(REVIEW ARTICLE)

Digital tools based differentiated intervention of a student with ASD

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Abstract

Eighteen (n=18) students from a 6th grade class in a general elementary school in Athens, Greece, including one student diagnosed with high-functioning Autism, are learning the subject of physics. The general education teacher and the special education teacher supporting the autistic student, they collaborate exceptionally well and meet the needs of the class. The special education teacher has made necessary adjustments to satisfy the interests and needs of the student, actively involving them in the learning process. This research lasted for three (3) instructional hours and aimed to highlight digital tools as a good practice for differentiated teaching and inclusion of students with Autism, in accordance with the objectives of the curriculum. At the end of the research, questionnaires were administered to the students to explore their attitudes towards the digital tool ToSakidio. Additionally, a semi-structured interview was conducted with the student with Autism. The findings showed that the student diagnosed with ASD using the digital tool ToSakidio is capable of following the detailed curriculum smoothly as long as he is given the opportunity to approach the content in a way that facilitates his understanding as well as he is capable of developing effective collaboration skills with his peers.

Keywords: Differentiated instruction; ASD; Inclusion; Digital tools

1. Introduction

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition that involves difficulties in social communication, interaction, and repetitive behaviors with restricted interests. The challenges in social skills can greatly affect an individual's capacity to build relationships, sustain friendships, and engage in social activities. Conventional interventions for individuals with ASD, like role-playing and group therapy, have limitations in providing a secure and controlled setting for practicing social skills (Sideraki & Drigas, 2023).

Individuals diagnosed on the autism spectrum constitute a heterogeneous population in terms of psychological characteristics, skills, and cognitive functions. However, they exhibit certain common characteristics, such as significant difficulties in social interaction and communication, stereotypical behaviors, and reliance on routines to alleviate anxiety. For instance, individuals on the autism spectrum often engage in uncommon topics, such as astronomy, focusing on objects with specific characteristics or details that may not interest others. The exact causes are not yet fully understood, although it is clear that there is a genetic predisposition. Additionally, boys are more likely to be diagnosed on the autism spectrum.

Regarding individuals with Asperger's syndrome, they typically exhibit high cognitive functioning and excellent verbal skills (Attwood, 2012). They have acute visual perception, excellent visual-motor coordination, and can easily recognize auditory patterns. Additionally, they possess strong visual memory, easily recall information and words, and maintain their attention over time. In fact, approximately 10% of this population demonstrates exceptional abilities in areas such as technology, arts, sciences, design, and craftsmanship (Attwood, 2012).

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On the other hand, individuals with an ASD diagnosis require more time to process information. They face significant difficulties in drawing conclusions, understanding metaphors, irony, and humor, and may exhibit hypersensitivity or hyposensitivity to sensory stimuli (Mavropoulou et al, 2011). They often rely on routines or consistently use the same strategy to solve problems or navigate situations due to inflexible thinking (Hallahan et al., 2022). Additionally, individuals with Asperger's syndrome experience anxiety or awkwardness in social interactions. For example, they struggle with forming and maintaining friendships as they find others' behavior unpredictable and anxiety-inducing, leading them to prefer isolation. Moreover, they find it challenging to grasp unspoken social rules, resulting in behaviors that are perceived as socially unacceptable (Attwood, 2012).

It is crucial to be noted that previously, Asperger's syndrome was considered a distinct condition. However, in 2013, the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), which is widely used by mental health professionals, reclassified it. Currently, Asperger's syndrome is no longer recognized as a separate diagnosis. It has been integrated into a broader category known as autism spectrum disorder (ASD). ASD encompasses a range of related disorders that share some common symptoms. Nevertheless, many people still use the term Asperger's to refer to this condition. Professionals and practitioners refer to Asperger's as a "high-functioning" type of ASD, meaning that the symptoms tend to be less severe compared to other forms of autism spectrum disorders. The DSM-5, also, introduced a new diagnosis called social pragmatic communication disorder, which shares certain symptoms with Asperger's. This diagnosis is used for individuals who experience difficulties in verbal and written communication but have neurotypical intelligence.

2. Differentiated instruction

The differentiation of teaching aims to support all students in the general classroom, taking into account their individual characteristics, readiness for learning, and interests. It is an instructional approach based on the premise that students' failure reflects the school's failure to provide appropriate diverse opportunities for different students. In order to maximize the chances of success, the necessary adjustments and principles governing differentiated instruction should be an integral part of the daily educational process and not emerge as a remedy for previous unsuccessful lessons (Tzivinikou, 2015).

In more detail, differentiation involves adaptations in (a) the learning environment, (b) the content of the curriculum, (c) the teaching methods employed for content comprehension, and (d) the evaluation of teaching outcomes (final product) (Tomlinson, 2017). Within the framework of differentiated instruction, educators strive for the active participation of all students through the implementation of flexible grouping, adopt a more guiding role, and maintain high expectations for all (Cholevas et al., 2018). Through continuous assessment, the educator identifies errors and weaknesses and utilizes them as stepping stones for constructing new knowledge. Within this context, they adapt activities, materials, objectives, and pacing (Valiandes, 2015). This differentiation and subsequent success lead to higher self-esteem independence, and critical thinking on the part of the students. The educator's effort focuses on the daily progress of the students, who learn to communicate and collaborate more effectively with one another (Cholevas et al., 2018). The ultimate goal is for all students in the general classroom to understand the content of the lesson in the most suitable way for each of them (Tomlinson, 2017). Therefore, it can be concluded that differentiated instruction has a dynamic nature, as the educator designs the lesson with an in-depth understanding of the subject matter and the students' needs (Valiandes, 2015). Simultaneously, it enhances the quality and effectiveness of teaching by providing equal opportunities for knowledge to all students without exception (Tomlinson, 2017).

On the other hand, the universal and proper implementation of differentiated instruction encounters many difficulties and challenges. For example, it requires continuous professional development and a significant amount of time for preparation and implementation of adaptations (Panteliadou et al., 2020). Additionally, creating a collaborative spirit within the classroom requires time and effort, while the overwhelming and rigid curriculum often hinders its systematic implementation since educators are pressured to cover the required "content" (Panteliadou et al., 2020).

3. Inclusion

"Inclusion" is a multidimensional conceptual construct that embraces the model of diversity as a fundamental aspect of each individual. It is grounded in socio-cognitive theory and revolves around ensuring equal access and participation for all students, including those with disabilities, within the local school community. The concept of inclusion emerged in the 1990s, replacing previous terms such as "incorporation" and "integration." Its primary goal is to eliminate social discrimination and provide equal opportunities for all children within mainstream educational programs (Bravou et al, 2022). Inclusion aims to maximize the potential of students in various areas of human development. It goes beyond simply placing students with disabilities in regular classrooms and emphasizes their active participation in a cohesive

curriculum. Inclusion promotes social acceptance, facilitates the development of new academic skills, and encourages dynamic interactions that enhance both socialization and cognitive development. This approach involves a radical restructuring of educational systems, focusing on the social and environmental aspects of educational settings.

"E-inclusive" pedagogy is a subset of inclusive education that focuses on the integration of ICTs (Information and Communication Technologies) in educational processes and activities. It involves the decisions made by teachers, which reflect their beliefs and attitudes towards diversity and the functional use of technology to address digital inequality. In e-inclusive pedagogy, ICTs are seen as tools that support holistic inclusion. The digital divide in education refers to the inability to access, learn, and utilize technology effectively, which negatively impacts various aspects of human development. This divide can be attributed to several factors, including the lack of sufficient digital resources to motivate teachers to implement innovative educational strategies, inadequate knowledge among teachers regarding the effective use of technology for differentiated instruction, and limited physical access to technology for students (Drigas & Papagerasimou, 2015)

In e-inclusive pedagogy, the focus is on adapting and personalizing the content of the curriculum to make it meaningful for each student. This involves modifying the inclusive classroom environment by integrating educational technology tools and services in a consistent and non-disruptive manner. These tools and services are designed to compensate for any deficiencies or absence of skills, enabling students with disabilities to actively participate in authentic self-regulated learning and development situations. The level of commitment from the educational community to incorporate these tools in teaching practices and flexibly differentiate the curriculum depends on their perception of these tools as reliable resources for learning and development, as well as their knowledge of how to effectively utilize them in the educational process

3.1. The future school

The School of the Future is an educational institution where technology is utilized as a tool for accessing and engaging with knowledge from any location and at all times. As a dynamic environment involving educators, students, parents, and the wider community, the school adapts to the changing demands of the times. In order to ensure equal access for all participants in the learning process, the school of the future will employ similar strategies, techniques, tools, and policies as traditional schools (Drigas et al, 2023).

In the school of the future, teachers will adopt the role of partners, companions, and guides instead of being confined to a desk. They will design, motivate, and facilitate hands-on activities that align with students' interests and abilities. Embracing cooperative learning, students will collaborate in groups and actively engage in the learning process by gathering, analyzing, and processing information. The aim is to acquire experiential knowledge, teach others how to learn, and approach knowledge based on their individual learning profiles (Drigas et al, 2023).

4. Methodology

4.1. Research Design

The present research used qualitative methodology. A semi-structured interview was conducted with the student with ASD to investigate their attitude towards the digital tool ToSakidio. 12 questions were grouped into three categories - biological, social, and daily life - with four questions in each category, exploring the student's with ASD attitude towards the digital tool ToSakidio as a differentiated instruction in the subject of physics. The main purpose of the study is to investigate the impact of digital tool ToSakidio on the learning attitude and social attitude on the inclusion of the student with ASD of 6th-grade primary school students. In line with this objective, the study aims to address the following research questions:

Does the digital tool assist the student with ASD to achieve the set goals for the learning process?

Does the digital tool facilitate the student with ASD to develop effective collaboration skills with peers?

4.2. Research Sample

The study was conducted with eighteen (n=18) 6th grade students of 4th Primary School of Metamorfosis, Athens, Greece. One of them (n=1) is diagnosed with high-functioning autism. The student with ASD is a 12 years old child with high emotional intelligence and sensitivity. He has excellent knowledge in technology beyond his age and a perfect proficiency in English. He also shows a great interest in music, which helps him relax. His relationship with his classmates and teachers is very positive. The student with ASD generally has very good relationships with his classmates

and is accepted by the entire class and the whole school. He maintains a friendship with three children of his class and he has a strong bond with his teachers, especially with special education teacher, whom he has become more familiar and comfortable with her and they have developed a relationship of trust and security. Based on his educational profile, the student with ASD displays a refusal to engage and lacks interest in school subjects, he quickly loses his interest. Thus, the digital tool ToSakidio used during the physics class due to it combines his interest in technology and the learning in which he has to enhance his potential.

4.3. Research Instrument and Procedure

The digital tool ToSakidio has been developed by two special education teachers and digital education enthusiasts; Dimitris Esopos and Eftychia Plakarou. The digital tool ToSakidio is a website that has been created with great passion, dedication, and respect, with the purpose of hosting a wide variety of educational videos as well as suggestions for their pedagogical utilization. ToSakidio's main goal is to create a welcoming space where one can find interesting material for processing and utilization. The purpose of the videos is not to teach, nor do they aim to comprehensively cover the topic and the field they address, but they invite you on a journey of interaction and discovery. The website aims to share with students the activities that have been created and broaden their potential. ToSakidio has been used by the general education teacher and the special education teacher in order to enhance the course of physics and to include actively the student with ASD in the process of learning.

The study took place in a mainstream classroom setting with the presence of a general education teacher and a special education teacher. It lasted for three (3) instructional hours, with one (1) hour per week over three (3) weeks.

The research focused on the subject of physics, specifically on the topics of energy, climate change, and the importance of recycling for our planet. These three topics have been covered in the form of educational videos from the ToSakidio platform. During these three instructional hours, the student with autism had the role of coordinator and host of the lesson. His main task was to turn on the classroom computer, connect the projector, lower the projection screen, and adjust the classroom lighting (closing the curtains and turning off lights). A reason that led to the implementation of the lesson in the specific classroom is the familiarity of the student with both the space and the technological equipment. The student's knowledge of the environment and the resources is expected to benefit him in working without anxiety (Hallahan et al., 2022). Then, he had to type the web address of ToSakidio (www.tosakidio.gr) and click on the right video session and present it in front of all his classmates by adjusting the sound and subtitles. His final goal was to present a quiz which is featured at the end of the video and randomly select classmates to shout out the correct answer. This entire framework was quite demanding for the student with autism, as he had never before managed to remember even the names of his classmates or he had never complied with everyday classroom routine. The student diagnosed with ASD is capable of following the detailed curriculum smoothly as long as he is given the opportunity to approach the content in a way that facilitates his understanding.

5. Results

Within the context of exploring the first and second research questions, a qualitative analysis was conducted on the data obtained from the semi-structured interview to the student with ASD. The participant's responses from the semi-structured interview appear to align with the existing literature, as digital learning has been shown to benefit students with ASD and serves as a tool that promotes enjoyment and enhances enthusiasm for learning. Additionally, it strengthens interaction with peers and social skills. The findings suggest that digital learning can be an effective approach for supporting the educational needs and overall development of students with ASD, as it combines academic engagement with social interaction.

When asked, "Would you invite a friend to study together on your laptop for the next day's lessons?" the student with ASD enthusiastically replied, "Yes, of course." He was then asked, "Do you think you became popular among your friends by presenting videos on ToSakidio?" He responded, "Definitely, yes." Furthermore, he mentioned that digital tools would greatly empower him in the computer science subject at school, and he would also assist many of his classmates.

In another question, "If you had a story, would you choose to read it in print or digitally?" the student responded enthusiastically, "Definitely, digitally!" He justified his opinion by stating that the screen would offer him more enjoyment, with vibrant colors, brightness, and a "nice layout." With this statement, he obviously meant the ability to pause the story and play it again, anytime.

When asked, "Did you experience physical discomfort, such as eye strain, headache, or back pain, while reading from the screen?" He responded that the vibrant colors helped him watch better, and the ability to adjust the brightness levels of the screen was important for him.

Lastly, the researcher asked, "Is there any difficulty with the use of the digital tool? If yes, what is it?" In response to this question, he stated that he did not encounter any difficulties. However, he pointed out the use of the laptop's battery and he asked for Wi-Fi everywhere he goes!

At the end of the collaboration and throughout the intervention, the student with ASD appeared to enjoy presenting the digital tool ToSakidio and found it engaging and enjoyable. No problems or complaints were observed, neither from the student with ASD nor from the neurotypical students during the intervention period. On the contrary, all students expressed excitement and eagerness to participate in the weekly video presentations by their autistic classmate. Additionally, it was noticed that the student's desire and enthusiasm to read digitally stemmed from the fact that he could read a different text in a different way, thus increasing his motivation to read and change his mood and acting like a TV presenter!

6. Conclusion

Finally, we must highlight the productive and effective role of digital technologies in the field of education. These technologies, which include mobile devices (21-25), a variety of ICTs (26-37), AI & STEM ROBOTICS (38-52), and games (53-55), facilitate and improve educational procedures such as assessment, intervention, and instruction. In addition, the use of ICTs in conjunction with theories and models of metacognition, mindfulness, meditation, and emotional intelligence cultivation [56-90], as well as with environmental factors and nutrition [17-20], accelerates and enhances educational practices and outcomes, particularly for gifted students with ADHD.

More specifically currently, Information and Communication Technologies (ICTs), particularly assistive technology, play a crucial role for teachers and students, especially those with disabilities (Chaidi et al., 2021). The use of ICTs, including assistive technology, is becoming increasingly important due to the growing emphasis on social inclusion, which seeks to integrate individuals with disabilities into all aspects of society. For many individuals with disabilities, ICT resources are essential for tasks such as mobility, learning, work-related activities, communication, and engagement with the world, enabling them to develop and enhance their primary functions (Drigas & Papagerasimou, 2015).

Results shown the implementation of the digital tool ToSakidio reinforces the metacognition students with ASD. Metacognition refers to a collection of regulatory abilities and skills that learners consciously employ to manage and optimize their cognitive and psychophysiological processes, leading to enhanced learning outcomes. It encompasses learners' ability to monitor, regulate, and adapt their internal cognitive operations, distinguish between effective and ineffective mental states, and deliberately select states that maximize their learning potential (Drigas et al, 2023). Metacognition reflects learners' awareness of their own abilities, skills, and strategies, as well as their capacity to flexibly utilize their cognitive faculties to achieve higher-level objectives. By engaging in metacognitive processes, learners gain a unique sense of control over their own learning, actively seek explanations, contemplate the significance of knowledge, and strive for self-understanding (Drigas et al, 2023).

The implementation of differentiated instruction is imperative since the majority of students with disabilities and/or special educational needs, such as the student diagnosed with ASD, now attend their neighborhood school, in accordance with the Convention on the Rights of Persons with Disabilities as adopted by the United Nations General Assembly in 2006 (Guillemot et al., 2022) and ratified by law in Greece (Law 4074/2012). Taking this into consideration, the present research aimed to present evidence-based practices that would assist educators in addressing the teaching challenges they may face in the general classroom. All the aforementioned adaptations are expected to minimize the likelihood of anxiety and facilitate the student diagnosed with ASD in focusing on instructional collaboration and achieving the set goals for the learning process, as well as developing effective collaboration skills with peers. In conclusion, it can be argued that the systematic implementation of differentiated instruction within the general classroom appears to be the most appropriate approach for meeting the individualized needs of all students, without exception (Tomlinson, 2017).

Compliance with ethical standards

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