Impact of Digital Game-Based Learning on the Social Competence and Behavior of Pre-Schoolers

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Abstract

Digital gaming has become a regular part of life for today's pre-schoolers. Hence, there is a need to look at the integration of digital technology into the preschool education. The present study aims to examine the effect digital games have on children's behaviour and their social competence if played to reach an educational purpose (supervised play) and for fun (without educational aim). The study population consists of 54 pre-schoolers (26 girls and 28 boys), aged 4 to 6, who were recruited in Moscow, Russia. All children were divided in two groups: children playing digital games with peers ($n = 28$) and children playing digital games at home ($n = 28$). Findings revealed a higher level of social competence in the experimental group ($+11.71$, $p \leq 0.05$) as compared to children playing without being told what they were expected to achieve. The experimental group also scored lower on Anxiety-Withdrawal (-7.94 , $p \leq 0.05$). A higher Anxiety-Withdrawal score normally means that a child experiences some degree of depression or anxiety, and exhibits overly dependent behaviour. The results of this study may help parents and teachers to use digital learning tools, in particular video games, effectively when working with young children.

Introduction

Play is the leading type of activity that is available for children during their preschool years and whereby they make cognitive, emotional, and physical progress. It helps pre-schoolers to improve their attention, memory, imagination and dexterity and makes them disciplined¹. In addition, play is a natural way to assimilate social experience. As digital technologies are embedded into our daily lives, modern children grow up playing digital games more than previous generations and education is changing accordingly. The past decade has seen phenomenal growth in digital game-based learning. A learning environment that is interactive and visually stimulating becomes increasingly desirable². A shift to digital game-based learning raises questions about game strategies and teaching methods³. Most of the statistical data on digital usage relate to children aged 11 and older, but the current trends suggest that the focus should be shifted to younger kids, whose lives have also changed with new technology. In a digitalized world, we should abandon the futile attempts to cut our kids from the digital space and focus more on giving them the right digital content and resources that will help them develop in positive ways^{4,5}. One of the most important factors affecting a child's mental and emotional development is virtual play⁶. Hence, preschool education programs should focus on creating a favourable learning environment using, among other things, digital means, including digital games that promote emotional development, socialization, and creativity in preschool-aged children. This paper investigates whether learning through digital play reduces or enhances the levels of aggression and anxiety in preschool-aged children. It also examines the impact of learning through digital play on the preschool-aged children's level of social competence.

Literature review

The impact of digital games (mobile games, computer games, etc.) is a relevant topic that attracts the attention of many scientists. Research has shown mixed results in terms of how digital games affect player's behaviour. Some studies reported negative implications, such as increased aggressiveness,

health issues, and psychosocial struggles, and others found that video games were able to improve hand-eye coordination and self-esteem^{7,8}. Digital games that require teamwork make learners communicate with each other to discuss and agree upon the following steps, thereby improving their social skills⁹. A well-designed digital game can provide powerful interactive experiences fostering young children's learning, skill building, and healthy development¹⁰. In general, researchers agree that electronic games have a certain impact on the behaviour of preschool children¹¹⁻¹³. Games, including digital ones, can provide a meaningful environment for problem-based learning, which is important given that a problem-solving skill is among the essential skills a person must possess. Since the purpose of the education is, among other things, to train learners how to handle new situations, play can serve as a means to create these new situations^{14,11}.

Educational games, which are central to the 'serious play' movement, show promise for the integration of learning with an inherently motivational gaming environment. Learning through digital games enables children to actively participate in the learning process¹¹. Digital game-based learning, shortly DGBL, is defined as an instructional method that incorporates educational content or learning principles into video games with the goal of engaging learners^{15,16,9}. An unexpected or repeated encounter with new challenges (video games) requires additionally motivation to interact with educational material through play¹⁷. Kids between the ages of 3 and 8 prefer games that are animated, oriented toward problem-solving, and give them a sense of control¹⁸.

There are 12 structural elements of learning through play: a form of fun, rules, goals, interactivity, outcomes and feedback, adaptability, win state, challenges, problem-solving, interaction, and story^{6,12}. Not all video games are effective learning environments though. To suit the educational purpose well, video games must match the age, abilities, and skills pre-schoolers need to learn¹⁹.

Social competence and behaviour

Socialization is a process by which people learn social life, master social relations, develop social roles, and acquire skills and abilities necessary to become part of a community²⁰. This process is closely related to a person's understanding of himself or herself and depends on how active they are in life. Socialization comes from multiple sources, including family, preschool institutions, educational organizations, and other institutions of socialization^{21,22}. Across the developmental periods of preschool years, prosocial skills (friendly, cooperative, and helpful behaviours) and self-control skills (anger management, negotiation skills, and problem-solving skills) are key facets of social competence. In addition, however, developmental changes occur in the structure and quality of peer interactions that affect the complexity of skills contributing to social competence²³. Children with higher levels of social-emotional competence are more likely to receive acceptance and sympathy among their peers and they tend to have a more positive attitude towards preschool²⁰. In contrast, rejected children tend to be more aggressive or isolated and exhibit lower levels of prosocial behaviour²⁴. Children displaying low social competence demonstrate peer rejection and lower school performance than children who are more

socially competent²⁵. Low social competence can also be a source of behavioural issues, such as internalizing (e.g., anxiety and withdrawal) and externalizing (e.g., acting out and conduct disorders) behaviours, as well as over-control (inhibited, and dependent) and under-control (impulsive, inattention, and aggressive) behaviours^{26,27}.

The effect of digital games on kids is a topic that sparks much debate in the scientific community. The use of digital games and, more broadly, digital technology in early childhood education received substantial criticism. The interactive play was reported to distract children from socio-emotional and psychomotor learning activities²⁸. In addition to that, there are issues that stem from inadequate physical and cognitive ergonomics, as well as situations where children put more efforts to master digital skills, rather than developmental skills²⁹. Since playing too much video games can lead to a more sedentary lifestyle and distract from social connection, the use of digital games in the classroom is limited to make sure that children receive the necessary amount of physical activity³⁰. Between ages 3 and 6, children demonstrate variability in how they develop their intellectual, social, emotional, and physical skills, and they also differ in their character and interests. Pre-schoolers have fewer real-life social experiences as compared to older children and adults and they are far less able to tell fantasy from reality, especially at age 3^{31,32}. Long-term studies show that using games in educational contexts leads to greater learning, stronger motivation, and more productivity^{33,34}.

Research into DGBL tends to focus on the motivational effects of the methods, in part because learners playing the game may find it to be very engaging: sometimes, players are totally immersed in the game and can play it for hours with little or no awareness of the broader world around them³⁵. The production of intrinsic motivation in players was postulated to depend on seven factors, which include both individual and interpersonal factors^{35,36}. The *individual* factors are a challenge, curiosity, control, fantasy, competition, cooperation, and recognition. The *interpersonal* factors are associated with the use of incentive structures, such as stars, points, leader boards, badges and trophies that player might want to earn, as well as the game mechanics and actions that students enjoy or find interesting to try³⁷. From the perspective of impact on social competence, it is desirable to use less extrinsic motivators and focus instead on making the game feel more interesting and fun to play³⁸.

Research question

Today, Kazakhstan and Russia continue to reform the education system to eliminate problematic issues identified during the assessment activities. The impact of digital games on children is a topic that causes a lot of controversy in the scientific community in these countries.

So far, there is still a debate going on about which aspects of play lead to learning and what effect play has on the psychological development of children. Do educational video games affect children's interpersonal relationships and behaviour in a group? Without assessing the impact of play on child's self-esteem and social competence, it will continue to be regarded as a tool that is motivational and fun, but useless in terms of fostering social development in children. The rapid growth in the use of

educational digital games has generated the need to determine if they can provide learners with suitable learning environments. The evaluation is done by assessing the impact of digital games on a child's social, emotional, cognitive, and physical development. At the same time, the digital games research generally lacks a consistent research paradigm. Most articles on educational digital games focus on the motivational potential of games or their benefits to learning. Therefore, there is a need to assess the impact of digital educational games on the social competence and behaviour of children. Given the fact that everyday life of people is now digitalized, we must to understand what consequences digital technologies have for development and how they affect the levels of social competence, anxiety, and aggression in children. The present study aims to explore the impact of digital educational games on the behaviour and social competence of preschool-aged children in controlled and for fun (unsupervised play). The following research questions are raised:

Are there differences in levels of anxiety, aggression, and social competence between children who play digital games in a classroom for learning purposes and children who plays just for fun?

How will the behaviour of preschool children change after integrating digital games into their classroom routine?

Methods

Participants

The study involve 54 preschool children (26 girls and 28 boys), aged 4 to 6 (mean age = 5.5, SD = .76), attending two state kindergartens in Moscow, Russia. All children were divided in two groups of 28 children each: an experimental group and a control group.

Procedure

Before the study began, parents and caregivers were invited to a preliminary meeting with the researchers to explain the objectives and methods of the study, as well as to obtain their informed consent. None of the parents objected to their child's participation in the study. The lesson schedule was agreed upon with the administration of the kindergarten.

The study lasted 3 months and involved the use of age-appropriate digital games. Despite the fact that these games were selected for educational purposes, they facilitated the social interaction between pre-schoolers as children shared their impressions with each other and engaged in discussions regarding the complexity of games and their in-game achievements. A brief description of these games and their training aims are presented in Table 1³⁰.

Children in the experimental group played digital educational games in the classroom during specially organized lessons. Their parents were strongly advised not to permit their children to play mobile games more than 20 minutes at home during the experiment. Parents of children in the control group were asked

to download the same games and allow their children to play them freely. Therefore, children in the control group played the same games as children in the experimental group but for fun (not educational purposes) during the breaks. Children in both groups were evaluated before and after the experiment. For this, caregivers working with children at the time were asked to complete a number of questionnaires. Evaluation was done with the involvement of trained developmental psychology graduate students of the Abai Kazakh National Pedagogical University, Almaty, Kazakhstan. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Measures

The study has a pre-test/post-test design in which the pre-schoolers' social competence and behaviour were assessed before and after the experiment using the *Social Competence and Behaviour Identification* (SCBE-30) questionnaire³⁹. The SCBE scale evaluates the teacher's perspective of the affective quality of a child's relationships. The principal intent of the scale is to describe children's social behaviours at school rather than to classify children within diagnostic categories for clinical intervention³⁹. The social competence subscale consists of 10 items that indicate positive social interactions as well as prosocial behaviour empathy (e.g., "Works easily in groups" and "Cooperates with other children"). The anger-aggression subscale is composed of 10 items that describe angry, aggressive, and oppositional behaviour (e.g., "Irritable, gets mad easily" and "Defiant when reprimanded"). The anxiety-withdrawal subscale is composed of 10 items that describe anxious, isolated, and dependent behaviour (e.g., "Remains apart, isolated from the group" and "Does not talk or interact during group activities"). Items are rated on a 6-point Likert scale: 1 (never) to 6 (always). The maximum score possible is 60. Score distribution is as follows: 0-20 – low level, 20-40 – middle level, 40-60 – high level.

The Anxiety-Withdrawal subscale reflects depressed, anxious, isolated, and overly dependent behaviours. The Anger-Aggression subscale includes items that measure angry, aggressive, selfish, and irritable behaviours. The Anger-Aggression subscale reflects children's angry, aggressive, and oppositional behaviours. Children scoring high on the Anger-Aggression subscale show negative affect and are unable to regulate negative emotions. The Anxiety-Withdrawal sub-scale is composed of items that measure shy, anxious, and isolated behaviours. Children scoring high on the Anxiety-Withdrawal scale spend much of their time alone and demonstrate anxiety when involved in group activities. Finally, the Social Competence subscale includes items that assess positive social interaction as well as prosocial behaviour empathy with peers. Higher scores thus represent higher levels of social competence. Socially competent children interact with others in positive ways and are appreciated by peers and teachers³⁹. The t-test was used to determine statistically significant differences between groups (significance level is set as $p < 0.05$). The 95% confidence intervals (CI) were calculated to perform mediation analysis. Tables present means and standard deviations.

Instruments

Statistical data processing was carried out in Statsoft Statistica V. 6.0 and data presentation was carried out with the help of Microsoft Excel.

Results

The comparison of pre-test and post-test levels of anxiety, aggression and social competence in children playing digital games for fun, without educational aim (control group) and children playing digital games exclusively to reach an educational goal (experimental group) is displayed in Table 2.

Results for the control group

There were no statistically significant differences in before and after SCBE-30 composite scores within the control group ($p > 0.05$, Table 2). The mean AA and AW scores show a statistically non-significant improvement by 4.22 and 3.07 points, respectively ($p > 0.05$). The post-test SC score decreased (-7.56, $p < 0.05$). A drop in the level of social competence in children playing digital games without supervision indicates a shortage of positive social interactions with peers, as well as communication issues.

Results for the experimental group

In contrast to the control group, children playing digital games in control conditions displayed a slight improvement in the post-test SC score, which increased by 3.18 points from baseline ($p > 0.05$). In addition to that, the experimental group (Table 2) saw a statistically significant improvement in the AW and AA scores (-6.26 and -2.1, respectively, $p < 0.05$), indicating that children became less aggressive and less anxious.

The comparison of pre-test and post-test levels of anxiety, aggression and social competence between groups is summarized in Table 3.

There were no statistically significant differences in pre-tests between groups. Nevertheless, this is not the case for post-tests as there are statistically significant differences in SC and AW scores ($p < 0.05$). The experimental group exhibited a lower AA score (-4.37, $p > 0.05$), but the difference was statically insignificant. The post-test SC score of the experimental group was higher (+11.71, $p < 0.05$) than that of the control group and its post-test AW score was lower (-7.94, $p < 0.05$). These findings indicate an improvement in the level of social competence among children who played mobile games for learning purposes. Meanwhile, children playing mobile games freely failed to demonstrate such an improvement.

Discussion

This study examines the effect digital games have on children's behaviour and their social competence if played to reach an educational purpose (supervised play) and for fun (unsupervised play). It was found that children playing digital games exclusively during the course of preschool lessons and for up to 20 minutes at home exhibited higher levels of social competence and lower levels of aggression and anxiety.

At the same time, children playing digital games without control experienced a decrease in their levels of social competence (-7.56), as evidenced by the post-test, even though the games they played were designed to promote their social development. The consequences of such decline may include feelings of withdrawn, awkwardness, and insecurity. Other findings include a slight increase in the levels of aggression and anxiety among control children, suggesting the presence of irritable behaviour⁴⁰. These results are congruent with other studies in this field. Some types of digital games were reported to provoke unstable individual attitude, hinder creative gaming, and lead to negative psychological and social implications, such as feelings and thoughts of aggression, aggressive behaviour, and decreased prosocial behaviour⁴¹. The present findings, however, show the opposite (Table 2), namely children who played digital educational games for learning purposes demonstrated a downward trend in their levels of anxiety and aggression, as well as an increase with respect to social competence. Stronger social competence means higher self-confidence and a better emotional state, and it helps to be more active^{42,1}. A study on the cognitive, emotional, and behavioural impacts of using an iPad in a primary school setting showed that children who used the iPad scored higher on overall engagement, cognitive engagement, and emotional engagement when compared to children in the control group, but not behavioural engagement⁴³. The previous research on game-based learning and its effect on the personality of preschool children in Kazakhstan showed that games facilitated the development of organizational skills. Players were found capable of handling any game situation and finding the right decisions promptly⁴⁴. Moreover, it seems that real-life social interaction during digital play enhances the positive impact of digital games on social development (Table 3), making the child feel more comfortable around other kids. Access to digital games in the classroom encourages children to attend preschools and stimulates their interest in preschool activities. A possible reason behind this effect may be the amount of digital-game play: children in the control group play digital games without aims, just for fun. Previous research holds that those who play video games for 2–3 hours become less sociable, withdrawn and irritable²³. The present study suggests that the insignificant difference in post-test AA score between groups may stem from sample and time limitations. Some studies have put forward a hypothesis that video games help in learning because they provide different cognitive and emotional experiences and are interactive, and, perhaps most importantly, because of their social development ability^{28,45,46}. The use of digital games in the classroom was reported to potentially help children understand the purpose of learning better, which prevents them from developing gaming addiction. Most studies criticized the use of digital games in preschool because they can lead to the formation of sedentary lifestyle patterns and distract from psychomotor learning. The present study, however, shows that well-organized guided digital play can enhance the social development of pre-schoolers. Many scientists focus on exploring gender differences in the use of video games. Future research can focus on other aspects of learning through play than specifically play, e.g., game creation. The practice of game development gives more room for creating unique stories, and the intent of game developers to meet the social-emotional needs of preschool aged children and foster their social development can influence the way they design their game interfaces. Also, future studies can last longer and examine the impact of digital games on the social competence of children of different age groups, from different backgrounds, with different intellectual abilities. Future

studies will take place in elementary school classrooms in the city of Almaty, Kazakhstan. Finally, the study population can be larger, especially now that digital devices are widely used by children worldwide.

Limitations

The present study has several limitations that should be considered: (1) the population for this research is limited to children living in one city, (2) no regard was made for racial and social status differences. Future research may benefit from expanding the research area and including children of different social and ethnic groups. In addition to that, the study lasted 3 months, which is a significant period for a pre-schooler, and no other drivers of social competence development in pre-schoolers were considered.

Ethical issues

Children with informed consent from both parents were recruited and guaranteed anonymity. The research process did not affect the performance or development of the child participants.

Conclusions

Digital play creates a deeply engaging experience that can be either rewarding, or frustrating, either build, or destroy a child's self-confidence and teach how to socially adapt successfully. This study shows that the use of digital games for educational purposes in the classroom stimulates social interaction between and reduces their levels of anxiety and aggression. The post-test SC score of the experimental group was higher (+ 11.71, $p < 0.05$) than in children who played games in uncontrolled setting (at home). The experimental group also scored lower on AW (-7.94, $p < 0.05$). There were no statistically significant differences in before and after SCBE-30 composite scores within the control group ($p > 0.05$).

Most studies indicate that digital play negatively affects the behaviour of preschool children. The present study, however, shows that the use of mobile games for learning purposes has a positive effect on social behaviour. During the experiment, the negative effects of digital game play were not seen.

Based on the results of the study, one can assume that playing video games in a learning environment will make children more adaptive to changes and more successful at interaction with others, putting them in a better position to thrive in modern world. This study may be of importance to students of pedagogical universities when building preschool lesson plans.

Declarations

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Conflict of interests. Authors declare that they have no conflict of interests.

Availability of data and material. Data will be available on request.

Code availability. Not applicable.

Authors' contribution. MF conceived and designed the analysis; OT collected the data; NZ contributed data or analysis tools; SK performed the analysis; MF, OT, NZ and SK wrote the paper. All authors read and approved the final manuscript.

Ethics approval. The research was approved by the local ethics committees Lomonosov Moscow State University.

Consent to participate. Children with informed consent from both parents were recruited and guaranteed anonymity.

Consent for publication. Parents gave their consent to the processing of information, subject to the anonymity of the participants.

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Tables

Table 1. Digital Games Selected for the Study and Skills They Help to Develop

Type of the game	Skills a pre-schooler is expected to develop
Rings Linking	The ability to recognize colours and shapes,
Puzzles	Logical thinking
Bubble Mania	Mathematical skills and logical thinking
Team Umizoomi Math: Zoom into Numbers	Mathematical and literacy skills
The Checkout Cookie	Mathematical skills and logical thinking
The Choo-Choo Choices	Skills of caring, sharing, and helping others
Unblock Me	Logical thinking, cognitive skills, and problem-solving through planning
BabyBus	Imagination, creativity
Lamsa early education	Intelligence, educational and language skills, critical thinking and problem-solving skills, emotional and social skills, creativity
Games for spelling	Language skills
Music games	Music perception skills

Table 2. Pre- and Post-Test SCBE-30 Scores in the Control and Experimental Groups

	Control Group			Experimental Group		
	Pre-test N = 27 M(SD)	Post-test N= 27 MD(SD)	p-value	Pre-test N = 27 M(SD)	Post-test N= 27 MD(SD)	p-value
Anxiety-Withdrawal (AW)	19.91(2.46)	24.11(2.53)	p>0.05	22.37(2.16)	16.17(2.53)	p<0.05
Anger-Aggression (AA)	20.34(2.72)	23.41(2.81)	p>0.05	21.05(2.52)	19.04(2.14)	p>0.05
Social Competence (SC)	41.76(3.11)	34.21(3.74)	p<0.05	40.73(3.12)	43.91(3.23)	p>0.05

*p <0.05

Table 3. Differences in Pre- and Post-Test SCBE-30 Scores between the Control Group (CG) and Experimental Group (EG)

	Pre-test			Post-Test		
	CG	EG	p-value	CG	EG	p-value
	N = 27	N= 27		N = 27	N= 27	
	M(SD)	MD(SD)		M(SD	MD(SD)	
Anxiety-Withdrawal (AW)	19.91(2.46)	22.37(2.16)	p>0.05	24.11(2.53)	16.17(2.53)	P<0.05
Anger-Aggression (AA)	20.34(2.72)	21.05(2.52)	p>0.05	23.41(2.81)	19.04(2.14)	p>0.05
Social Competence (SC)	41.76(3.11)	40.73(3.12)	p>0.05	34.21(3.74)	43.91(3.23)	P<0.05