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Remote learning for children with Special Education Needs in the era of COVID-19: Beyond tele-conferencing sessions

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ABSTRACT

The unprecedented situation of Covid-19 which resulted in the closure of schools, enforced the educational community worldwide to find alternative ways to design the learning process. In special education the challenges are greater due to the need of individualized learning in 1:1 base, physical prompt, visual support and direct reinforcement. Nowadays, the internet services, like remote learning and teletherapy, could be an alternative and effective method of providing virtual intervention services using either well known video conferencing platforms, or more specialized ones. However, while such platforms hold great promise, there are few research studies that discuss the design decisions of the remote learning services and the most effective learning model that could be offered to children with Special Education Needs (SEN). The goal of this paper is to present a case study where SEN teachers and therapists applied a remote learning approach using an innovative online education gaming platform in combination with a video conferencing platform during the period of school closures due to Covid-19. Thirteen (13) children from three special schools participated in the study, with the majority having the autism diagnosis. The positive effects of this remote learning approach are discussed with the focus remaining on autism population.

KEYWORDS

Remote learning; students with autism spectrum disorder; educational gaming platform; effective teletherapy sessions

Introduction

Autism spectrum disorder (ASD) is a pervasive neurodevelopmental disorder characterized by deficits in reciprocal social interaction and communication as well as in cognitive flexibility, commonly appeared with the presence of restricted and repetitive behaviors (American Psychiatric Association, 2013). During the last two decades there has been a dramatic increase in the number of people receiving this diagnosis with prevalence ratings reaching 1 in 68 in the USA (Centers for Disease Control and Prevention, 2014). The average prevalence in Europe is estimated 0.61%, however, great differences among countries have

been reported, especially in Mediterranean and Southern Europe (Perez-Crespo et al., 2019). No large-scale of epidemiological data are available in Greece except a recent study conducted by Thomaidis et al. (2020). ASD overall was 1.15% for 10-and-11 years-old children. Indeed, the total number of individuals with ASD in Greece is yet unknown. Thus, the need for further epidemiological studies and educational provision of these individuals is imperative. In educational settings, individualized educational plans (IEPs) are designed to differentiate teaching according to unique educational needs children with ASD present. However, during Covid-19 pandemic where many schools have closed to minimize the spread of the disease, the challenge of special education provision and related services is even greater.

The remote learning practices that they have been used so far in special education is telehealth or teletherapy. Telehealth or teletherapy is referred to the delivery of therapeutic sessions and other services through the use of electronic or digital information and telecommunication technologies to support clinical healthcare, health-related education, public health and health administration (Brennan et al., 2009). It may include video and audio conferencing, wearable and sensor technologies, virtual reality, robotics, and therapeutic gaming. However, the most common way is the use of video conferencing, which enables real-time discussion between specialists, local service providers and clients (Careau et al., 2008).

The use of teletherapy in educational and home settings to deliver intervention to children with disabilities is developing rapidly during the last decade (Tsami et al., 2019). Barriers such as geographic location, limited access to local expert providers and resources (Antezana et al., 2017) as well as the high financial cost of in-home therapy (Lindgren et al., 2016) led to adaptation of assessments and interventions to allow for online delivery via telehealth. In addition, in 2010 the American Telemedicine Association (ATA) created standards for tele-practice focusing on occupational, physical and speech therapy as the most commonly offered therapies in school settings (Brennan et al., 2010)

However, there is yet very limited evidence regarding the use of teletherapy in school settings and, in such cases, it is restricted to promote real-time coaching to school personnel for the implementation of applied behaviour analysis (ABA) strategies (Rosenberg et al., 2020). Indeed, the majority of published research is focused to applications on parents' and teachers' training to address social communication and behavioral goals of young children with ASD (Ferguson et al., 2019). Other research to the field addresses on how to promote remotely daily-living skills to adolescents and adults with intellectual disability (e.g., Parenai et al., 2018). Also, the majority of remotely intervention programs are not comprehensive and instead focus on certain skills, especially on parents' training to functional communication (FCT) and behavior support (see Ferguson et al., 2019).

Taking into consideration the identification of those specific gaps in the literature, the purpose of the current study is to present the effects of using synchronous and asynchronous remote learning to provide interventions to students with a diagnosis of ASD and other neurodevelopmental disorders. Main intervention components and outcomes will be extracted and combined to provide an overall picture of participants, research aims, procedures and effects. A case study was conducted including 13 students with SEN, 15 teachers and interventionists from three (3) special schools while using an innovative online education gaming platform in conjunction with a video conferencing platform during the period of school closure due to COVID-19. The structure of the paper will be: next session contains a brief review and synthesis of literature studying the effects of using telehealth/remote learning to provide interventions to individuals with a diagnosis of ASD. Then, a description of the proposed remote learning model that has been applied to a case study with participants from three (3) schools during lockdown due to COVID-19, will be given. Details about the case study for validating the proposed model will be given in the following sections. The paper will end with concluding remarks about the way remote learning services could be offered to students with SEN.

Is teletherapy an effective solution in special education?

The increase in ASD diagnoses has resulted to a growing demand for intervention services. New challenges appear such as constraints for travel, cost of services, and the number of available therapists. Researchers have been focusing on teletherapy and remote learning for children with ASD, that entail various delivery models:

- parent-mediated intervention with or without therapist assistance,
- one-to-one therapy-based parent coaching model,
- one-to-one intervention sessions using networked platforms.

Concerning the applications of teletherapy to individuals with ASD, some of the innovators were service providers from the USA and Australia delivered ASD screening and diagnosis as well as specialist therapy to families of young children with autism who live in rural areas (Antezana et al., 2017; Ashburner et al., 2016). One of the most challenging and promising applications of teletherapy for ASD is the potential for increasing access to diagnostic services, which in turn can facilitate early access to interventions and family support. A very recent study by Corona et al. (2021) provides evidence on how assessment tools adapted for tele-assessment of ASD can be used by parents in an efficient way, while allowing clinicians to remotely observe child's behavior.

Moreover, most of studies in teacher coaching have focused on the implementation of ABA strategies via video-conferencing sessions in areas where local expertise to the field is limited. For instance, Neely et al. (2020) and Zhu et al. (2020) developed a videoconferencing training program delivered by

providers in the USA for professionals in Japan and China, respectively, to implement incidental teaching and discrete trial teaching with children with ASD.

The researchers' and practitioners' decisions on what teletherapy platform is going to be used are determined by specific criteria including:

(a) Secure and HIPAA compliant video with peer to peer connection with encryption so that meetings are private and authenticated. Easy to use for both clinicians and their clients, (b) costs as low as possible, (c) easy to use for both special educators and interventionists as well as parents and children (d) extra features and tools such as built in whiteboard, screen sharing, scheduling, assignments, etc. (Lee et al., 2015).

Furthermore, a range of commercial school-and-home based teletherapy platforms are available either to provide psycho-educational assessments or therapy services to children with disabilities. Global Teletherapy, Presence Learning, eLuma TinyEYE are such well known platforms, which are consistently growing. They are being used for speech-language pathology, occupational therapy, physical therapy, special education, psychoeducational assessments to children and mental health counselling from licensed therapists and counsellors. They are accompanied by resources such as blog posts, webinars, and online publications to therapists transitioning into teletherapy.

Despite the wide-spread use of video conferencing tools and specialized platforms for teletherapy and remote learning sessions, it has been reported, though, that educators and interventionists need user friendly ways to organize and present own resources such as pdf worksheets or slides as well as interactive therapeutic/educational resources such as drill & practice games. Both educators and students should be able to manipulate the resources and monitor usage/progress. Interventionists also need to share such resources offline for further practice or homework. This is the reason in our case study we focused on a model that makes use of a videoconferencing system with an interactive educational gaming platform so that teachers and interventionists can apply both synchronous and asynchronous remote learning.

A model for designing backwards remote learning sessions for children with SEN

In synchronous remote learning, students participate in real-time instruction using a video-conferencing platform (Finkelstein, 2006), whereas in asynchronous remote learning, students use computer and communication technologies to work with remote learning resources, but without the requirement to be online at the same time (Hiltz & Goldman, 2004). The current study has validated a blended synchronous and asynchronous remote learning sessions with the use of the Zoom video-conferencing platform and the Kinems educational gaming platform. The blended model was based on the principles of backward

design, an approach that makes learning outcomes the driver of course design decisions. The central question in backward design is “What do you want your students to know and be able to do by the end of your course?” (Wiggins & McTighe, 2005). Consequently, we begin with the end in mind, starting with desired learning outcomes, clearly stated in measurable terms, and working backwards through assessment activities, teaching and learning activities, and content delivery (McTighe & Wiggins, 2012).

In terms of the proposed blended model, the teacher/interventionist starts the synchronous session through Zoom platform. The student joins the zoom session and also signs in the Kinems students’ portal with the help of the parents in the case of young children. Children play multimodal educational games which help them accelerate their academic performance in math and language, improve their attention and concentration and enhance their eye-hand coordination and motor planning skills (see Figure 1). Kinems learning games are highly recommended for children with developmental disorders and learning disabilities such as autism, dyspraxia and ADHD. Teachers and occupational therapists can offer personalized and engaging learning sessions that best fit to the individual needs of a child, by choosing the games, their difficulty level, adjusting the learning content and the body gestures. The Kinems learning gaming platform is accompanied by a monitoring and reporting cloud-based system that helps interventionists see the children’s progress and access to reports with Kinesthetic & Learning Analytics anytime, anywhere and from any device.

The learning flow is as follows: The teacher shares the computer screen to present the Kinems game-based learning activity, focusing on the type of interaction with the digital game (e.g., with your mouse or finger move the



Figure 1. Screen shots of games from the Kinems learning gaming platform – [After the 2nd paragraph in chapter: A model for Designing Backwards Remote Learning Sessions for children with ASD].

avatar left and right to select items), and the content (e.g., select all triangles). The teacher encourages the student to answer (e.g., which is a triangle; the blue or the yellow one?). Then, the student practices on his device (laptop or tablet). Via the Kinems monitoring dashboard, the teacher can remotely launch and pause the game to give explanations, and scaffolds. At the end of the session, the teacher assigns digital game-based learning activities for asynchronous extra home practice and monitors the student engagement and performance through detailed cloud-based reports which are automatically saved when the student completes a game.

Aim of the study

The present study seeks to investigate: (a) If and to what extent the combination of synchronous and asynchronous tele-education using the Kinems learning platform is effective for the development of academic and cognitive skills of children and adolescents with SEN, (b) If and to what extent the intensive exercise with the Kinems learning platform can develop motor skills related to mouse use, fine-motor and hand stability and, (c) If and to what extent the Kinems learning platform is positively evaluated by parents, therapists and educators.

Method

Participants

Thirteen (13) students with Special Education Needs (SEN) participated in the current case study; 9 boys and 4 girls, aged from 7 to 15. All of them attended special education in Greece. Specifically, 9 students were attending two public primary special education schools in Attica region and 4 a public secondary special education school in Aetolia-Acarnania region. Ten children and adolescents have been diagnosed with ASD and the rest of them with other neuro-development disorders. Thus, individuals within the autism spectrum constitute the majority of sample. Moreover, 15 educators and therapists participated in the study. The educators and therapists were responsible to design the remote learning sessions following the backward design approach, deliver the synchronous instruction and assess the performance of their students based on the data gathered, both from the synchronous and the asynchronous practice. Students' parents participated as well, supporting their children during the sessions when needed. Moreover, they evaluated the effectiveness of the remote sessions and their children's progress by filling detailed reports when the intervention completed.

Design overview

The intervention was carried out in 3 different phases: (1) The preparation phase during which the educators, principals and parents were informed about the context of the remote interventions. Informative and consent forms were signed by educators and parents. The educators participated in two one-hour virtual trainings on Kinems learning platform and prepared the learning goals based on the principles of backward design, (2) The implementation phase, during which the educators were conducting one-hour weekly synchronous learning sessions with their students using the Zoom teleconference platform. During the sessions, the educators were implementing only the Kinems learning activities which they have selected for their students according to the individual students' needs. Furthermore, after the synchronous session educators were assigning learning activities to their students to practice further at home (asynchronous tele-education). The implementation phase lasted 5 weeks in total, (3) The evaluation phase, during which the overall assessment of the effectiveness and acceptability of the proposed model was conducted using reliable evaluation tools; questionnaires, interviews and reports (*see below on "Evaluation Tools"*). All data was collected and thoroughly analyzed. The ethics of the investigation was ensured through anonymity and coding for the protection of personal data. All students and teachers had voluntarily participated to this initiative.

Evaluation tools for data collection and analysis

Due to examine the first and the second research question related to the effectiveness of the Kinems based remote learning model on children's skills, the evaluation tools as detailed below were applied:

Learning and kinesthetic analytics: Kinems platform provides the potential of a dynamic assessment recording the learning performance of each student in a form of tables, graphs and reports and saved in a cloud-based system. This type of data has been successfully utilized in similar studies in the past (Kosmas et al., 2018; Kourakli et al., 2017).

Overall skills assessment questionnaire: Teachers and therapists completed a 12-item questionnaire in a form of a structured phone interview to measure attention skills, fine-motor control, motivation and emotional affect as well as co-operation and autonomy/independence. The questionnaire included close-ended (yes/no) checklists and a 5-point Likert scale ranging from 1 (*almost never*) to 5 (*almost always*). This questionnaire was modified for the needs of our study, however, based on the sections of the standardized in Greek Achenbach's Child Behaviour Checklist (CBCL) and Teachers' Report Form (Roussos et al., 1999). CBCL is a well-established questionnaire worldwide which has been

studied in the past for addressing behaviour and social problems in autism population (Biederman et al., 2010).

Psychometrically equivalence tested goal attainment scaling (PET-GAS):

Because each child had different learning goals according to an Individualized Educational Plan (IEP), an assessment system utilizing the PET-GAS (Kiresuk et al., 1994) was used to measure the amount of progress each student made on the IEP goals while using the Kinems platform. Goals included a wide range of learning domains related to cognitive and academic skills as well as emotional understanding and fine-motor co-ordination. Each goal attainment scale used the following 5-point rating scale: $-2 = \text{child presents much lower levels of performance}$, $-1 = \text{child presents lower levels of performance}$, $0 = \text{expected level of outcome}$, $+1 = \text{somewhat more than expected}$, $+2 = \text{much more than expected}$. PET-GAS has been widely implemented in school environments assessing a range of skills (Brady et al., 2014; Chiarello et al., 2016) and has been utilized for the assessment of special population such as autism (Ruble et al., 2012), and other developmental disorders (Wehmeyer et al., 2003).

Similarly, for examining the third research question related to the acceptance of Kinems platform by parents, teachers and therapists the following tools were used:

Acceptance assessment scale: Teachers and therapists completed a Likert-type scale due to evaluate their perceptions regarding the efficiency and practicality of Kinems platform. A 5-point scale was used ranging from 1 (*not at all*) to 5 (*very much*).

Parents' written reports: In order to evaluate the program efficacy on the whole, it was asked to parents sent a written report to the program co-ordinators as a part of action evaluation.

These tools were developed by the researchers in terms of assessing the social validity of the intervention (Horner et al., 2005). Indeed, a large body of research in the field indicates questionnaires and interviews with caregivers and educators as a valid source of data for the efficacy of training programs (e.g., Bartoli & Lassi, 2015; Kourakli et al., 2017; Muller et al., 2018).

Results

Associating students' performance with duration of involvement and educational needs

The students gradually joined the project according to the availability of their parents and the readiness of the educators due to COVID-19 quarantine measures. As a result, the participants were divided into two zones according to the duration of their participation in the project (see Table 1). Students, who have joined the project in a different zone, practicing on the same goals, have noted a high goal achievement. For example, student STK2 belongs to zone A, whereas student STA5,

Table 1. Students' goal and skills achievement – [After the 1st paragraph in chapter: Associating Students' performance with duration of involvement and educational needs].

Students	Learning Goals	Goal Achievement				Number of Game Questions	Average Game Score	Average Skills Score
		Much more than expected	More than expected	Expected	Less than expected			
Zone A: Long Involvement Duration (5–4 weeks)								
STK4	4	1	1	1	1	53	70%	3,83/5
STK7	1	-	-	-	1	72	50%	1,17/5
STK3	3	1	1	-	1	612	70%	5/5
STK8	5	1	2	2	-	202	70%	4,67/5
STK6	4	-	1	1	2	74	60%	2/5
STK2	8	4	3	-	1	931	100%	4,58/5
Zone B: Short Involvement Duration (3–2 weeks)								
STM1	6	4	-	1	1	161	90%	3,9/5
STM3	9	6	2	1	-	176	60%	4,10/5
STM4	5	2	1	2	-	157	70%	4/5
STA5	4	1	2	1	-	204	80%	5/5
STA6	1	1	-	-	-	46	40%	3,5/5
STM2	8	4	4	-	-	208	70%	4,59/5
STA3	4	-	1	3	-	174	40%	4,3/5
Total	62	26	17	12	7	3,070	-	-

belongs to zone B. Both students had been practicing with addition and subtraction up to 10 and noted a high achievement, regardless the involvement duration.

Associating now the goal achievement of the students with their needs, it is observed that even students with severe disabilities benefited from the program. Non-verbal student STK6, diagnosed with comorbidity of ASD and Attention-deficit/hyperactivity disorder (ADHD) not able to focus his attention without the adult assistance was assessed with +1 and 0 in 2 out of 4 learning goals. For the other two goals he was assessed with -1, since the learning sessions were decreased; the student was not able to concentrate during the synchronous learning sessions. According to his teacher, if the remote learning sessions continued for another month, the student would be able to reach the highest goal achievement for the rest learning goals as well. This statement is in agreement with the satisfying average game score that he achieved; 60%.

Associating goal achievement and skills improvement with number of games

Associating at this point the goal achievement with the number of games, it is observed that students who practiced more with a specific activity (i.e. played the game more times), made significant improvement and were highly rated in PET-GAS. For example, student STK2, who practiced 10 times with the Kinems activity GR.ELA-LITERACY.L.2.1.B and the game Suffizz (see [Figure 2](#)), working on the “Singular and the Plural nouns”, reached the highest mastery level; “Mastered”, and her performance was evaluated with +2 in PET-GAS by the teacher.

In addition, students whose learning goals were motor skills and mouse or touchpad computer skills improvement, received a positive grade in PET-GAS of +1 and +2, having practiced in over 20 games. This trend is in agreement with the kinesthetic analytics of the platform (see Figure 3 & Figure 4).

Associating students' engagement with number of learning goals and frequency of blended remote learning

Teachers set specific days for the 1 hour synchronous sessions per week according to the availability of the parents and the needs of the child; the majority of students participated in 2 synchronous sessions per week, 4 students in 3 synchronous sessions, 1 student in 4 synchronous sessions, 1 student in 5 synchronous sessions and 1 student participated in 1 synchronous learning session per week.

Student STK2, despite participating in 1 synchronous learning session per week noted a high engagement rate, playing 151 games, answering 931 questions, with a total engagement time of 7 hours and 67 minutes (see Table 2). After the completion of each synchronous learning session, Kinems game-based learning activities were assigned for extra home practice. The student had gained great autonomy in the use of the platform within this short period of one month, a fact that contributed even more to her high percentage of involvement in both synchronous and asynchronous learning activities.

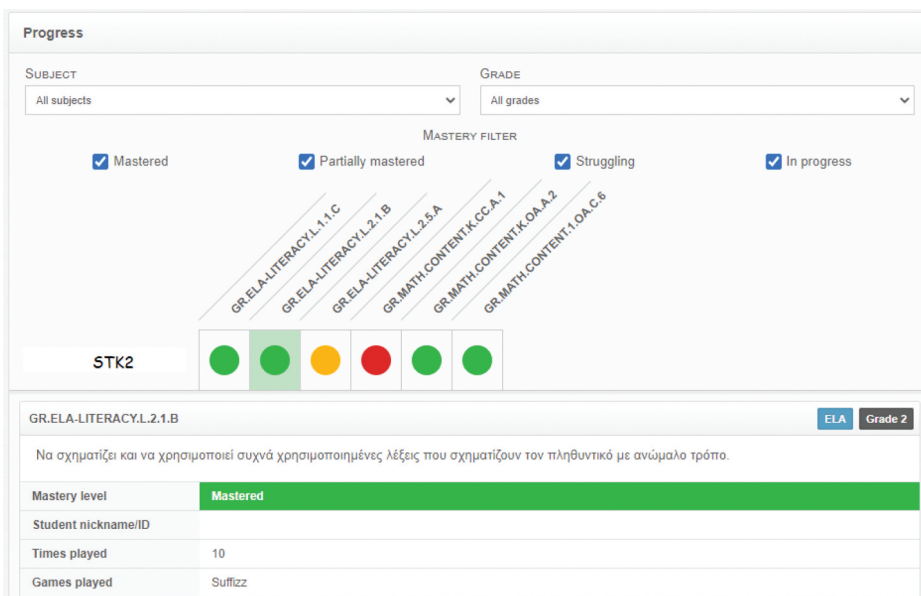


Figure 2. Kinems Graphic display of progress towards the goal – [After the 1st paragraph in chapter: Associating goal achievement and skills improvement with number of games].



Figure 3. Kinems Walks Game Reports over time (first-middle-last session) – [After the 2nd paragraph in chapter: Associating goal achievement and skills improvement with number of games].

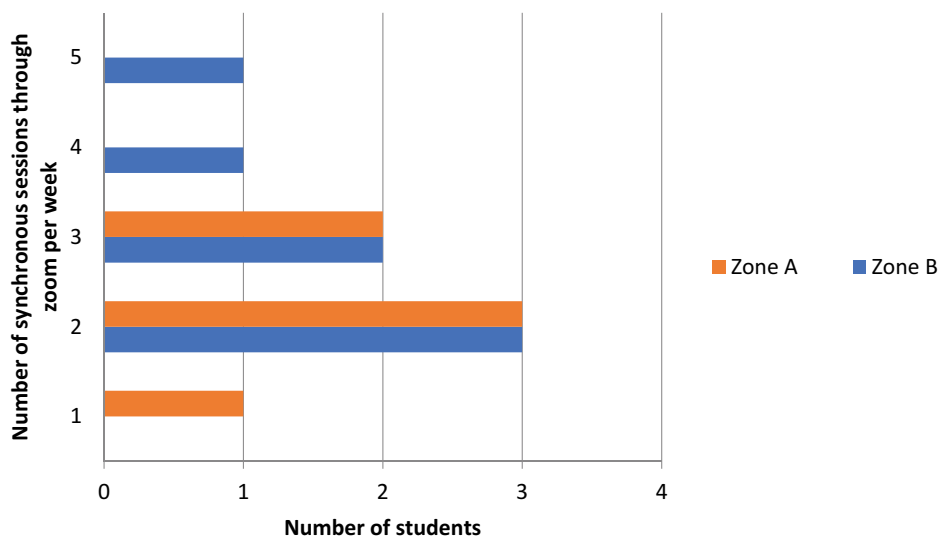


Figure 4. Students' grouping based on the frequency of synchronous learning sessions via Zoom – [After the 1st paragraph in chapter Associating students' engagement with number of learning goals and frequency of blended remote learning].

Consequently, the total duration of students' involvement in the program is related not only to the number of synchronous learning sessions and the learning goals, but also to other factors such as the autonomy in the use of the computer, and/or the cooperation with the family. Students who had greater autonomy in the use of the mouse and computer in general, could practice more with the Kinems games. Students with shorter engagement, such as STK6, STA6, STM3, who were not that familiar with the computer use, needed more time.

Table 2. Number of sessions and level of student involvement – [After the 1st paragraph in chapter Associating students' engagement with number of learning goals and frequency of blended remote learning].

Students	Number of synchronous sessions per week	Number of learning goals	Number of games	Number of questions	Total engagement (h)
Zone A					
STK4	3	4	199	612	0,54
STK7	3	1	55	202	1,11
STK3	2	3	27	74	5,46
STK8	2	5	17	53	2,58
STK6	2	4	72	36	1,69
STK2	1	8	151	931	7,67
Zone B					
STM1	5	6	35	157	4,44
STM3	4	9	55	161	1,63
STM4	3	5	48	176	3,37
STA5	3	4	71	208	1,08
STA6	2	1	32	204	0,71
STM2	2	8	21	46	2,78
STA3	2	4	51	174	2,04

Table 3. Child's attention to orders [After the 1st paragraph in chapter: Children's overall skills performance].

	Frequency		Percent	Valid Percent	Cumulative Percent
Valid	almost never	1	7,7	7,7	7,7
	seldom	1	7,7	7,7	15,4
	frequently	5	38,5	38,5	53,8
	almost always	6	46,2	46,2	100,0
	Total	13	100,0	100,0	

Table 4. Child's attention while performing activities [After the 1st paragraph in chapter: Children's overall skills performance].

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	never	1	7,7	7,7
	seldom	1	7,7	15,4
	frequently	4	30,8	46,2
	almost always	7	53,8	100,0
	Total	13	100,0	

Children's overall skills performance

In addition to GAS assessment and Kinems platform analytics, it was also assessed the overall children's skills performance through a close-ended questionnaire completed by teachers and therapists. As far as the cognitive domain is concerned, significant outcomes have been found for children's attention skills. Tables 3 and 4 show the children's attention skills performance while listening to orders and carrying out the Kinems activities. As it is shown below, 53,8% and 46,2% of the whole sample significantly increased attention, and specifically auditory and sustained attention, during the program. We consider this finding as very important taking into consideration the very short

implementation of the intervention as well as the significant role of attention in learning.

Another significant finding concerns children's interest towards the Kinems platform. According to practitioners' reports, the majority of children exhibited an increasing tendency to play with the Kinems activities not only in their scheduled sessions during synchronous learning, but also asynchronous during the week (see Table 5). This finding reveals Kinems as an attractive educational material which enhances children's motivation and positive affect towards the platform.

In addition to the above results, professionals reported an increase to co-operative behavior while working with children through Kinems activities (Table 6). It seems that the specific type of educational material- the Kinems games specifically- maximized children's interest and motive to learning activities in a way that the positive stance that had been developed through games also increased children's particular social skills such as co-operation.

Also, teachers and therapists reported a progressive autonomy while children were playing with the games, although different levels of autonomous learning have been observed (Table 7). Children with low levels of autonomy were mainly those with the greatest difficulties, showing that the level of children's

Table 5. Increasing interest to Kinems platform [After the 2nd paragraph in chapter: Children's overall skills performance].

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	always never	1	7,7	7,7	7,7
	seldom	2	15,4	15,4	23,1
	occasionally	1	7,7	7,7	30,8
	frequently	1	7,7	7,7	38,5
	almost always	8	61,5	61,5	100,0
	Total	13	100,0	100,0	

Table 6. Co-operation with the teacher/therapist [After the 2nd paragraph in chapter: Children's overall skills performance].

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost never	1	7,7	7,7	7,7
	seldom	1	7,7	7,7	15,4
	frequently	2	15,4	15,4	30,8
	almost always	9	69,2	69,2	100,0
	Total	13	100,0	100,0	

Table 7. Child's autonomy during sessions- [After the 4th paragraph in chapter: Children's overall skills performance].

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost never	4	30,8	30,8	30,8
	seldom	1	7,7	7,7	38,5
	frequently	3	23,1	23,1	61,5
	almost always	5	38,5	38,5	100,0
	Total	13	100,0	100,0	

functioning affects the level of children's autonomy. Possibly, further physical support in combination with suitable learning goals as well as further duration or frequency of the intervention are needed for autonomous learning. In relation to children's autonomy, the use of mouse and the habituation with that during sessions was also another factor that has been examined (Table 8). As it is shown below, children exhibited great habituation with the mouse use regardless their level of functioning giving a light of evidence that the platform is suitable to be used by children with severe difficulties and to promote fine-motor co-ordination.

An additional analysis of these data concerns the duration of the intervention's implementation (see Tables 9 & 10). Table 9 illustrates the performance of children with ASD who participated to the long implementation of the program according to the "Overall skills questionnaire". In general, the data indicate that increased performance to the most of the domains is noticeable to children with high and moderate functioning, whereas the exercise with the platform seems to highly related both to the level of autonomy and interest towards the activities (*e.g.*, *students STK3 & STK4*). Overall, the greatest improvement has been achieved in attention skills and co-operation.

Table 10 shows the performance of children who participated to the short implementation of the programme. This group is mixed including children

Table 8. Habituation with mouse use -[After the 4th paragraph in chapter: Children's overall skills performance].

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost never	1	7,7	7,7	7,7
	seldom	1	7,7	7,7	15,4
	occasionally	1	7,7	7,7	23,1
	frequently	4	30,8	30,8	53,8
	almost always	6	46,2	46,2	100,0
	Total	13	100,0	100,0	

Table 9. Students participated to the long duration and their performance per domain. [After the 6th paragraph in chapter: Children's overall skills performance].

Student's Code	Diagnosis	Frequency of tele-sessions per week	Attention	Co-operation	Interest	Autonomy	Number of games
STK4	ASD (high functioning)	2	5	5	2	3	17
STK7	ASD (low functioning)	2	1	1	1	1.5	30
STK3	ASD (high functioning)	3	5	5	5	5	199
STK8	ASD (high functioning)	3	5	5	5	4	55
STK6	ASD (low functioning) & ADHD	2	2	2	2	2	27
STK2	ASD (moderate functioning)	1	4.5	5	5	5	151
Mean			3.75	3.8	3.3	3.4	

Table 10. Students participated to the short duration and their performance per domain. [After the 6th paragraph in chapter: Children's overall skills performance].

Student's Code	Diagnosis	Frequency of tele-sessions per week	Attention	Co-operation	Interest	Autonomy	Number of games
STM1	Neurological Disorder (non-specified)	4	4.5	4.5	5	5	55
STM3	ASD (low functioning)	3	3.95	4.6	4.6	3.6	48
STM4	ASD (moderate functioning)	5	4.5	5	3	3	35
STA5	ASD (high functioning)	2	5	5	5	5	32
STA6	ASD (moderate functioning)	2	4.5	5	5	1	21
STM2	Intellectual Disability	3	4.25	5	4.5	4.75	71
STA3	Developmental Delay & Developmental Motor Co-ordination Disorder	2	4.5	4	4.5	4	51
Mean			4.45	4.7	4.5	3.7	

diagnosed with ASD and other neuro-developmental disorders. Data indicate high performance to all domains and even higher mean performances than children to the other group, although the short duration of the intervention.

The least improvement has been achieved in the domain of autonomy, which seems to be related to the number of games and the overall use of the activities (e.g., student STA6). It is also noticeable that children in this group played more games than children in the group with the longer duration. This outcome gives us evidence to conclude that the frequency of exercising the activities – and not the duration per se – is a very powerful indicator for the children's skills improvement (e.g., students STM7 & STM3).

Finally, it seems that children with high functioning ASD responded very well to the intervention regardless the duration of the programme, the frequency of tele-sessions and the number of games. More factors regarding the efficacy of the intervention seem to be associated to children with low to moderate functioning. One such might be the suitable goals adjusted to the children's needs and strengths for this short-time period intervention.

Concerning the outcomes for children with neuro-developmental disorders except ASD, these are also very encouraging. However, because of the very low sample clear conclusions are not yet feasible.

Educators' and parents' perception

In Table 11, we notice that the criteria related to the usefulness of the platform in remote learning, the possibility to propose the platform to colleagues and the positive correspondence from the family, sum an average of 4.7/5. The last is also confirmed by the views of parents: *"Our first impressions of the program are very positive. Our child is very happy. He has his own time on the platform and he enjoys the games", "Kinems is an innovative tool for SEN children. It is helpful for*

Table 11. Teacher evaluations per field- Data from the evaluation forms [After the 1st paragraph in chapter: Educators' and parents' perception].

Educators	Usefulness of Kinems platform in remote learning	Clarity of educational material	Functional implementation of Kinems platform for SEN students	Positive correspondence from the family	Suggest the Kinems platform to colleagues	Use of the Kinems platform at school	AVG
Zone A							
TK6	5	5	5	5	5	5	5
TK10	4	5	5	3	4	3	4
TK5	5	5	4	5	5	5	4,8
TK11	5	4	4	5	4	4	4,3
TK9	4	5	2	3	3	2	3,2
TK4	4	5	5	5	5	5	4,8
TK3	5	4	5	5	5	5	4,8
Zone B							
TM2	5	5	5	5	5	5	5
TM1	4	5	4	5	5	5	4,7
TM6	5	5	4	5	5	5	4,8
TM5	5	5	4	5	5	5	4,8
TM7	5	5	4	5	5	5	4,8
TA4	4	5	5	5	5	5	4,8
TM4	5	5	5	5	5	4	4,8
TM3	5	4	5	5	5	5	4,8
AVG	4,7	4,8	4,4	4,7	4,7	4,5	4,6

teachers and parents based on good learning strategies and occupational therapy techniques “.

Concerning the functional application of the platform in remote learning for SEN students, the average score was 4.4/5. According to the teachers' feedback, the students with severe disabilities weren't able to use the mouse. This fact emphasizes the need to provide students with multiple tools according to their needs.

Meanwhile, the qualitative comments of the parents' reveal:

- The joy of their children when practicing with the assigned learning activities.
- The satisfaction of parents for the initiative of their schools to participate in the program, which enabled their children to practice academic skills through digital, educational activities during COVID-19 closure.
- The will of parents to integrate the Kinems platform as a basic educational tool in the classroom.
- The impatience of children to practice with Kinems learning games at home.
- The common assumption that the Kinems games were very attractive and helped their children acquire knowledge in an easier way compared to the traditional teaching.
- The desire of parents to enable their children with mobility difficulties to practice with games on touch screens.

- Their gratitude to the educators for the excellent cooperation they had with their children.

Discussion

The primary aim of this study was to investigate the implementation of Kinems education gaming platform applied remotely in SEN students during the period of school closure due to COVID-19 and its effects on students' learning. Thirteen (13) children and adolescents with SEN participated, 10 out of 13 diagnosed with ASD, their parents as well as their teachers and therapists. The intervention was carried out in three separate phases: the preparation, the implementation and the evaluation phase. In addition, the participants were divided into two zones according to the duration of their participation in the project; zone A: long duration (4 & 5 weeks) and, zone B short duration (2 & 3 weeks).

Results regarding students' performance are considerably encouraging. According to practitioners' evaluation the majority of students achieved greater than the expected performance to the learning goals on the whole, regardless the duration of their participation. Moreover, there was a dramatic rise in attention skills, in motivation and positive affect towards the platform, in the mouse use and finally in co-operation and interaction with the educators during the intervention regardless the students' level of functioning. Mixed results have been recorded for the level of autonomy. It seems that the level of autonomy is affected both by the exercise of games (through synchronous and asynchronous tele-education) and the level of children's functioning. Children with the greatest difficulties may need further asynchronous education with physical support and guidance. Indeed, the greatest performance was observed in children that exercised more the Kinems activities both during synchronous and asynchronous learning. It seems that the frequency of exercising with the activities rather than the duration per se is a more powerful indicator for the successful performance.

Furthermore, the vast majority of teachers and therapists positively evaluated the Kinems platform not only for its efficiency on a range of students' skills, but also for its utility as a tool for improving their educational practice. A strong feedback regarding the effectiveness of the platform on children's skills as well as on their emotional affect was reported by parents too, confirming the beneficial evaluation received by the educators. We consider the evaluation both by parents and practitioners as crucial for the effectiveness of the intervention, supporting its implementation as an evidence-based practice (EBP). A large body of research in special education has been addressed the social validity of an intervention in order to be recognized as EBP, in terms of implementing socially important goals, procedures that are acceptable and feasible by natural change agents, such as caregivers and professionals, and outcomes

that are effective in natural settings (i.e. homes and schools) (e.g., Snodgrass et al., 2018 *for a review*).

Moreover, our results support the efficacy of studies using computerized intervention programmes directly to children with SEN for developing executive function, academic performance and motor skills. For instance, in a recent study conducted in the UK, researchers implemented a computerized attention training in mainstream and special educational settings to improve academic performance in school-aged children with ASD (Muller et al., 2018). Similarly, Hilton et al. (2014) using a light and sound speed-based exergame found significant improvements in executive function and motor skills of children with autism. Other studies using the Kinems activities also support the efficacy of the platform to enhance academic, cognitive and motor skills as well as positive emotional affect to children with SEN in Greece and Cyprus (Kosmas et al., 2018; Kourakli et al., 2017).

Taking into consideration previous research and the outcomes of this one, we could conclude to some new insights this preliminary study offers. The most critical point is the child-centered direction of the present intervention. To the best of our knowledge no published research is available so far in autism and special education, concerning the direct intervention to children through online learning. Within this study we do not focus on parent or teacher training, but on child education per se in a variety of skills through an innovative remote learning platform. Indeed, children had the opportunity to exercise their skills in a variety of fields such as academic, cognitive, motor and socio-emotional according to the learning goals that had been set by their educators. Thus, the purpose of using the specific platform was to design a comprehensive intervention model rather than to address a single skill or goal of a student under the umbrella of “focused intervention practices”. Another critical point is the combined use of synchronous and asynchronous learning for the success of the intervention. No published research so far in the field has focused to asynchronous learning too. We do suggest blended learning for a number of reasons; particularly, synchronous learning for the development of children’s social skills such as the interaction and co-operation as a core learning goal in ASD, and asynchronous for the development of autonomy, and eventually for the gradual development of self-regulated learning. Finally, this is the first research in Greece which examined the effectiveness of a remote learning model in special education and was implemented in natural settings.

Limitations and future implications

There are several limitations to this study that should be considered while interpreting the findings. First, the very short duration of the study (1–2 months during schools’ closure) and the time period of its application (during COVID-19 lockdown) were not the expected for the implementation

of an educational intervention. Second, the limited technical equipment that was available at schools and families (e.g., no touch screens and Kinect sensors) further restricted the exercise with the platform, especially for students with mobility difficulties and severe disabilities. This fact emerges the need for the educational practice to provide multiple technological tools according to the students' needs. In addition, due to the qualitative nature of the intervention, the experimental control of all variables that may affected the outcomes of the study, such as the duration of the intervention, the total time of practicing with the platform, the students' cognitive, social and motor functioning and the appropriate targets that were set by practitioners, was not feasible. Finally, because of the emergency of the intervention's implementation, no follow-up was conducted.

Future research is needed in special education in order to bridge the gap between research and practice on remote learning. Regarding our findings yet generalized conclusions are precarious. Further studies are needed to examine the outcomes of this study with greater sample and wider range of participants' age, for instance, including preschoolers. Moreover, future studies could focus on the remote implementation of Kinems platform as a practice for educational assessment and intervention for SEN students living in rural areas where specialists are limited.

Disclosure Statement

No potential conflict of interest was reported by the author(s).

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