



Training children with autism in computer science through inclusive and distance learning: A descriptive and explanatory case study

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ABSTRACT

In inclusive education, information technology and traditional teaching methods significantly impact the development of child's intelligence, motor skills, and visual and motor analyzers. In this regard, the role of Computer Science (CS) in school is special. In this context, children with autism spectrum disorders (ASD) often benefit from simplified curricula and technological tools, such as distance learning tools, which have gained popularity after COVID-19. This study investigated the pedagogical strategies and outcomes of CS distance learning for children with ASD in inclusive education and determined its effectiveness. This descriptive and explanatory case study focuses on the practice of distance learning process (effectiveness, impact, barriers, problems, etc.). In the context of inclusive education, students with ASD in CS could perform computer tasks remotely along with normal children, and their academic activity increased. While studying remotely, they also encountered several difficulties, as a result of which they tried to solve the problems themselves. It was shown that children with ASD can be taught CS remotely and its advantages are demonstrated. The study indicates that teaching children with ASD to learn CS in inclusive education and distance learning settings is feasible and effective. The results suggest that children with ASD can make significant progress in their computational skills when provided with an environment that meets their learning needs, whether through flexible applications, individualized support, or virtual classroom structures.

Keywords: inclusive education, distance learning, computer science, children with special educational needs, autism

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INTRODUCTION

According to data from 2022, the number of people with disabilities in Kazakhstan is 707, 980 people, compared to 680, 000 in 2010. Also, according to data from December 2020, 95,497 students with SEN study in general secondary education institutions (Shatayeva et al., 2025). This number is increasing year by year. Accordingly, there is need to optimize the provision of special education for special children in the educational process.

Special children need special education, and it is difficult to even talk about it without addressing the issue of special educators, that is, personnel. Since 2020, the Ministry of Education of the Republic of Kazakhstan has introduced the position of assistant teacher in schools, who accompany children with ASD in the educational process. The personnel training system has its hierarchy.

Well, let's say there is a teaching assistant, but during the pandemic, there were some obstacles in the field of education. Not only did special children become a problem, but normal students themselves also became a challenge. Children with ASD have the right to study in the same school as other students. However, when they come to school, they cannot immediately

participate fully in the lessons. Special pupils find it difficult to sit still and study for extended periods.

The advantage of using new technologies in complex correctional education for children with intellectual disabilities is that they have a positive effect on their ability to visualize educational material. Therefore, in the education system, most of the education for children with SEN is based on new technologies, mobile games and information and communication technologies. Visually presenting information increases the effectiveness of any activity (Al-Dababneh & Al-Zboon, 2020). This effect is of enormous importance in inclusive education. The use of modern tools, diagnosis methods, and technologies not only identifies the child's current functioning, but also helps to identify objective difficulties that arise at this time and overcome them in an accessible way.

Teachers significantly reduce the educational opportunities of children with ASD if they fail to organize the learning process in an inclusive education setting, taking into account their individual needs during lessons, along with those of typical children. As a result, their motivation to learn, learning outcomes decrease, and limitations begin to appear (Zhang et al., 2020; Colizzi, et al., 2020).

Therefore, it is necessary to organize a more effective educational process for children with SEN (Kossybayeva et al., 2025). The development of teaching and learning methods, technologies, and tools that provide maximum opportunities for children with disabilities is a pressing issue. Not all subject taught in school may be interesting to children with SEN. However, education can be effective if various digital resources and information and communication technologies are used in working with a child.

The main objective of this study was to investigate how children with ASD can be effectively taught in CS using methods adapted to inclusive educational settings and distance learning. In addition, the task was to identify effective teaching strategies and tools adapted to the cognitive and social needs of children with ASD and assess the impact of these teaching methods on students' learning outcomes, engagement levels, and CS skills acquisition. Our study addresses the following two research questions (RQ): RQ-1: Is distance learning of computer science effective in inclusive education and distance learning for children with ASD? RQ-2: What challenges do children with ASD face during distance learning in computer science?

METHOD

The study was reviewed and approved by the university ethics committee. This descriptive and explanatory case study (Simon, 2009) is a case study (Stake, 1995) focuses on the practice of special distance learning of CS in the context of inclusive education and changes that occur in the educational process (effectiveness, impact, obstacles, problems, etc.).

The following criteria were used to select participants: (1) school management and parents of a special child agreed to participate in the study of their children (agreement is saved), (2) ASD students received special education services, and (3) students had basic computer skills such as turning on a computer and logging in. the study of participants was carried out in the first 4 weeks in a rehabilitation center for children with ASD and speech disorders and then at school. Many approaches to step-by-step triangulation of data have increased the reliability of case study results (Merriam & Tisdell, 2016). Data sources included interviews, observation results, and additional open conversations. A semi-structured interview guide was used to conduct the interviews, allowing respondents to express their thoughts freely (Fejes & Thornberg, 2015). Interviews were conducted with parents directly involved in children with SEN, a center specialist, a school psychologist, and a computer science teacher. Direct observation of students in the inclusive classroom participating in the research experiment (workspace, distance learning activities, student behavior, academic activity, interest in the lesson and etc.) was conducted. Open conversations (perception of the learning of a special child, teacher professional change, parental support, assistance from special professionals) were included.

Study participants

The study was conducted over a period of 20 weeks in 1 school and “The Rehabilitation Center for Children with Autism and Speech Disorders” in Almaty, Republic of Kazakhstan. The study involved 1 CS teacher, 1 defectologist-psychologist, 1 teaching assistant, 4 center specialists, 2 parents, and 12 students studying in an inclusive class (including 2 children with SEN). The study participants were given pseudonyms and were described using these pseudonyms throughout the study.

Teacher

Shynar has been working at the school for three years. At first, she was shocked when she saw the aggressive behavior of a special child in an inclusive class. Shynar says that she was not ready to work with special children. The school where Shynar is employed features additional inclusive classrooms and a teaching assistant. This has helped Shynar a lot. Shynar teaches computer science to an inclusive class once a week (45 minutes). A special student sometimes does not attend classes, and if he does, he does not sit for a long time. He acts out in various ways and sometimes interferes with normal children. At such times, the teaching assistant says, the special child is taken away separately. Shynar was directly involved in the research. She organized an inclusive class in each computer science lesson. She focused the students' attention on the lesson and participated in observing the experiment with the researcher.

Students with special educational needs

Alisher is in the sixth grade of a comprehensive school. Alisher was diagnosed with an ASD. He doesn't engage in much play with his peers in the classroom. He is most active during the first lesson of each day. Alisher spends his free time from school in a rehabilitation center for children with autism and speech disorders. My mother says that this center has helped a lot. Almas, a classmate of Alisher, is in the sixth grade at a comprehensive school. He spends a lot of time with teacher assistants. Loves physical education. In other words, he enjoys playing and interacting with his body. Does not stand still, hyperactive child.

They both love playing with gadgets. They only want to play games on the computer in CS class. They don't pay much attention to the teacher. Both have a teaching assistant with them all the time.

Data collection

To get an idea of the behavior of students when using distance learning technologies in inclusive education, the basic form of data was used. Interviews were conducted with people with SEN (parents, a specialist of the Rehabilitation Center, a speech pathologist, a teacher at the school) who attend an inclusive class.

Observations in classroom and distance learning were used to determine the level of academic activity of participants and the level of attendance in classroom CS. In addition, the teacher was interviewed even after the observations were analyzed to obtain contextual information about the students as a whole and to determine the results.

The study began with the well-known "Rehabilitation Center for Children with Autism and Speech Disorders" in Almaty. The center has been working with special children for many years and has shown good results. The center is engaged in the rehabilitation of special children based on the ABA therapy methodology. According to the head of the center, learning this method is very necessary for specialists working with children in all educational systems. There are many types of modern traditional and non-traditional innovative work with children with early childhood autism. One of them is unique; one of the most effective programs today is the "ABA" method. ABA therapy is the only method in the world for teaching children with developmental disabilities with scientifically proven effectiveness (Saigh, 2022).

That is, before working with a special child, it is better for every teacher to know the ABA method. Therefore, having studied many studies, we began our study with a center that conducts rehabilitation work with ABA therapy. The center has children aged 3-14. Focusing on school-going children, the work carried out with these children and the methods used were studied. The

center's specialists teach children to behave properly at school and to communicate properly with peers and teachers. This is important for special children attending inclusive classes. Parents of the children under observation were also met at this center and interviews were conducted. The interviews were conducted using pre-prepared, mixed-structured questions.

The mother of two school-age children who visit the center said that her children have not been systematically participating in the learning process during the quarantine. They noted that distance learning has not been effective due to the lack of training of teachers, the lack of suitable educational materials for distance learning, and the lack of interest of the child in the online platform for conducting lessons.

Thus, for 4 weeks, we observed the children psychologically. Seeing that the children played well on gadgets at a certain time, mastered and managed various games well, it was noticed that a special platform or service was needed when teaching the school program to the child remotely. Also, this learning platform needed to be visual and integrated with elements that would not bore the child. After all, when the children's mothers were interviewed, they said that learning platforms or services should have game elements and cartoon/game characters that children know. Taking this into account, there was a need to search for the best platforms and services in world practice.

Convenient platform for Distance Learning in CS

After studying effective tools for some time, we conducted a special survey of CS teachers. Among several platforms, the teachers who responded to the survey focused on the code.org platform. Code.org is a nonprofit organization dedicated to educational innovation that aims to make CS a part of the core curriculum for every school. Before using the platform for our research, we wrote to the platform's developers and obtained their permission.

The platform has been positively evaluated in many countries as a convenient resource for teaching computer science courses to school students. The platform includes lessons and courses of various levels and durations (1 hour, 1 month, 1 quarter, 1 year) for students in grades 1-12. The platform allows the user to choose the most convenient device type (computer, tablet or mobile phone).

The platform has many unique features. The platform also has a set of courses and tasks for children with SEN. This optimizes the lesson by explaining the subject of CS to a special child using various course elements. The subject teacher registers on the platform as a "teacher" and, depending on the child's characteristics, selects the type of task that is most convenient for the student and assigns it to the child's personal profile. At the same time, the student must also register on the platform as a "Student" in advance. After the teacher assigns the task to the student, he can send a letter to the student's parents. The letter will show the parents how to use the platform, go to the assigned task, and use it. This is because special pupils must have a parent or a teacher or teaching assistant at school with them during remote learning at home.

Data analysis

The primary data were analyzed using a qualitative general inductive approach (Creswell, 2017). The recorded interviews were transcribed. Transcripts were loaded into the QDA Miner Lite database to facilitate organization and analysis (Silver, 2014). The initial analysis began with the coding generated by the research questions. In the course of the study, additional topics appeared and were included in the coding process. The second stage of coding concerned the concept of distance learning and problems in it. For reporting, the codes were grouped into the following categories to focus on answering the research questions: (a) adaption of a special child to school and interest in the subject, (b) additional special education for teachers, (c) the impact of distance learning in CS, (d) teacher readiness for distance learning of special child in an inclusive education setting. An iterative cycle of coding, research, linking findings, and further exploration identified a chain of evidence that made sense of the data, thereby increasing the credibility and validity of the findings. Qualitative research requires participants to be shown the data. During data analysis, interview transcripts were shown to participants and approved.

Observation notes were taken after each lesson. Observations were made multiple times to gain insight into how children with ASD interacted with peers and teachers, as well as with platform tasks.

FINDINGS AND DISCUSSION

Findings

Readiness of subject teachers

In the early stages of our research, a parallel interview was conducted with the CS teacher. Once we informed the teacher about the anonymity of the interview content, she provided candid responses. We observed the teacher’s willingness to work and teach with children special needs. However, she noted that in the context of inclusive education, there is a lack of specialized skills and physical time to work with children with diverse needs.

“...First of all, I think that all children should be loved equally. Before teaching a child with special educational needs, you need to get complete information about the child and be ready to work with them. Special children are different. They need to be given individual tasks. The teacher should take this into account”.

Teachers who have not worked with children with SEN for a long time, including young ones, have reported significant difficulties in their experience. When asked, *“What do you take into account when working with children with special educational needs? What principles do you adhere to?”*. However, she acknowledged that sometimes, due to physical constraints, they may not have the time to assign specific tasks for each lesson. In such a situation, it seems that they have to perform tasks together with normal children.

According to the teacher, the conditions for working with special children are being improved in schools. In certain cases, schools provide special rooms for private play and relaxation, particularly if the child exhibits aggression or requires individual tasks.

Additionally, we did not teach lessons remotely on days when a special child could not attend school due to specific reasons. And in cases where permission was granted for home study for a certain period (in the event of a long illness), the child was prepared with easy tasks and taught at the child's home. However, the sudden emergency that swept the world, such as the pandemic, caused a number of difficulties in teaching a child with special needs remotely. First, it was hard for parents and teachers to prepare kids for screens and focus on lessons.

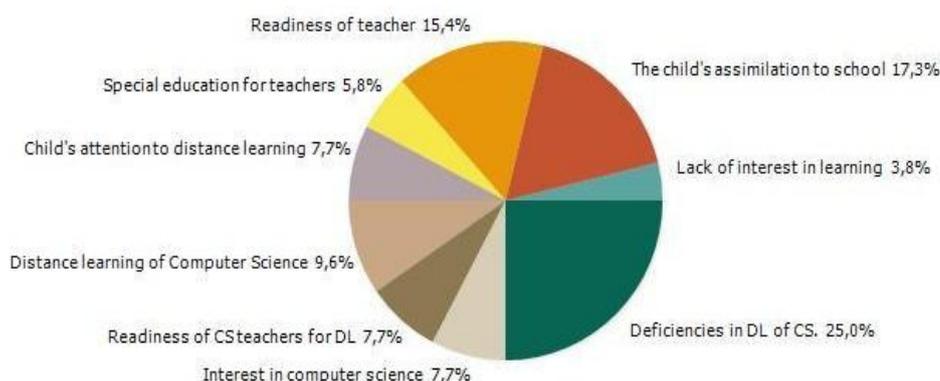


Figure 1. Problems of Distance Learning of CS in Inclusive Education

The lack of special teaching aid, the lack of online learning services, and Platforms focused on the specifics of the child, there were many inefficient aspects of distance learning (Figure 1). In addition, CS teachers expressed the need for methodological assistance in distance learning of children with special needs, and they would like to organize more pedagogical and psychological professional development for teachers who work with these children.

“First of all, to prevent this problem, it is necessary to prepare future teachers, that is, students, for distance learning of children with special educational needs in

inclusive settings. Then, it is necessary to conduct high-quality professional development courses for teachers currently working at the school. In that course, at first, it is important to teach how to work psychologically with a special child, the category most often found in an inclusive class. Because, without psychological work with a child, we cannot use pedagogical techniques. Methodological support is very necessary. Each class needs a manual on the use distance learning technologies in teaching computer science to a special child."

Studying the results of interviews with parents and teachers, we realized that the trio of "teacher-student-parent" needed a convenient and effective platform, which is an equally necessary tool during distance learning. That is, this proved the relevance of our research.

During the initial research period, the platform task was given only to children with ASD as an adaptation week. The child understood the task and was able to continue on his own. However, he always wanted to have someone with him. That is, during distance learning, parents, a teacher, or a teaching assistant in the classroom needed to provide support. It was noted that the ASD child needed a comfortable learning environment, both at home and in the classroom. This is because ASD children did not like noisy environments and long-term tasks.

The children completed the task on the platform without haste. *"I don't know,"* they said. *"Why don't I get results so quickly?"*, *"He is ahead"*, *"I must finish first"* and showed a high emotional state. This sparked a competitive spirit within the children.

Distance learning of CS inclusion

The next stage of our study describes the participation of students, including a special child, in distance learning of CS, their participation in classes, task completion, communication with peers, distance learning activities, academic activity, and cooperation with peers. The children who participated in our study were sixth-grade students studying in an inclusive class. On the day of the CS lesson, students ask the teacher for a special code to complete the task. By entering the code, the student can view and complete the task. The student sees explanatory video lectures before completing the task.

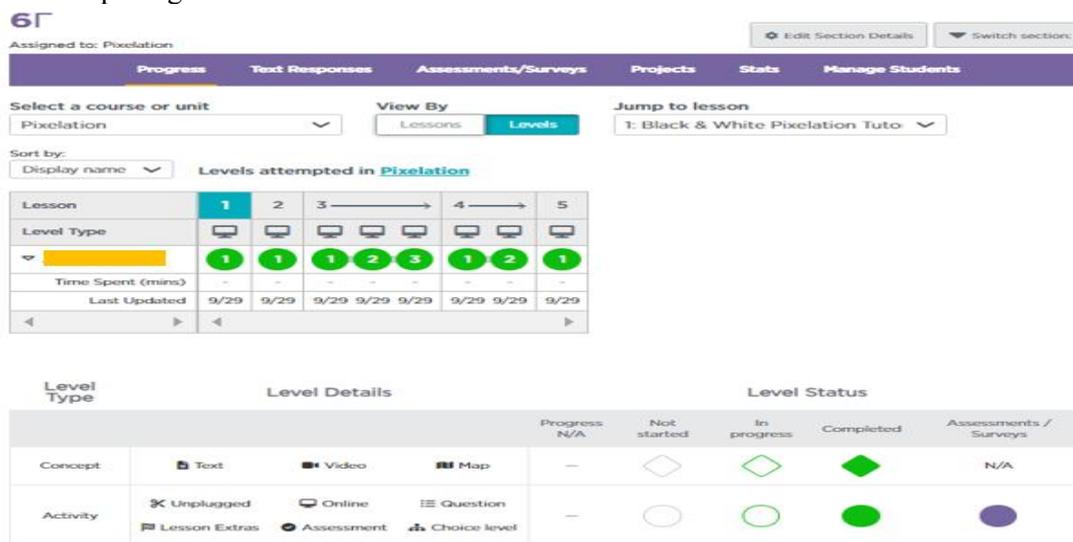


Figure 2. Window for Monitoring the Progress of Students' Tasks

In order to capture the child's interest, we first provided special needs students and the CS teacher with information about the platform, along with an explanation of its use rules. Next, the teacher asked the students to select a curriculum-aligned topic from the platform, ensuring the topic lasted only one lesson. In the first lesson, special needs students showed indifference and did not want to participate in the CS lesson. Students were given a code. They began to look at the task given on the platform. The teacher and researchers observed the children as they

performed the tasks in the classroom. The teacher has the authority to see how each student is performing the task. This took place on the platform (Figure 2).

In the first weeks, only the special children worked on the platform. The researcher, as an assistant, explained the task to the child. The special children sometimes showed impatience and did not want to complete the tasks. However, if they were able to complete the first task, they began to show some enthusiasm in moving on to the next task. However, they were unable to complete some tasks (Figure 3). Since the task was too long or difficult to complete, the child showed aggressive behavior. Therefore, after the assistant said that it was possible to proceed to the next tasks, the child began to return to normal.

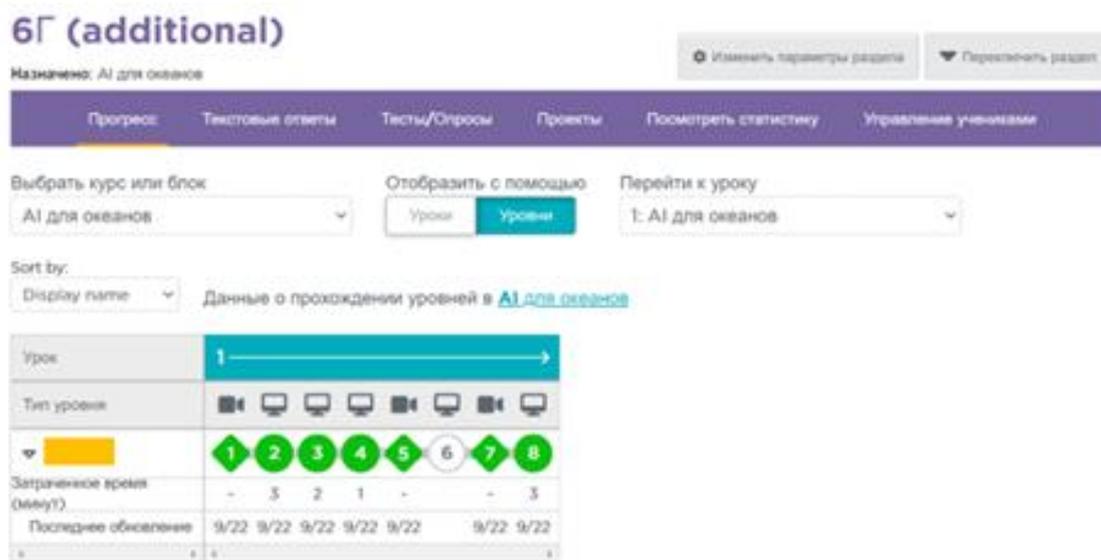


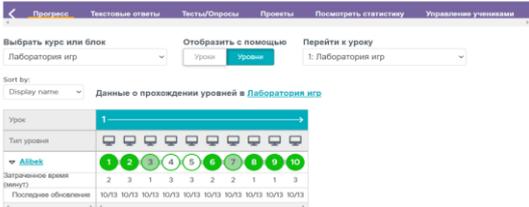
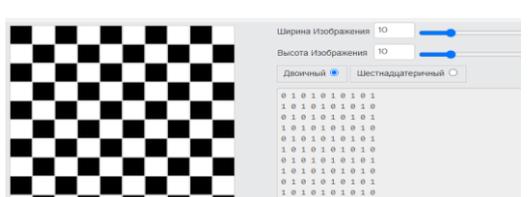
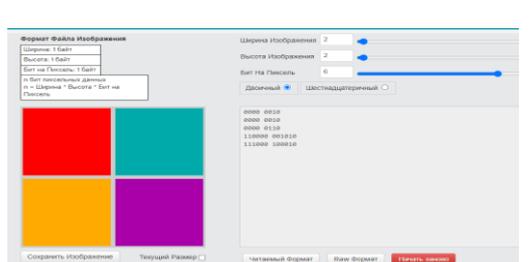
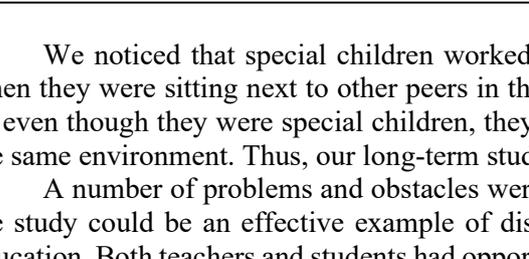
Figure 3. The student's task execution window at the initial stage

Starting from the fourth week, the children began to perform tasks alongside normal children in the classroom (Table 2). The lesson plan guided the preparation of the tasks in advance. Both special children and normal children found the tasks engaging. We believe that this approach has significantly contributed to the effective learning of all children in an inclusive class, as well as the subject teacher. After completing each task, the platform awards a specially designed certificate to the student as support. The special children who saw this were also very pleased with the normal children. Since we were in contact with the parents of special children, we sent their children's certificates electronically after each lesson. The mothers were also very happy with their children's achievements.

Over the next 7 weeks, all students in the inclusive class (both normal and special children) used the platform as a form of distance learning. That is, 20 minutes of the 45-minute lesson were devoted to this platform. Students were seated at a great distance from each other, and each was given a separate laptop. The teacher started the lesson via Zoom and explained the topic for the first 15 minutes. Students had to complete the task on the platform without leaving Zoom. At this time, special children sat in the inclusive classroom with a teaching assistant. It's beneficial that their parents are seated next to their children at home.

For children who have adapted to the platform for some time, it was simple to work with the platform interface. All children in the class completed the task with minor difficulties. However, special children became passive and did not immediately start the task. They started the task with the help of the researcher. But the children were not as motivated as in the classroom. Nevertheless, they tried to complete the task in full. Since the teacher could see how each student was completing the task on the platform, he commented on the children's work on Zoom. When the teacher mentioned students who were successfully completing the task, one of the special children became motivated, saying things like "I need to finish quickly...", "Why don't I get results quickly...", and so on.

Table 2. Task performance of children with ASD

Task performance	Description
	<p>The tasks were not fully completed</p>
	<p>As the normal child was completing the task quickly, the special children tried to keep up.</p>
	<p>Striving to complete tasks</p>
	<p>Special children completed the tasks in full.</p>
	<p>Special children were able to work with piskels through the binary code.</p>
	<p>Based on the hexadecimal number system, they understood the color transfer in the computer system and filled out the given squares themselves.</p>

We noticed that special children worked less than their peers in the classroom. Because when they were sitting next to other peers in the classroom, they had competition to learn. That is, even though they were special children, they wanted to act together with their peers, to be in the same environment. Thus, our long-term study was completed in two quarters (Figure 4).

A number of problems and obstacles were encountered. The ready-made platform used in the study could be an effective example of distance learning in computer science in inclusive education. Both teachers and students had opportunities and limitations in using the platform. The platform offered both traditional and distance learning computer science lessons that were both interesting and effective for children with special needs. Special children were willing to

participate in computer science lessons and looked forward to participating in this lesson. At the end of the study, we interviewed the subject teacher who had participated in the observation.

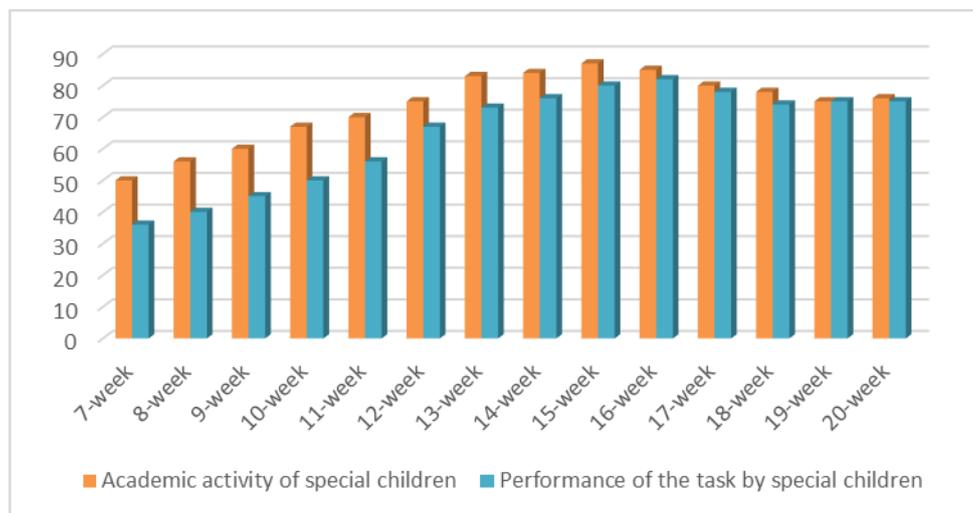


Figure 4. Observation during Research

Challenges in distance learning

In inclusive education, the organization of distance learning requires several steps. The students who participated in the study, including children with special needs, were able to turn on the computer, log in to the platform, and complete the log out. However, the observations identified several problems. Among them, they did not understand how to use small programs or how to assemble blocks. Since they were not sitting in the same classroom as the teacher, when such a problem arose, they became frustrated and refused to complete the tasks. In both cases, the students immediately sought support from adults or peers around them. Thus, it became necessary to think about how to conduct learning in a way that would not disappoint all students when complex multi-step problems arose.

The teacher and a peer of the special needs child in the inclusive classroom, who participated in this study, provided various instructions to the special needs child during remote learning. These instructions often involved explaining specific actions during the task. These instructions were implemented after the special needs child encountered difficulties. For example, Almas could not use the necessary code when working with pixels; that is, he had to use the pixels to compose colors. The teacher explained to Alisher which color corresponds to which code. Sometimes the special needs child did not understand what the teacher was saying or what the teacher wanted.

Student collaboration in an inclusive classroom

This study placed great importance on the interaction and cooperation of children in an inclusive classroom, both in traditional and distance learning formats. Each of the children participating in the study had different social and academic levels. For example, special children in the class could not fully communicate with their peers in a normal situation. However, thanks to the platform with a user-friendly, understandable interface and new software, they were able to ask each other for help. This, at least in a small way, brought special children and their peers closer together. Peers, seeing the enthusiasm of the special children who were able to work with the platform, were initially surprised. However, this did not affect the interaction in real time during the lesson. When Alisher initially asked his peer, “*What did you do to move forward?*” he generally replied, “*You put the appropriate codes.*”

Alisher was not satisfied with this answer and did not want to ask further. Although the children with special needs received support from their peers and teachers, none of the children with special needs received sufficient support to enable them to complete the task successfully. In the second phase of the study, when the children with special needs performed the task remotely

in a separate classroom, they received support from the adults around them (in our case, it was a teaching assistant, a research assistant, one of the researchers, and their mother). They took turns and tried to complete the task without rushing. This is because the special person who was found nearby paid attention to only that child with special needs and provided personal support, which contributed to the child's successful completion.

Discussion

This study aims to explore the effectiveness of distance learning in the subject of Informatics for children with autism spectrum disorder (ASD); how Informatics learning is implemented within the framework of inclusive education; as well as to identify the challenges encountered during the process. Based on the results of observations and interviews, the researcher identified several important findings that will be discussed by referring to previous studies.

The effectiveness of distance learning in informatics for children with ASD

The findings indicate that platform-based distance learning such as Code.org can serve as an effective medium for teaching basic Informatics concepts to children with ASD. When the material is presented visually and interactively, children with ASD demonstrate increased academic activity and interest. This finding is consistent with Al-Dababneh & Al-Zboon (2020), who emphasize that the visual presentation of information can enhance learning effectiveness, particularly for children with special needs.

This success cannot be separated from the function of the platform as a form of assistive technology (AT). Chambers (2020) defines AT as a product or software used to enhance the functioning of individuals with disabilities. In this context, Code.org functions as AT by helping children with ASD access learning materials in ways that align with their cognitive needs. The platform provides tasks with varying levels of difficulty that can be adjusted. It also offers immediate feedback as well as video- and game-based instructions. According to Larco et al. (2018), such characteristics can improve user experience in educational settings.

Referring to the observational learning theory from Bandura and Jeffrey (1973), there are four processes underlying learning. These four processes are attention, retention, motor reproduction, and motivation. Where these four processes serve as the basis for learning using this platform. As an example, visual and interactive elements in Code.org help maintain the attention of children with ASD. Meanwhile, the repetition of tasks facilitates the retention process. Whereas immediate feedback in the form of certificates functions as a motivational reinforcer. This can be seen from the enthusiasm of the children when completing tasks

In addition, distance learning has been shown to reduce the sensory and social overload that often hinders children with ASD in traditional classrooms. Aubé et al. (2021) states that the home environment can reduce the sensory overload experienced by autistic children. Reicher (2020) further notes that learning from home may yield greater success compared to learning in large classrooms, as classroom settings often have limitations in providing individual attention to learners with special needs. In this study, children with ASD were able to focus more effectively when completing tasks independently in front of a screen, although they still required guidance. These findings reinforce previous literature. The results demonstrate that a structured visual learning platform can serve as an effective bridge between the sensory needs of children with ASD and curricular academic demands. This represents a contribution that has not been widely explored in the context of Informatics learning at the secondary school level.

Challenges in distance learning for children with ASD

Although quite effective, this research reveals a number of significant challenges. The main challenges include the lack of teacher readiness in the learning process; then the limited social interaction between students; and finally, the emergence of child dependence on individual assistance. The lack of teacher readiness in the learning process is admitted by the teachers themselves. The research results reveal that online Informatics subject teachers are not yet fully ready pedagogically or psychologically in facing children with special needs. This is reflected in

the difficulty of teachers in maintaining the attention of children with ASD while online learning takes place. This finding is in line with the research of Thorell et al. (2024). Thorell et al. also found similar difficulties in teacher readiness in teaching children with special needs online. Even the research results of Roberts & Webster (2020) also show that teachers often do not know how to involve autistic students in the learning process. Anderson (2020) emphasizes that in the context of distance learning, teachers might not have effective methods in learning with children with special needs.

This can happen because of the absence of special training and the lack of understanding about various types of autism. The teachers in this study stated that they need methodological guidance and more in-depth professional training. Guidance and training especially in psychological aspects before applying pedagogical techniques. These teachers' statements are in line with the suggestion of Smile (2020). Smile states that children with ASD have a need for programs that are easy to implement and consider individual aspects.

Another challenge is the limited meaningful social interaction between children with ASD and their classmates. Even though building a relationship of mutual trust is very important so that autistic students feel connected with the school and their environment (Hodges et al., 2020). In this study, children with ASD tend to be passive in distance learning. These children with ASD will be active again following the learning when given direct assistance by an adult. However, when facing complex tasks, they show frustrated behavior. Such behavioral changes are in accordance with the findings of Colizzi et al. (2020) in their research on the increase of behavior problems during the pandemic.

In addition, this research also indicates the need for further study about individual support for children with special needs. Because as the research conducted by Snodgrass et al. (2016) which found that there is an increase in involvement when students with special needs receive individual support while in class. But of course, individual support is only one strategy in Informatics distance learning, so that learning takes place effectively. Besides teacher readiness, in this context, parents also need pedagogical support. As well as guidance to teach Informatics learning online to their children.

An important contribution of this research is that the researcher successfully identified that platforms like Code.org are effective to support cognitive aspects, social and emotional aspects of children with ASD in learning. Nevertheless, children with ASD still require direct human interaction. In other words, the use of technology can function optimally as a supplement only, not a replacement. Individual assistance in inclusive education is still needed. This research also shows that in distance learning for children with special needs, important factors that must be considered are teacher readiness and task design that considers the attention span of children with ASD.

Limitations and future research

This research has several limitations. Namely, the relatively short research duration (20 weeks) certainly might not be enough to see the impact in the long term. Second, the limited number of participants, only two children with ASD. This can make the generalization of findings need to be done with caution. Third, this research only uses one platform, which is Code.org. So, it cannot yet be compared with the effectiveness of other learning platforms. Based on the research findings, future research needs to focus on (a) the interaction between teachers and children with special needs online, (b) the effective organization of computational tasks for students, and (c) ways to increase the academic activity of children with special needs during distance learning in inclusive education settings. And of course, longitudinal research with more participants, accompanied by diverse levels of their autism spectrum. This is necessary to test the validity of the findings and explore the long-term impact of distance learning on the cognitive, social, and technical skill development of children with ASD.

CONCLUSION

This study objectively provided all students in the class participating in the study during distance learning of CS in the context of inclusive education. The study confirms the conclusion that children with ASD in the inclusive class need individual support. CS can be considered as one of the prerequisites for future success for children with ASD in teaching. It can be said that in the context of inclusive education, distance learning of CS can be organized taking into account the following recommendations. They are: 1) Availability of special platforms or software that can be used to teach computer science remotely; 2) Availability of educational and methodological support for parents and teachers in distance learning of CS; 3) Software language support (in our case in Kazakh); 4) The presence of professional competence in which the teacher can teach a child with SEN; 5) Availability of a methodological manual or curriculum for distance learning of CS in the context of inclusive education for a teacher.

This case study shows that it is appropriate and effective to teach children with ASD to CS in the context of inclusive education and distance learning. The results show that students with ASD can make significant progress in computing skills when provided with an environment that meets their learning needs through flexible speed, in-person support, or a virtual lesson structure. The integration of computer science learning is well combined with the cognitive strengths of many students on the autism spectrum, such as logical thinking and pattern recognition. Distance learning platforms offer additional benefits when adapted to sensory and interactive needs, sometimes by reducing environmental stressors that can occur in traditional classrooms.

In summary, the case study highlights the potential for inclusive, adaptive CS education to develop not only technical skills, but also social and cognitive development in children with ASD. Future research can explore targeted teaching methods and explore long-term outcomes for students studying CS in inclusive and flexible learning environments.

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