things and situations when playing violent play. Thus, the impact of violent games on attention was also measured. Slightly more than half of the respondents answered that the stated statement was not valid for them, 55.1%, while 53 respondents answered that violent games affect the attention of their children, in a way that the child is sometimes afraid of new things or situations 44.9% . That the child more often chooses an educational computer game, when the parent is nearby, is confirmed by 80 respondents or 67.8%. In this way, it was confirmed that the parent influences the child's attention when it comes to choosing a game because the child is more careful, and at the same time this statement confirms the learning variable, since educational games have a positive effect on the same. 83.1% of respondents believe that educational computer games help children to improve concentration, while 16.9% of 20 disagree with this statement. Both the concentration and learning variables were confirmed so that 75.4% of parents confirmed that the child learned the alphabet, numerators, and concepts more easily with educational computer games. Further to the concentration, a large percentage of respondents 61.9% answered that the child often does not hear what the parent is saying when playing computer games, so the child continues to play. From the same it can be seen that children are very concentrated on computer games and find it difficult to be distracted by them, which of course affects their attention, and this can have consequences for learning. The cognitive development of a child at an early age is extremely important because through play the child learns, as already mentioned. That this is the case is confirmed by the fact that 86.4% of children recognize things / concepts from play and in reality, so children show or explain the same to their parents if 80.5% of them also encourage them to do so.

If used to a reasonable extent and in the presence of parents, educational computer games will help better concentration and increased attention and thus improve learning in preschool children.

#### **4 Analysis regarding hypothesis**

**H1a** According to [28] if a child has a computer in their room, the likelihood of playing computer games with violent content increases. The results obtained in this study confirm that as many as 61.9% of children most often play computer games on mobile phones, while 41.5% of the total number of respondents own their own device (tablet or mobile phone). The social environment in which a child plays a computer game is very important because negative consequences most often occur when a child uses a device (i.e., plays a computer game) without supervision. [23] Consequently, the data show that 65.3% of parents occasionally play computer games with their children, 28% never play computer games with a parent, and 6.7% always play computer games with a parent. The results are thus much better compared to the [29], where more than half of children never play computer games with a parent, indicating a lack of control over the content of the computer game and possible negative consequences. However, the parents of preschool children in the majority believe that they closely monitor the content of computer games 50.8%, and they do so by the vast majority of them in cooperation with children (50.8%) or themselves (30.8%) choose computer the game that the child will play, which is also one of the reasons why most children are not exposed to violent content, 54% of them. If preschool children are exposed to violent content, they are on average 27.96% on average, often 14.7%, and very often on a daily basis, only 3.33%. Most parents do not believe that computer games affect the aggressive behavior of preschool children. 60.2% of parents claim that the child does not imitate a hero from an action and / or violent game, so the theory of social learning which states that children imitate what they see is not valid for most respondents [5], also a large number of respondents 74.6% he does not think that the child is careless towards others or that he does not want to share a computer game with others when he plays it, which is similar to previous research. [30] 70.3% of parents agree that a child is angry, grimaces or cries when a child is deprived of a device on which he plays a computer game, which is the only indicator of possible misbehavior of preschool children. The influence of violent games on attention was confirmed in 44.9% of respondents, so the majority of 55.1% do not notice that the child is afraid of new things or situations when the child plays violent game. Following all the above, hypothesis H1a which states "**The content of playing violent games will have a bad effect on the behavior of the preschool population**" is rejected.

**H1b** Parental attention to the use of computers in preschool should be constant and the child should not be allowed to use the computer for more than twenty minutes a day, [11] argues. According to the research results, children spend an average of about 44.4 minutes playing computer games, and similarly watching 46 minutes on TV, which is half the time children spend learning new concepts (50 minutes) a day. However, preschool children spend most of their time in organized activities such as sports, etc. 56 min / day, and playing outside for 1 hour and 20 minutes.

According to Pearson's correlation coefficient, playing computer games is weak, ie it is not related to other activities, so children do not replace any of the activities for playing computer games. Preschool children mostly play educational computer games, and parents are of the opinion that they help cognitive development 75.4% (children learn the alphabet, concepts, etc. more easily), followed by arcade games. 60.2% of children do not think that their parent gives them too little time to play computer games, but they refuse to cooperate with the parent when they need to complete their tasks 61.9%. But despite the same, the vast majority of parents 66.1% said that the child owns only 1 to 3 computer games, which suggests that they do not spend too much time on the same, which confirms the hours spent playing outside and in sports activities, also from the total minutes they spend playing are, among other things, educational content, which has a positive effect on the cognitive development of a preschool child. In support of this is the fact that parents mostly control the time of playing the games. Cognitive patterns develop over a long period of life and they can develop through imitation into positive and / or negative effects so children can eventually learn that violence is a generally accepted phenomenon in the world and that aggression is a normal response to some events. In the same way, these cognitive scripts become a guide for future behavior, Huesmann argues. [31] Accordingly, this study confirmed that playing time of computer games influences aggressive behavior as a result of negative cognitive patterns, but this only applies to a small group of children, a total of 11 out of 118 respondents, accounting for about 10% of respondents. Considering all the above, hypothesis H1b which states "**The amount of time playing games will have a bad effect on early learning, ie cognitive development**" is rejected.

**H1c** Given the limitations in cognitive development in children between the ages of three and four, memory is "unintentional", and it becomes "intentional" between the ages of four and five, [32] it is important to adapt the educational computer game according to the age of the child [33]. The preschool group of children plays the most educational computers, the data show that 32.2% of them occasionally play, often 50.8%, very often 11% and 4.2% daily, while only 2 respondents answered that they never play educational games. Parents most often occasionally watch educational computer games, ie 66 respondents, which is not surprising given that parents confirmed that in their presence children most often choose this type of game 67.8%, so children with parents together choose instructive content and properly direct their attention that is important to learning and behavior. As the authors [10] point out, it is important that the content of a computer game is positive and instructive, and that by using educational computer games parents can teach their child without That this is indeed the case, parents confirmed that their child learned the alphabet, counters and concepts more easily with educational computer games 75.4%, while 86.4% found that their child recognized things / concepts, 83.1% of respondents said that they helped the child to improve their concentration. It can be said that educational games encourage positively shaped cognitive patterns according to Huesmann [31], so it affects better behavior, and what proves the fact that 80.5% of children show and explain to their parents the concepts they have learned. According to the above, hypothesis H1c which states "**Educational games will have a positive effect on early learning and behavior**" is accepted.

**H2a** It is important that parents understand the virtual world in which children spend their time, that they are interested in the content of the game, the story and characters, and the rules and agreements about the place and time of play. The more parents are interested, the sooner they can recognize the dangers and react to them in a timely manner. [1] More than half of parents who in cooperation with their children 50.8% or 30.5% themselves choose computer games for their children confirm that parents are more careful about which games their child uses, also most of them occasionally 65.3% or always 6.8% play computer games with children, so it is understandable that they can better control the content of the game and thus reduce possible addiction and problems. This is supported by the result that according to the content of the game, action games (9.3%) and shooter games (10.2%), the smallest number of parents are left unattended, while they are completely supervised by most respondents. Thus, action is completely controlled by 62.7%, and shooter games by 68.6% of parents, and it is similar with arcade games by 56.8%. When it comes to time control according to the type of computer game, the largest number of respondents constantly follow the shooter games 51.7%, followed by action games with 45.8%, and arcade with 42.4%. That is because, if game is with more violent content, the longer is the parental control time (Pearson  $r = 0.91$  shooter games, 0.82 action, 0.85 arcade). The majority of respondents agree that parents fully or partially control both content and time, and the result of this monitoring is that looking at the whole, neither the variable aggression nor dependence in children is confirmed in the majority (only one in three statements is positive). Therefore, it can be concluded that greater parental supervision reduces the signs of addiction (79.7% of children do not hide from their parents that they have played violent play) and prevent problematic behavior, especially in relation to aggression. According to the results of hypothesis H2a which states "**Greater parental supervision will reduce addiction and behavioral problems**" is confirmed.

**H2b** For children at an early age, all activities represent some form of learning. This includes educational games that encourage the child's literacy and numeracy, and are just as important as conventional learning. But without parental involvement, it is unlikely that a child would receive the same positive incentives to use them. [34] It has already been mentioned that the more violent the game is, longer is parental control time ( $r = 0.91$  shooter games, 0.82 action, 0.85 arcade), but the same is not true for educational computer games where Pearson ( $r$ ) is 0.30. There is a relatively weak correlation with time, which is understandable because it refers to computer games that encourage learning and without violent content. Regardless of the same, according to the content of the game, parents mostly partially supervise educational games 33.1%, and fully 46.6%, adding up the total supervision we come to 79.7% of parents. That parents are not inclined to constantly (temporarily) monitor educational computer games is shown by the fact that not only 28.8% do so, but that is why 55.9% most occasionally follow the management of this type of game. Adding up all the respondents who occasionally play educational computer games every day, we come to 98.2% of respondents, so it is not surprising that this form of computer game in cooperation with parental supervision helps to improve concentration in 83.1% of children, facilitates learning 75.4% and recognizing real concepts using virtual 86.4%. If we compare the total supervision of educational games 79.7% and the total number

of respondents who play the above 98.2%, and the high percentage of positive effects (already mentioned) on cognitive development, it can be concluded that the last hypothesis H2b which states „**Greater parental supervision will improve the cognitive development of the preschool child**” is confirmed.

## **5 Conclusion**

Unlike adults who play computer games for entertainment, preschoolers ages 3 to 6 use them as one of the ways they learn about the world around them. Half of the parents of the younger preschool population (children aged 3-4), guided by this knowledge, still don't allow their children to play computer games because they believe that children are not yet mature enough for the same or they are afraid of negative consequences, while parents are more inclined to allow playing when kids are older. The cause for concern is confirmed by the fact that children nowadays use mobile phones and tablets much more, so that 61.9% of them use them to play computer games, while 41.5% of the total number of respondents own their own device (tablet or mobile phone). Therefore, parents should be extremely careful when using the device by their children and should not leave them unattended, so as not to be exposed to violent content. That parents of preschool groups closely monitor the content is proved by the fact that computer games are chosen in cooperation with the child, and computer games occasionally or always play with the child, so most children about 54% are never exposed to violent content. Overall, the preschool population is not aggressive because of playing, and children don't show addiction, but playing violent games can affect the child's attention, so children show fear of new situations or things in a smaller number of respondents 44.9%, and in order to the percentage is still decreasing in the future is the key role of parents that will allow them permanence and predictability, all the more so because at an early age attention and concentration develop, and cognitive patterns are formed for future behavior. It has been found that playing computer games affects aggressive behavior, but this only applies to a small group of children, which makes up about 10% of respondents. It is certainly worth noting that children at such an early age still spend most of their time playing outside and other organized activities such as sports, which is important for the proper growth and development of this group. This research showed an increased use of computer games, compared to previous years, and it is expected to increase in the future, so it is not considered that there is a reason why children at that age should not play computer games, especially since the need increases for children's computer literacy. Children between the ages of 3 and 6 mostly play educational computer games, do not have a lot of computer games, parental control over violent games has increased, and parents are happy to use the time to play educational computer games together with their children, learn new concepts and improve their cognitive development and behavior, of course if parents carefully determine the playing time and control the content of computer games.

Similar research papers can be found in references such as [35-38], but keep in mind that some of those are leaving our research focus, so they can be used for wider purpose and possible future work.

## References

- 1 Harviainen, J. T., Meriläinen, M., & Tossavainen, T. (Eds.). *The Game Educator's Handbook*. The Finnish Game Educators Network.
- 2 Kovačević, S. (2007). Slobodno vrijeme i računalne igre. *Školski vjesnik: časopis za pedagoškijsku teoriju i praksu*, 56(1.-2.), 49-63.
- 3 Lieberman, D. A., Fisk, M. C., & Biely, E. (2009). Digital games for young children ages three to six: From research to design. *Computers in the Schools*, 26(4), 299-313.
- 4 Singer, D. G., & Singer, J. L. (2009). *Imagination and play in the electronic age*. Harvard University Press.
- 5 Bandura, A. (1986). *Social foundations of thought and action*. Englewood Cliffs, NJ, 1986, 23-28.
- 6 Kotilainen, S., Suoninen, A., Walamies, T., & Tuominen, S. (2011). *Children's media barometer 2010: The use of media among 0-8-year-olds in Finland*. Helsinki: Finnish Society on Media Education.
- 7 OFCOM: Children and Parents: Media Use and Attitudes Report 2018. Available at: [www.ofcom.org.uk/research-and-data/media-literacy-research/childrens/children-and-parents-media-use-and-attitudes-report-2018](http://www.ofcom.org.uk/research-and-data/media-literacy-research/childrens/children-and-parents-media-use-and-attitudes-report-2018)
- 8 Eurostat (2019). *Digital economy and society statistics - households and individuals Internet access of households*. Available at: [https://ec.europa.eu/eurostat/statistics-explained/index.php/Digital\\_economy\\_and\\_society\\_statistics\\_households\\_and\\_individuals](https://ec.europa.eu/eurostat/statistics-explained/index.php/Digital_economy_and_society_statistics_households_and_individuals)
- 9 Roda (2016). *American Pediatric Academy Recommendations on the Use of Digital Media*. Available at: [roda.hr/portal/roditeljstvo/izazovi-roditeljstva/preporuke-americke-pedijatrijske-akademije-o-koristenju-digitalnih-medija.html](http://roda.hr/portal/roditeljstvo/izazovi-roditeljstva/preporuke-americke-pedijatrijske-akademije-o-koristenju-digitalnih-medija.html)
- 10 Anđelić, S., Čekerevac, Z., & Dragović, N. (2014). Utjecaj informacijskih tehnologija na razvoj predškolske djece. *Croatian Journal of Education: Hrvatski časopis za odgoj i obrazovanje*, 16(1), 259-287.
- 11 Armstrong, A., & Casement, C. (2000). *The Child and the Machine: How Computers*. Robins Lane Press, Beltsville.
- 12 Klimentko, A. (2018). Psychological features of interpersonal communication of senior preschoolers in the transition to school education. *EUREKA: Social and Humanities*, (6), 19-24.
- 13 Council on Communications and Media, & MBE. (2016). Media use in school-aged children and adolescents. *Pediatrics*, 138(5), e20162592.
- 14 Weis, R., & Cerankosky, B. C. (2010). Effects of video-game ownership on young boys' academic and behavioral functioning: A randomized, controlled study. *Psychological science*, 21(4), 463-470.
- 15 Hastings, E. C., Karas, T. L., Winsler, A., Way, E., Madigan, A., & Tyler, S. (2009). Young children's video/computer game use: relations with school performance and behavior. *Issues in mental health nursing*, 30(10), 638-649.
- 16 Papanastasiou, G., Drigas, A., & Skianis, C. (2017). Serious games in preschool and primary education: benefits and impacts on curriculum course syllabus. *International Journal of Emerging Technologies in Learning (iJET)*, 12(01), 44-56.
- 17 Kokkalia, G., Drigas, A., & Economou, A. (2016). The role of games in special preschool education. *International Journal of Emerging Technologies in Learning (iJET)*, 11(12), 30-35.
- 18 Drigas, A. S., & Kokkalia, G. K. (2014). ICTs in kindergarten. *International Journal of Emerging Technologies in Learning*, 9(2).
- 19 Mikas, D. (2007). Kako roditelji i odgojitelji procjenjuju emocionalni razvitak i ponašanje djece predškolske dobi. *Odgojne znanosti*, 9(1), 49-73.

- 20 Creasey, G. L., & Myers, B. J. (1986). Video games and children: Effects on leisure activities, schoolwork, and peer involvement. *Merrill-Palmer Quarterly* 251-262.
- 21 Common Sense Media (2019). Parent reviews for New Super Mario Bros. Available at: <https://www.commonsensemedia.org/game-reviews/new-super-mario-bros/user-reviews/adult>
- 22 Ružić Baf, M., & Radetić Paić, M. (2010). The impact of computer games on young people and the use of PEGI tools. *Life and school: a journal for the theory and practice of education*, 56(24), 9-18.
- 23 Buljan Flander, G., & Karlović, A. (2004). *Odgajam li dobro svoje dijete?. Savjeti za roditelje*. Zagreb
- 24 Fisher, S. (1994). Identifying video game addiction in children and adolescents. *Addictive behaviours*, 19(5), 545-553.
- 25 Bilić, V., Gjukić, D., & Kirinić, G. (2010). Mogući učinci igranja računalnih igrica i videoigara na djecu i adolescente. *Napredak*, 151(2).
- 26 Suravarapu, S. (2016). What is the Difference between Concentration and Attention (or Mindfulness)? Available at: <https://suryas.org/blog/what-is-the-difference-between-concentration-and-attention-or-mindfulness/>
- 27 Sirius (2015). Center for Psychological Counseling, Education and Research. How to improve children's attention and concentration? Available at: <http://centar-sirius.hr/wp-content/uploads/2015/07/Publikacija-pa%C5%BEnja-i-koncentracija.pdf>
- 28 Kutner, L. A., Olson, C. K., Warner, D. E., & Hertzog, S. M. (2008). Parents' and sons' perspectives on video game play: A qualitative study. *Journal of Adolescent Research*, 23(1), 76-96.
- 29 Olson, C. K. (2010). Children's motivations for video game play in the context of normal development. *Review of general Psychology*, 14(2), 180-187.
- 30 Ferguson, C. J. (2009). Research on the effects of violent video games: A critical analysis. *Social and Personality Psychology Compass*, 3(3), 351-364.
- 31 Rowell Huesmann, L. (1988). An information processing model for the development of aggression. *Aggressive behavior*, 14(1), 13-24.
- 32 Selimović, H., & Karić, E. (2011). Teaching preschool children. *Methodological Horizons: A Journal for Educational Theory and Practice*, 6(11), 145-160.
- 33 Peirce, N. (2016). Chapter Eight Digital Game-Based Learning for Early Childhood. *Game-Based Learning and the Power of Play: Exploring Evidence, Challenges and Future Directions*, 156.
- 34 Griffith, S. F., Hanson, K. G., Rolon-Arroyo, B., & Arnold, D. H. (2019). Promoting early achievement in low-income preschoolers in the United States with educational apps. *Journal of Children and Media*, 13(3), 328-344.
- 35 Blumberg et al., *Digital Games as a Context for Children's Cognitive Development: Research Recommendations and Policy Considerations*, 2019. <https://srcd.onlinelibrary.wiley.com/doi/full/10.1002/sop2.3>
- 36 Martinovic et al., Computer games that exercise cognitive skills: What makes them engaging for children?, *Computers in Human Behavior*, Vol 60, July 2016, 451-462.
- 37 Claudia Sălceanu, The Influence of Computer Games on Children's Development, Exploratory Study on the Attitudes of Parents, *Procedia - Social and Behavioral Sciences* 149 ( 2014 ) 837 – 841
- 38 Cecilia M.R., Di Giacomo D., Vittorini P. (2015) Influence of Gaming Activities on Cognitive Performances. In: Mascio T., Gennari R., Vittorini P., De la Prieta F. (eds) *Methodologies and Intelligent Systems for Technology Enhanced Learning. Advances in Intelligent Systems and Computing*, vol 374. Springer, Cham. [https://doi.org/10.1007/978-3-319-19632-9\\_9](https://doi.org/10.1007/978-3-319-19632-9_9)