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Research Article

An Innovative Educational Digital Game Design for Primary School Children with Autism

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Abstract –The aim of this study is to reveal the opinions of special education teachers regarding the implementation of an educational digital game developed for primary school children with autism. For this purpose, an educational digital game called "Together with Autism" was developed. The designed game includes numbers, geometric shapes, concepts of size, colours and emotions as taken from the curriculum of the Ministry of National Education for students with autism. The game was applied to 5 students with autism in the presence of a special education teacher, and data on the subject were collected from 5 special education teachers through semi-structured interviews consisting of 9 qualitative questions. The collected data were processed for descriptive analysis after which the findings were interpreted, and conclusions were reached. When the findings were examined, it was found that educational digital games have positive effects on students with autism and the number of such contents should be increased. During the implementation phase of the game, students with autism had fun and reacted to audio and visual stimuli with laughter. Teachers mentioned the lack of digital materials specifically created for this field. In this context, it was concluded that educational digital games should be developed in the field of special education. Teachers stated that educational digital games developed for students with autism increase motivation, support faster and permanent learning, provide learning experiences by having fun, appeal to multiple sensory organs and reduce the burden of the teacher.

Key words: educational digital game, autism, gdevelop, special education, autism and gamification

Introduction

Everyone has different abilities and learning levels. Given these differences, a variety of needs arise as technology advances. These differences are evident in school-age individuals. In this context, the inadequacy and improvement of education and training programmes are on the agenda. Children who cannot develop at the desired level due to individual differences need special education (Çuhadar, 2013). In cases of inadequacies in education and training programmes or due to individual differences, the education of individuals by specially trained people with curricula prepared specifically for this field is called special education (MEB, 2006).

People with special educational needs should be provided special education in order to achieve the same results as their peers, to develop their communication skills and to be integrated into real life. Apart from people who are able to make mental and physical decisions independently and without the need for special support in society, individuals who need support for these needs fall within the framework of special education. Accordingly, individuals whose development is different from normal have special needs (Baykoç Dönmez, 2010). In another definition, the aim of special education is to prepare individuals for independent living (Metin, 2012). It is well known that individuals in society have different physical, mental and social characteristics. Individuals who are physically, mentally and socially less adequate than their peers and who need special education are referred to as "privileged children" (Çağlar, 2019).

Autism is a combination of the Greek word “autos” (self) and the Latin word “ismus” (opinion) (Kuhn & Cahn, 2004). Autism is a spectrum disorder experienced by individuals with social and behavioral inadequacies, indifference to more than one situation, and deficits in understanding and interpretation (APA, 2013). It is crucial that individuals with autism, which is common today (Kurşun, 2022), be prepared for life. In order to integrate these individuals into society, social and psychological pressure factors such as exclusion and labelling must be removed. This is because exclusion is a behaviour that individuals perceive as negative and degrading (Goffman, 1968). Research is needed to prevent these situations, to integrate people with autism into society and to provide targeted benefits in terms of education and training. Although autism spectrum disorder has been included in the low incidence group, the number of individuals with autism is increasing (Eldeniz-Çetin, 2017). According to data from ADDM (Autism and Developmental Disability Monitoring) and CDC

(Centre for Disease Prevention and Intervention), the incidence of autism in individuals is 1/68 (Christensen et al., 2016).

It is indicated that individuals diagnosed with autism have a mental disorder caused by genetic and environmental factors, their social development is not at the desired level, and they have communication and behavioral problems (A Parent's Handbook, 2013; Geller, 2008; Volkmar & Lord, 2007). Considering the mental and social consequences, the main symptoms of autism spectrum disorder are as follows (Aydın, 2019; ASPB, 2016; DSM-IV-TR, 2000):

- Socialization problems
- Language and communication problems
- Reluctance to play mutual games
- Exhibit repetitive behaviours and obsessions
- Having limited interests

People diagnosed with autism have problems communicating with their peers, are reluctant to play and often display similar behaviours. Children with autism who require special education are expected to acquire the necessary skills by remaining in an active position in the field of cognitive development from preschool age. They also need to adapt to the social order of their peers and express themselves. Children with autism who are socialized should be provided with an environment in which they can express themselves well in order to develop their receptive and expressive language.

To improve the cognitive processes of individuals with autism, it is necessary to continue scientific studies and produce evidence-based results (Kurşun, 2022). To this end, computer-based learning activities should be designed and presented in a practical manner to support the mental development of students with autism. Educational digital games to be developed for children with autism should be coded and designed in line with the special education curriculum established by the Ministry of National Education. The digital competencies that should be acquired and considered for children in special education are listed below (MoNE, 2018):

- Cognitive Development Area
- Receptive Language Development Area

- Expressive Language Development Area
- Social-Emotional Development Area
- Adaptive Skills Development Area

Children with autism who require special education are expected to develop the necessary skills by remaining in an active position in the field of cognitive development from preschool onwards. In addition, children need to adapt to the social order of their peers and express themselves. Children with autism who are socialized should be provided with an environment in which they can express themselves well in order to develop their receptive and expressive language. It is possible to provide a conducive environment through educational digital games.

Including educational digital games for children with autism to achieve the benefits offered by the Ministry of National Education can enable them to concentrate by having fun and improve their hand-eye coordination (Bedir Erişti et al., 2017). Therefore, increasing the number of educational digital games, which is one of the computer-assisted pieces of training for children with autism in special education, will be beneficial for special education. It is believed that this study will contribute to the literature.

Purpose and Importance of the Research

This study aims to explore the opinions of special education teachers about the effectiveness of the educational digital game called "Together with Autism" designed by considering the target outcomes for primary school children diagnosed with autism spectrum disorder. It is aimed to eliminate the deficit of educational digital games for special education and to create the digitalization environment mentioned in many studies, to provide rich content based on outcomes for students with autism and to develop their digital competencies. It is aimed to make learning fun for students with autism, to learn by keeping up with technology, to increase their understanding, interpretation capacities and social skills, and to develop and improve their learning experiences. When the literature is reviewed, individuals with autism need rich curricula that activate auditory and multiple sensory organs rather than theoretical and limited curricula (Cohen & Sloan, 2007; Mirenda & Erickson, 2000; Nikopoulos & Keenan, 2006; Prizant et al., 2006).

Kurşun (2019), who wanted to reveal the impact of games on children with autism, organised developmental play therapy sessions for children with autism in a study. The results

revealed that there was an increase in the social relationships of children with autism. Josefi and Ryan (2004), in a case study for children with autism, applied play therapy sessions to 6-year-old children with autism. As a result of the study, it was found that there were improvements in children's sense of autonomy and role-playing skills. Considering the results of the studies, it is understood that the educational digital activities to be developed for children with autism will spark their interest.

İnce et al. (2023) examined the master and doctoral theses on children with autism published between 2008 and 2023 employing content analysis. They reached the conclusion that studies on the play skills of children with autism in the last 15 years were insufficient. At the same time, it was emphasized that it would be useful to include experimental studies. In addition to experimental studies, it was stated that observation, interview and descriptive studies would be valuable in terms of addressing the gap in the literature. It is thought that the research will contribute to the literature and pave the way for digital materials to be developed for special education and educational digital games to be integrated into the curriculum. In this context, the questions sought to be answered within the scope of the research are as follows;

1. What difficulties do the teachers experience in the education/teaching of children with autism?

2. What kind of study materials should be used in the education of children with autism according to the teachers?

3. Should technology be used in the education of students with autism according to teachers?

4. What are the views of teachers on the use of technological devices such as phones, tablets and computers in the education of students with autism?

5. Do educational materials prepared in digital environment support the learning process of students with autism according to teachers?

6. What do the teachers think about the educational digital game (together for autism) developed for children with autism?

Method

This section describes the research design used to arrive at the research findings, the study group, the data collection instruments, the analysis of the data collected and the stages of implementation of the research.

Research Design

The aim of this study is to reveal the opinions of special education teachers about the application after the implementation of the educational digital game developed for primary school children with autism and containing the achievements. This study was conducted using a case study, which is one of the designs of qualitative research methods. Qualitative research is a research method in which qualitative data collection methods such as observation, interview or document analysis are used and perceptions are revealed (Yıldırım & Şimşek, 2008). Case study is a qualitative approach in which the researcher analyses a limited situation using data collection tools such as observation and interview (Creswell, 2007).

Study Group

This research is aimed at students with autism spectrum disorder at the primary school. Since it would not be appropriate to collect data scientifically from the students with autism in the study, the study group of the research consists of 5 primary school special education teachers in a special education practice school in Sancaktepe district of Istanbul province. Demographic information about the 5 special education teachers from whom data were collected is given in Table 1 below.

Table 1 Demographic Information of the Participants

Gender	Age	Education Status
Female	24-30	Bachelor's degree
Male	24-30	Bachelor's degree
Female	30+	Bachelor's degree
Female	30+	Bachelor's degree
Female	24-30	Bachelor's degree

As shown in Table 1 4 of the teachers in the study group are female (80%) and 1 (20%) is male. Three of the participants (60%) were between the ages of 24-30 and two (40%) were between the ages of 30+. All participants have a bachelor's degree.

Data Collection Tools

In this study, Google Form tool, which consists of 9 questions, 3 of which are demographic and 6 of which are open-ended, was used as a data collection tool. This Google form also includes a semi-structured interview form.

Data Collection Process

Under this heading, the implementation details and data collection process of the educational digital game named "Together with Autism", which was designed by taking into account the curriculum prepared by the Ministry of National Education for students with autism, are given.

"Together with Autism" designed for primary school children with autism Details of Implementation

In this study, "Together with Autism" application was designed in order to reveal the effectiveness of educational digital games used in the field of special education and to include the opinions of special education teachers about educational digital games. The outcomes of the application within the scope of the curriculum for students with autism and the details about these outcomes are given in Table 2 below.

Tablo 2 Gains of the Together with Autism Practice

No	Achievement	Details of Achievement	Usage within the Application
1	Matching Objects by Their Colours	He/she recognizes and categorizes the given colours and shapes.	A total of 3 scenes related to colour recognition and matching are included. In Scene 1, the child with autism identifies the colour mentioned to them on the computer screen and selects the colour using the directional arrows on the keyboard (Appendix 1-a)
2	Counting rhythmically and recognizing numbers	He/she verbally identifies and rhythmically counts the numbers encountered in daily life	A total of 3 scenes related to recognizing and matching the numbers encountered in daily life on the computer screen are included. The child with autism verbalizes the number that appears on the screen and selects the correct number using the directional arrows on the keyboard (Appendix 1-b)
3	Recognizing rectangle, square, circle, and triangle	He/she recognizes geometric shapes and names them	A total of 3 scenes covering basic geometric shapes such as rectangle, square, circle, and triangle are included. The child with autism, after finding the requested shape, drags it with the mouse and places it inside the relevant box (Appendix 1-c)
4	Recognizing facial expressions depicting joy, anger, sadness, and crying emotions	He/she recognizes facial expressions for basic emotions	A total of 3 scenes aimed at recognizing facial expressions representing joy, anger, and crying are included. The child with autism clicks on the specified facial emojis (Appendix 1-d)

5	Differentiating objects by size	He/she identifies which of the specified shapes is larger and which one is smaller.	A total of 2 scenes related to the size of objects are included. The child with autism moves the character on the computer screen to the desired geometric shape using the keys on the keyboard (Appendix 1-e)

Table 2 shows the learning outcomes in the MoNE curriculum for students with autism. Looking at the objectives, we can see that students with autism are expected to be able to identify colours and represent them on the computer screen using the keyboard, to represent and highlight the numbers they encounter in everyday life on the computer screen, to understand the concepts of large and small, to identify commonly used geometric shapes and match them on the computer, to know the meanings of commonly used facial expressions and match them on the computer screen. Students with autism spectrum disorder are easily distracted. Their problem solving, comprehension, analysis and synthesis skills are at a lower level compared to their peers. Based on this situation, clear, understandable expressions, appropriate visuals, colours and sound stimuli have been included in the prepared digital game. In this way, the aim is to prevent the student with autism from getting bored with the digital game.

Advantages of the GDevelop Programme and Its Use in Special Education

GDevelop is a flexible game engine used to develop 2D games. With this programme, applications can be developed for web, desktop, Android and IOS environments. In addition, the programme can run on Windows, Linux and macOS. In this study, all contents of the educational digital game, titled “Together with Autism”, was developed and published for students with autism using GDevelop programme. GDevelop allows text-based coding as well as block-based coding. Therefore, it offers an ideal environment for developing and publishing applications. GDevelop provides a rich learning environment for the target audience as it facilitates the implementation of pedagogical elements such as easy to difficult, concretization, reinforcement, feedback, reminder, repetition, hint, rewarding and the others in accordance with the teaching principles used in the field of special education. At the same time, with this programme, different and integrated visual and auditory materials can be developed for students with autism.

Implementation of the Developed Educational Digital Game with Autism

The educational digital game “Together with Autism”, which was prepared for students with autism, was carried out with the participation of 5 students with autism who know how

to use a computer or can use it with guidance in a special education application school in Sancaktepe district of Istanbul province after having received the necessary permissions. The implementation phase of the research lasted a total of 5 lesson hours with 1 hour per student. At this stage, each teacher observed the reactions of the students with autism to the game on the computer and provided assistance to those having difficulty. Many students showed feelings of happiness towards the audio and visual stimuli in the educational digital game and reacted to reinforcers such as applause by laughing and rejoicing.

Data Collection

Within the scope of the research, after the implementation of the educational digital game named "Together with Autism", which was designed uniquely within the scope of the research and includes target acquisitions, to 5 students with autism, the data were collected face-to-face from 5 special education teachers via Google Form, which includes a semi-structured interview form, for it would not be appropriate to collect data from students with autism. After each implementation, special education teachers responded to the research questions. At this stage, 5 special education teachers were asked to evaluate the "Together with Autism" application and to indicate the effects of similar applications on the education of students with autism.

Data Analysis

In light of the qualitative data collected from special education teachers, the descriptive analysis was used to reveal the level of impact of the educational digital game developed for students with autism on students with autism and the teachers' views on the role of educational digital games in special education. The descriptive analysis is a method that is used to obtain summary information about the research on the basis of the collected data (Büyüköztürk et al., 2008). The answers given by the teachers to the open-ended questions were analysed, compared with the literature and classified according to the themes that were determined in advance. At this stage, the answers provided by the special education teachers to the research questions were not shared with third parties in order to protect personal data, and the teachers were given symbolic participant numbers (e.g., P1, P2.).

Data collected from the teachers using the interview form were presented to 2 experts. The experts examined and analyzed the codes extracted from the teachers' opinions. The method of Miles and Huberman (1994) was used to ensure the reliability of the extracted codes. The aim of this method was to increase the reliability of the study by means of inter-

observer agreement. Independent interobserver agreement method is used to ensure that results obtained by different experts using the same measurement tool to assess the same situation are compatible (Esin, 2014). The codes revealed by the Miles and Huberman method are included in the analysis of qualitative data based on formatting (Maxwell, 1992; Roberts & Priest, 2006; Öztürk & Balcı, 2014). The codes were calculated in the form of "reliability = agreement / (agreement + disagreement)". The reliability of the study was found to be 95%. The experts emphasized that the study was reliable.

The scheme summarising the methodology of the research is shown in Figure 1 below:

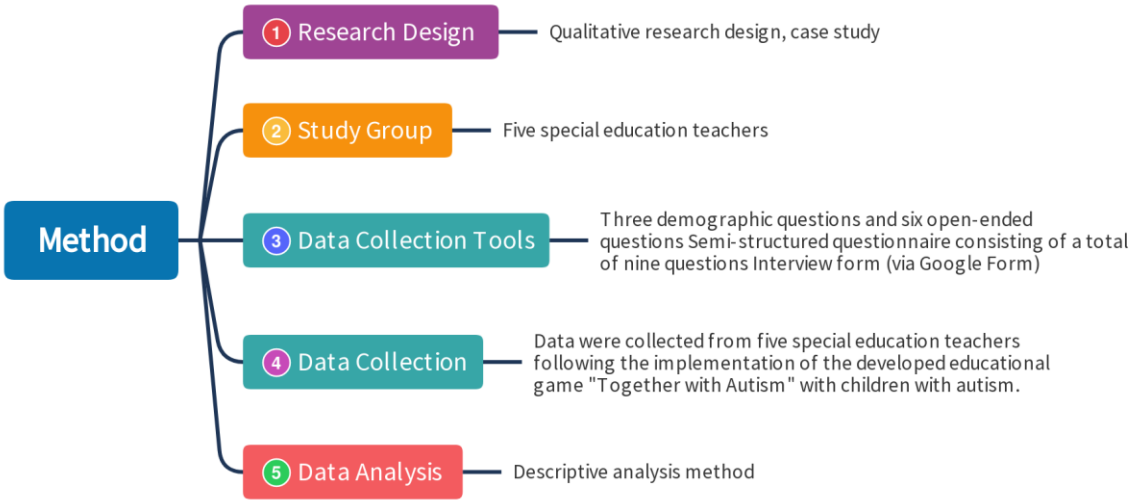

Figure 1 Summary Scheme of the Research Method

Results

Under this heading, after the implementation phase of the research was carried out, the opinions of special education teachers on educational digital games and "Together with Autism" application were included. The qualitative questions of the research were analysed under the relevant headings and the findings were reached by correlating them with the literature.

Findings related to the question of what difficulties the teachers experience in the education/teaching of children with autism

This question aims to unearth the problems encountered by special education teachers while helping students with autism achieve the learning outcomes. Teachers' responses to this question are shown in Table 3 below.

Table 3 Problems Encountered in the Education of Children with Autism

Theme	Codes	Participants	Frequency	%
Difficulties in the education/training of students with autism	Lack of academic digital materials	P1, P2, P3	3	60
	Behavioural problems	P1, P4, P5	3	60
	Lack of audio and visual materials	P3, P4	2	60
	Lack of smart board and educational videos	P2, P4	2	40

When the details of Table 3 are examined, it is seen that among the problems frequently encountered by special education teachers, the frequency of lack of academic digital materials and behavioural problems is 3 (60%), and the frequency of lack of audio-visual materials, smart board and educational videos is 2 (20%). Participant views on this question are as follows;

P1: "We have problems due to lack of digital materials and behavioural problems"

P3: "We have problems due to the lack of visual and audio materials"

P4: "We lack a smart board. We can progress faster with educational videos"

When the opinions of participants numbered one, three and four are examined, educational digital games, visual and audio-visual materials are the main deficiencies in the teaching of students with autism. In addition, behavioural problems are also seen as difficulties. Participants also mentioned the lack of smart boards. It is concluded that the lack of smart boards will create difficulties in the implementation of digital activities. Teachers mentioned the lack of academic digital materials in the field of special education.

Findings related to the question of what kind of study materials should be used in the education of children with autism according to the teachers

This question reveals what materials can be useful for students with autism in the classroom. The educational materials suggested to be used by teachers in order to direct students with autism to the lesson, increase their motivation and enable them to learn by having fun are shown in Table 4 below.

Table 4 Recommended Materials in the Education of Children with Autism

Theme	Codes	Participants	Frequency	%
Materials to be used in the education of students with autism	Digital materials	P2, P3, P4	3	60
	Concrete shapes	P1, P5	2	40
	Audio and visual materials	P3, P4	2	40
	Educational materials that appeal to more than one sense organ	P3, P4	2	40
	Materials supporting motor development	P4	1	20
	Puppet and concept sets	P5	1	20

When the details of Table 4 are looked into, it is seen that the materials recommended by special education teachers to be used in teaching students with autism. Considering the number of participants in the answers, it is seen that the frequency of digital materials is 3 (60%), the frequency of concrete shapes, visual, auditory and materials that appeal to more than one sense organ is 2 (40%), the frequency of materials supporting motor development and puppet-concept sets is 1 (20%). The answers given by the teachers are as follows;

P1: "Concrete shapes and colours can be used."

P2: "Digital activities and independent interesting materials can be used to appeal to more than one sense."

P3: "Colourful and digital materials."

P4: "Visual materials, smart board and materials to support motor development can be included."

P5: "Puppets and concept sets can be used for language development."

Participant 1 stated that concrete shapes and colours can be used in the education of children with autism. Another participant, teacher number two, suggested that materials that appeal to more than one sense organ can be used and pointed out that digital activities and interesting learning materials can be used in the education of children with autism. Participant 3 said that digital and colourful materials could be used as effective learning tools in support of participants 1 and 2. Participant 4 emphasized that smart boards and visual materials would be effective by highlighting the development of motor skills of students with autism. This view was interpreted as the development of hand-eye coordination in order for students with autism to acquire, use and infer information in the digital environment. Participant 5 stated that puppets and concept sets could be included by prioritizing the language development of

children with autism. When the responses of the teachers are considered holistically, it is seen that it would be useful to organise the existing learning environments of students with autism in a way to support technology. It is stated that rich learning environments will be created by using educational materials that arouse the interest and attention of students with autism, support their motor development, contain visual and auditory elements, and prioritise language development. In this case, it can be said that the use of digital materials such as computers and smart boards will increase the digital competences of children with autism.

Findings related to the question of that technology should be used in the education of students with autism according to teachers

This question seeks to answer whether technology can be used in addition to traditional teaching methods in the education and training of students diagnosed with autism. In this context, it was revealed to what extent and for what purpose and when technology is used in special education and what its effect is on students with autism. The responses of the teachers to this question about the use of technology in special education are shown in Table 5 below.

Table 5 Findings Related to the Use of Technology in the Education of Students with Autism

Theme	Codes	Participants	Frequency	%
The use of technology in the education of students with autism	Can be used according to the student's performance	P1	1	20
	Appeals to more than one sense organ, can be used	P2	1	20
	Makes teaching permanent, can be used	P4	1	20
	Increases attention span, can be used	P5	1	20

When Table 5 is analysed, findings related to the use of technology by students with autism in the field of special education are seen. It is understood that the use of technology can be evaluated according to student performance, appealing to more than one sense organ, making teaching permanent and increasing attention span. The answers given by the teachers are as follows:

P1: "Yes, it should be used according to the performance of the student."

P2: "Yes, technology should be used because it appeals to more than one sense organ."

P3: "Technology should be used for permanent teaching."

P5: "Yes, I think it increases attention span in children with autism."

In the answers given about the use of technology in the field in question, it was emphasised that it can be used based on the performance of the student. From this response, it is understood that technology can be utilised aligned with the learning levels of students with autism who show individual differences in terms of learning. In this way, it is thought that the learning environment will be organised in light of individual differences and the digital skills of students with autism will be increased. Participant 2 emphasised that technology appeals to more than one sense organ and can be used in the education of students with autism. Participant 3 emphasised that technology should be used in order for the target outcomes to be permanent in students with autism. In this case, the use of technology can be interpreted as students with autism can progress at individual learning speed and internalise knowledge. It was also stated that technology can provide the opportunity to include elements that can capture the attention of students with autism.

Findings related to the question of what the views of teachers on the use of technological devices such are as phones, tablets and computers in the education of students with autism

This question explores the effect of technological devices such as phones, tablets and computers used in the education and training of autism students. Teachers evaluated the role of technology in the cognitive, affective and kinaesthetic skills of students in special education by considering the developing technology. Table 6 below shows the responses given.

Tablo 6 Opinions on the Use of Phones, Tablets and Computers in the Education of Students with Autism

Theme	Codes	Participants	Frequency	%
The use of technological devices in the education of students with autism	Can be used purposefully	P2	1	20
	Can provide fun and permanent learning	P3	1	20
	Increases attention span	P5	1	20

As demonstrated in Table 6, in the answers given by the teachers regarding the use of technology in teaching students with autism in special education, it is mentioned that the use of phones, tablets and computers can increase the attention span of students, make learning fun and permanent, and can be used purposefully. The answers given are as follows;

P2: "Educational digital games can be used for the purpose accompanied by teachers."

P3: "I find it right because learning can be more fun and permanent."

P5: "It increases attention span."

Teachers emphasised that educational digital games can be used in technological devices. Therefore, it is found that mobile and desktop applications to be created for the achievements of students with autism can be integrated with in-class and extracurricular activities. They also stated that a well-designed educational game content increases the attention span of students. In the implementation phase of the "Together with Autism" game developed in this study, it was observed that students with autism learnt while having fun. This situation supports the teachers' view that phones, tablets and computers "can provide fun and permanent learning". In addition, with the learning diversity provided by technological devices, audio and visual stimuli are used. Sula and Spaho (2014) stated in their study that individuals with autism who use technological devices access information more easily and provide individual learning. Therefore, it is understood that the amount of digital content should be increased in children with autism, and it may be appropriate to use digital content that stimulates visual, auditory and multiple sensory organs.

Findings related to the question of that educational materials prepared in digital environment support the learning process of students with autism according to teachers,

This question reveals how the learning processes of students with autism are affected as a result of the integration of the gains they have achieved within the scope of the curriculum into the digital environment. The answers given by the teachers include educational digital games designed and coded for students with autism and other teaching tools and materials in the digital environment. The positive and negative responses of the teachers regarding the effect of digital education materials on the educational process are given in Table 7 below.

Table 7 Opinions on the Effect of Educational Materials Prepared in Digital Environment on the Learning Process of Students with Autism

Theme	Codes	Participants	Impact	Frequency	%
The effect of materials prepared in digital environment on the learning of students with autism	Offers a fun environment	P2, P3, P4	Support	3	60
	Provides fast learning	P4	Support	1	20
	Improves visual memory	P4	Support	1	20
	Makes it easier to attract attention	P5	Support	1	20

This question reveals how the learning processes of students with autism are affected as a result of the integration of the gains they have achieved within the scope of the curriculum into the digital environment. The answers given by the teachers include educational digital games designed and coded for students with autism and other teaching tools and materials in the digital environment. The positive and negative responses of the teachers regarding the effect of digital education materials on the educational process are exhibited in Table 7 below.

P2: "...prevents children from getting bored by creating a fun environment."

P3: "can shorten the learning process."

P4: "Yes, they do. Their visual memory is stronger, and it is fun."

P5: "It affects attention span positively. Digital media is an attention-grabbing stimulus, it supports students by increasing their attention span."

From the participant opinion number two, it is concluded that digital materials support students with autism to learn by having fun. It can be said that educational digital contents increase classroom control and prevent students from getting bored. Therefore, educational digital contents can be included in special education for children with autism to have a pleasant time, to provide permanent learning at cognitive level and to increase their digital skills. Participant 3 stated that educational digital activities can shorten the learning process. Participant 4 stated that the visual memory of students with autism can improve as a result of the use of digital materials. In addition, participant 5 stated that such materials and activities would increase attention span and act as an attractive stimulus. Considering the responses of the teachers, it can be concluded that educational materials prepared in digital environment can positively affect the learning experiences of students with autism.

Findings related to the question of what the teachers think about the educational digital game (together for autism) developed for children with autism

This question reveals the effect of the educational digital game, which was originally developed for students with autism and includes colours, numbers, size and smallness concepts, geometric shapes and emotions, on students with autism. In this context, teachers' opinions were analysed and shown in Table 8 below.

Table 8 Teachers' Opinions on the Effectiveness of Together with Autism Practice

Theme	Codes	Participants	Frequency	%
Opinions on the "Together with Autism" application developed for students with autism	Offers a fun environment	P2, P3	2	40
	Reduces the burden on teachers	P3	1	20
	Increases awareness	P4	1	20
	Supports cognitive and affective processes	P5	1	20

When Table 8 is analysed, it is seen that the frequency of participants stating that the educational digital game in question offers an entertaining environment is two (40%), and the frequency of participants stating that it reduces the burden of teachers, increases awareness and supports cognitive-affective processes is one (20%). The opinions of the teachers are as follows:

P1: "I think educational digital games are useful, they should be developed."

P2: "By considering the principle of individual differences, the learning process can emerge, a fun environment is created."

P3: "Educational digital games make learning more fun and support learning in a shorter time. Having them in schools facilitates teachers' teaching."

P4: "It is a good project in terms of education, it is a good study in terms of awareness."

P5: "*There should be digital games in special education. I think that they support students developmentally (visual, hearing, mental). Using them as an attention-grabbing material for students and using them as reinforcers in the treatment of problem behaviour has positive effects.*"

Participant 1 stated that such educational digital games have a positive effect on students with autism and they are beneficial. After the implementation phase of the educational digital game developed originally, students with autism had fun, and after answering the questions, they reacted loudly with joy and laughter. In addition, in the opinion of participant 2, individual differences and learning by having fun come to the fore. It is thought that educational digital games to be developed in different difficulties especially for students with autism at different levels can make important contributions to individual progress. In the opinion of participant 3, such applications can be fun and reduce the burden

on teachers and support rapid learning. Considering the obligation of teachers to prepare materials in special education, it can be said that digitalisation can provide both diversity and time saving. Participant 4 stated that the "Together with Autism" application could be a pioneer in increasing the number of applications developed for special education. From the opinion of participant number five, it is found that the mental processes of students with autism can be supported by educational games. It was said that digital activities can be used in the treatment of students with behavioural disorders. In addition, it is understood that digital games will be useful in subjects where learning in certain subjects should be reinforced.

Conclusion, Discussion and Suggestions

This research can be considered as a contribution to enrich curricula for students with autism, to make them compatible with technology, to make learning fun and to make educational digital games widespread. When the findings of the research are examined, it is seen that the teachers working in special education field are warm to digitalisation, support the use of technological tools in the education and training of students with autism and stated that the variety of digital materials should be increased. As a matter of fact, during the implementation phase of the research, it was observed that students with autism were very interested in digital materials. They followed the instructions given to them carefully. In this process, teachers stated that students with autism enjoyed digital games and enjoyed working in a computer environment. This situation makes it possible to use technological devices such as phones, tablets and computers to achieve the target outcomes. On the other hand, seeing the concepts that students with autism have difficulty in understanding and internalising in the digital environment as moving, colourful and audible grabs their interest and attention. This finding shows that digitalisation and blending of curricula prepared for students with autism with technology would be beneficial.

As stated by the teachers in this study, educational digital games are a source of entertainment for students with autism. During the implementation phase, it was observed that students with autism touching the keys on the keyboard and reaching the desired result by moving the object on the screen is a rich learning environment for them. Educational digital games also reduce the burden on teachers in the classroom. Students can follow the achievements in the digital environment at their own individual pace. Therefore, individual differences are taken into consideration. Special education teachers were also satisfied with this situation and stated that the potential of the children was revealed because educational

games enable students with autism to socialise and develop their receptive and expressive language. It improves visual perception and increases interest. In line with this finding, Şenyürek et al. (2017) emphasised that more educational digital games should be developed to increase the participation of students with autism in the lesson and to ensure effective implementation of the instruction, as games enable individuals to discover themselves (Ünal, 2009) and increase their motivation.

Quill (1997) stated that using visual and auditory perceptions together will provide better learning in students with autism. It is known that games are used to correct behavioural disorders in students with autism. For behavioural disorders, which is one of the problems stated by teachers, Carrizales (2015) stated that as a result of the play therapy study on children, behavioural disorders decreased, and they started to behave normally. Therefore, it can be said that educational digital games to be created within the scope of the curriculum in digital media will have a positive contribution to the behaviour of students with autism. In the opinions of teachers regarding the use of technology in special education, it was found that educational digital games make teaching permanent, appeal to more than one sensory organ and increase attention span. It was also stated that there would be improvement in the motor skills of students with autism. In order to use technological tools, it is necessary to be technologically literate at a certain level. It can be said that the fact that students with autism are familiar with digital environments from an early age will help them develop their technology literacy skills in the future. Teachers stated that they needed academic digital materials in order to implement educational games. They said that smart boards are the most important of these. In this case, it is understood that the technological infrastructure in schools where special education is delivered should be improved in order to implement educational digital games developed for children with autism.

In a study by Bedir Erişti et al. (2017), they emphasized that educational digital games should be developed by taking into account the cognitive, affective and psychomotor characteristics of students with autism. They also stated that positive results will be obtained as a result of good and planned design of educational digital games for students with autism whose communication skills are weak and whose social development is not at the desired level. They stated that computer-assisted applications may be useful for students with autism. In addition, it is known that games will help children with autism improve their hand and eye coordination as well as improve their behaviour (Tsai and Lin, 2011; Faja et al., 2008). Therefore, it can be said that the educational digital game called "Together with Autism",

developed for students with autism can increase social relations and activate affective and cognitive processes.

Within the scope of this study, it was found that the educational digital game "Together with Autism" experienced by 5 students with autism was effective and the students saw the game as a tool, motivation enhancer and entertainment to achieve the outcomes. Considering the limitations of the study, it can be suggested that similar studies should be designed and implemented on more students with autism in a way that include different achievements. In addition, it may be possible to develop and disseminate innovative practices for the curriculum. It can be considered to provide smart board integration in special education autism classes and to create a learning environment that will appeal to multiple sensory organs of students with autism by switching to digitalisation. As stated by İnce et al. (2023), considering the limitation of studies on children with autism, it could be possible for different universities and researchers to contribute to the literature by using different methods.

Compliance with Ethical Standards

Disclosure of potential conflicts of interest

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CRediT author statement

The study was conducted and reported with equal collaboration of the researchers.

Research involving Human Participants and/or Animals

Ethics Committee Approval (Date: 29/09/2023, Number: 5) for this research was obtained from the Human Research Committee on Ethics at Bursa Uludağ University.

İlköğretim Otizmli Çocuklar İçin İnovatif Eğitsel Dijital Oyun Tasarımı

Özet:

Bu çalışmanın amacı, ilköğretim otizm spektrum bozukluğu bulunan öğrencilere yönelik özel eğitim öğretim programında bulunan kazanımları eğitsel dijital oyunlar vasıtasıyla öğretmektir. Bu amaca yönelik "Otizm ile Birlikte" adlı eğitsel dijital oyun geliştirilmiştir. Tasarlanan oyunda, Milli Eğitim Bakanlığı'nın otizmli öğrencilere yönelik öğretim programından alınan sayılar, geometrik şekiller, büyüklük küçüklük kavramları, renkler ve duygular yer almaktadır. Tasarlanan eğitsel dijital oyun 5 otizmli öğrenciye özel eğitim öğretmeni eşliğinde uygulanmış ve konuya ilişkin veriler 5 özel eğitim öğretmeninden 9 nitel sorudan oluşan yarı yapılandırılmış görüşme formu ile toplanmıştır. Toplanan veriler betimsel analizine tabi tutulmuş ve bulgular yorumlanarak sonuçlara ulaşılmıştır. Bulgulara bakıldığında, eğitsel dijital oyunların otizmli öğrenciler üzerinde olumlu etkilerinin olduğu, bu tür içeriklerin sayısının artırılması gerektiği vurgulanmıştır. Eğitsel yazılımın uygulama aşamasında otizmli öğrenciler eğlenmiş, sesli ve görsel uyaranlara gülerek tepki vermişlerdir. Öğretmenler, bu alana yönelik akademik olarak oluşturulan dijital materyallerin eksikliğinden söz etmişlerdir. Bu bağlamda, özel eğitim alanında kazanımlara yönelik oluşturulacak eğitsel dijital oyunlara yer verilmesi gerektiği sonucuna ulaşılmıştır. Öğretmenler, otizmli öğrencilere yönelik geliştirilen eğitsel dijital oyunların motivasyonu artırdığını, daha hızlı ve kalıcı öğrenmeleri desteklediğini, eğlenerek öğrenmeyi sağladığını, birden fazla duyu organını harekete geçirdiğini ve öğretmenin yükünü azalttığını belirtmişlerdir.

Anahtar kelimeler: eğitsel dijital oyun, otizm, gdevelop, özel eğitim, otizm ve oyunlaştırma

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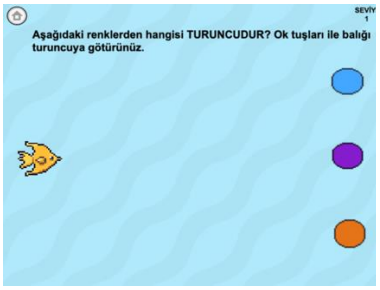
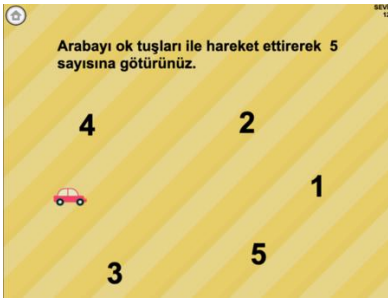
Appendices

Appendix 1-a



Appendix 1-b



Appendix 1-c

Appendix 1-d

Appendix 1-e