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Creating Structured, Differentiated Mobile Apps for a Student with ASDs

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Abstract

This paper presents the creation of a didactically differentiated digital mobile learning application for a student with Autism Spectrum Disorders (ASD), based on the principles of learner-centeredness, teamwork, and the Framework of Analytical Special Education Program (FASEP). For this purpose, it's investigated if the literature teacher can create a mobile phone application with "digital cognitive machines" for a student with ASD in the context of differentiated teaching. In the methodology, the pedagogical tool TISIPfSEN is used, as derived from the acronym of a Targeted, Individually Structured, and Inclusive Intervention Program for Students with Special Educational Needs. Based on the TISIPfSEN, differentiations are discussed with realistic intervention steps, such as differentiated pedagogical digital materials. As revealed by the results, the literature teacher is able to design and develop mobile apps according to the principles underlying the TISIPfSEN tool.

Keywords: TISIPfSEN, differentiation, mobile apps, mobile learning, ASDs.

1. Introduction

The aim of upgrading the education provided by the school is to meet the needs of all students by individualizing it to their special educational needs [SEN] and/or disabilities. Individuality is considered according to the pedagogical principles of TISIPfSEN, which are presented extensively below. To achieve this goal, it is necessary to have appropriate strategies for differentiating and individualizing instruction through the design of suitable curricula (Christakis, 2011). The emphasis on the specific learning difficulties and needs of students is also highlighted by Vygotsky (1978). He adopts a social approach to learning for people with disabilities, connecting educational needs to motivation and emphasizing their capabilities rather than their weaknesses. Following a socio-cultural perspective, Vygotsky points out that the understanding of the social environment by students with special educational needs results from their cooperation with others. Therefore, teachers are encouraged to interact with students with autism spectrum disorders (ASDs), emphasizing the social environment and their collaboration with peers and adults, as the researchers have shown by evaluating a school-based headsprout intervention for improving literacy (McWilliams et al., 2022). Therefore, the readiness for learning in students

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with ASDs, as observed by teachers (Drossinou Korea, 2017, 2020, 2022), is connected to Vygotsky's (1978) "zones of proximal development." Learning readiness encompasses oral language, psychomotor skills, cognitive abilities, and emotional organization, which collectively define the framework supporting autonomy in learning. According to Vygotsky's theory (1978), learners require appropriate assistance, whether from peers or teachers, to enhance and promote autonomy. In the assessment of inclusive education, which forms the basis the fifth from the five phases of TISIPfSEN, levels of autonomy in interventions are evaluated, using descriptors such as "with help," "without help," and "with significant help." To facilitate this process, teachers provide structured and differentiated pedagogical materials, including both stable and mobile cards, with the aim of engaging cognitive processes.

According to researchers (Valencia et al., 2019), emerging technologies such as "digital assistants" – robots, artificial intelligence, and virtual and augmented reality, can create a safe learning environment for students with ASDs under specific conditions, because there are many kinds of autism (National institute of child health and human development, 2000).

It is emphasized that these applications cannot replace human interaction (Hosseinzadeh et al., 2020; DiPietro et al., 2019). Therefore, a proposed differentiated pedagogical approach combines 3D pedagogical "cognitive machine" materials with digital applications during interventions (Drossinou Korea & Alexopoulos, 2022).

According to the Diagnostic Classification System for Psychiatric and Neurodevelopmental Disorders (DSM-5, 2013), autism spectrum disorders (ASDs) encompass challenges in social skills, interactions, as well as repetitive and obsessive behaviors. According the report of the national reading panel for teaching children to read as evidence-based assessment of the scientific research literature on reading and its implications for reading instruction from the National institute of child health and human development (2000), where show as the implications for the teaching of reading for the ASDs. Therefore, structured and differentiated intervention programs need to give specific attention to these aspects (Christakis, 2011), along with the student's individual behavioral variations, as observed by teachers (Drossinou Korea, 2017, 2020, 2022). According to the pedagogical principles of TISIPfSENs/ASDs, structured differentiated instruction can facilitate the education of students with special educational needs resulting from ASDs. With technological advancements and the increasing integration of new technologies into daily life, the need for differentiation extends to the digital realm, where structured, instructionally differentiated digital applications are being developed (Drossinou Korea & Alexopoulos, 2022). The learning environment is being restructured and adapted to the requirements of students (Drossinou Korea & Alexopoulos, 2020).

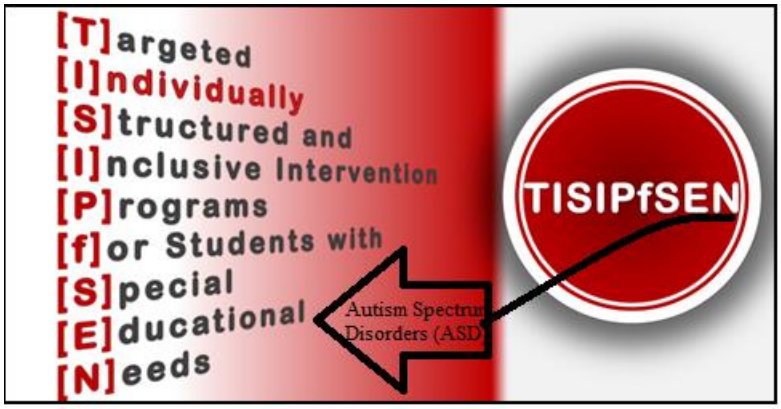
2. Differentiation based on the TISIPfSEN pedagogical tool

The structuring and differentiation are not limited to the boundaries of the taught curriculum but also take into consideration the individuality of the student and their family interactions. Furthermore, they consider the student's performance, deviations from the semester of study, adaptations to educational programs and materials, with the goal of facilitating access and improving skills. Regarding the criteria for differentiation in students with special needs, these are related to attendance, teaching, the schedule of interventions, expected behavior, rewards, success criteria, the time and place where differentiated teaching steps are applied, as well as methods for evaluating interventions. However, challenges persist in defining appropriate differentiated pedagogical tools and educational resources according to the human-centered model and new technologies with smartphones (Drossinou Korea, 2017). Moreover, students with special needs, based on their differences, require suitable adaptations. According to these adaptations, their environment is structured to detect and implement appropriate learning methods (Synodinou, 2007). TISIPfSENs/ASDs addresses the absence of pedagogical

methodology and the inconsistency of provided educational methods for the SENs of students with special needs. Each intervention program, in order to be successfully completed, is adapted to the student's interests, age, special needs and abilities, learning readiness and levels of autonomy.

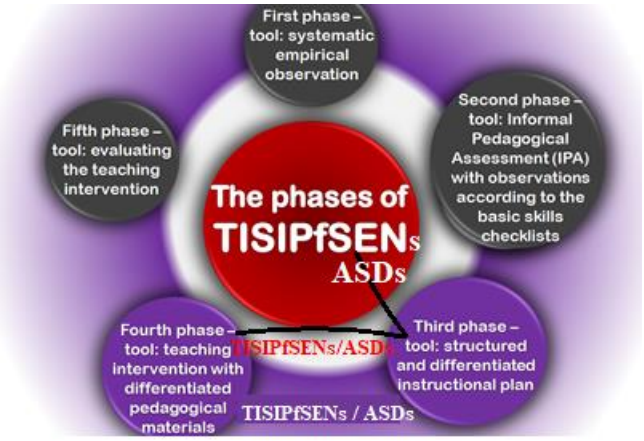
The need for structured differentiation in teaching students with ASD, achieved through direct instruction and project analysis, is addressed by the pedagogical tool TISIPfSEN, mentioned above. TISIPfSENs/ASDs offers a Targeted, Individual, Structured, Teaching Differentiated Special Education Intervention Program (Drossinou Korea, 2017; Christakis, 2013). Therefore, differentiation and structured instruction TISIPfSENs/ASDs are defined to promote the autonomy of students with ASDs in all aspects of their lives. The role of the teacher is being redefined as they are called upon to meet the demanding challenge of addressing the diverse educational needs of all students within the classroom (Christakis, 2011).

It is, therefore, a pedagogical approach that combines the cognitive theories of mobile learning. Through TISIPfSENs/ASDs, the student gains a clear understanding of the rules governing the weekly timetable and promotes inclusive education. This pedagogical tool includes variations in the timetable with visual clarity, personalized long-term and short-term teaching objectives for inclusive education, and corresponding personalized pedagogical materials with a range of exercises of graduated difficulty. These exercises are organized into structured dossiers that are transformed into cognitive tools with experiential learning readiness activities, signifying differentiated pedagogical uses with mobile phones (Drossinou Korea, 2020, 2022). The mobile phone is utilized as a modern interactive tool in education.



Picture 1. The pedagogical tool T[I]SIPf [SENs/ASDs]
focusing on the teaching structured differentiation

In this paper, the focus will be on creating differentiated educational digital materials, referred to as the “digital cognitive machine” using a mobile phone. This concept aligns with the third and fourth phases of TISIPf [SENs/ASDs], namely the design and implementation phases (Drossinou Korea, 2017, 2020, 2022). The structured implementation of differentiated didactic objectives (the fourth phase of TISIPfSEN) involves the use of suitable pedagogical materials with adapted exercises, following the segmentation of teaching objectives into intervention steps. These differentiated materials can take the form of three-dimensional objects, such as a rubber binder, or digital materials, such as a “digital binder” (Drossinou Korea & Alexopoulos, 2022). Within these materials, various components cater to the individuality of students with ASDs, including cards featuring their name, favorite color, preferred object, weekly timetable, and a card illustrating the classroom layout with their designated location (Drossinou Korea, 2017, 2020, 2022).



Picture 2. The phases of TISIPfSENs/ASDs (focus on the third and the fourth phase)

3. Students with ASDs and new technologies

As new technologies (NTs), with a particular focus on Information and Communication Technologies (ICTs), become increasingly integrated into the lives of students with ASDs, there is a need to create didactically differentiated digital materials, following the framework established by the pedagogical tool TISIPf-[SENs/ASDs]. It is worth noting that computers provide students with ASD an environment that is isolated from external distractions through the use of workstations. Also, the individualized levels of support during headsprout early reading instruction (Thompson et al., 2022) support children with ASDs. In fact, according to researchers (Valencia et al., 2019), when using digital applications, students with ASDs feel secure as they receive controlled stimuli within a context that has clear rules and interactions. Furthermore, every action is reversible, which helps reduce anxiety in students who can interact both verbally and non-verbally. Thus, it provides a theoretically virtual learning environment for people with ASDs (Aljameel et al., 2018), who often appear to enjoy engaging with new technologies (NTs).

In 18 international studies reporting on 11 interventions using robots and 7 using serious digital games, some positive results were observed for students with ASDs when utilizing augmented reality applications for interventions (DiPietro et al., 2019). Other research (Khowaja et al., 2020) further indicates that students with ASDs exhibit enhanced concentration and increased eye contact when using new technologies (NTs), particularly with robots. However, it is essential to note that IT applications cannot replace human interaction, aligning with the human-centered teaching model. Human interactive behavior is notably more unpredictable than interactions with computers (Hosseinzadeh et al., 2020), and concerns arise regarding the potential induction of self-stimulatory “obsessive” behaviors (Grandin, 2012). Therefore, to address social difficulties (Christakis, 2011; Drossinou Korea, 2017, 2020) and develop social skills, NTs, including IT, computers, and robotics applications, are being used.

For instance, according to Roberts-Yates and Silvera-Tawil (2019), immersive reality applications using glasses, while showing positive results in some interventions, can lead to unpleasant experiences for students and individuals with ASDs if not appropriately designed and differentiated for their needs. Students with ASDs, in particular, are hypersensitive to certain stimuli, and they may become overwhelmed by the excessive audiovisual stimuli in immersive applications. This can lead to experiences of nausea, headaches, and disorientation.

4. Students with ASDs and teaching with mobile learning material

The COVID-19 pandemic has led to conditions of distance learning online, as noted by Mahyoob in 2020. The fact that an increasing number of students with ASDs possess a mobile device for daily use encourages the incorporation of mobile phones in inclusive school pedagogy. As a result, differentiated learning readiness activities include mobile phone applications in the educational process, similar to the use of gamification.

According to researchers (Novack et al., 2019), the utilization of mobile phones in interventions for students with ASDs can enhance learning, as it allows the integration of text and images with multimedia content (Kagohara et al., 2013), and the use of the sense of touch on the screen can provide multisensory stimulation (Kamaruzaman et al., 2016). Nevertheless, developing mobile apps tailored for students with ASD is a complex process that requires consideration of numerous parameters. Focusing on these criteria, research by Ntalindwa et al. (2021) concluded that it is crucial for the app to be relevant to the student's life and experiences, as outlined in learning readiness activities. Moreover, the app should provide a clear user interface with legible text and images, along with appropriately selected sounds at the learner's preferred volume. Additionally, it is essential to avoid colors that may confuse and distract the learner and, instead, opt for familiar images and colors. In terms of functionality, the application should include, among other features, clear menu buttons for returning to the home screen and the ability to revisit and repeat actions. Under these conditions and with the parallel use of 3D educational material, there can be some effective interventions that support long-term goals for students with ASDs (Drossinou Korea, 2017; Drossinou Korea & Alexopoulos, 2023a).

As revealed by a literature search in popular application databases, such as the “Play Store,” there are no educational mobile phone applications available with a Greek-language user interface for students with ASDs (Drossinou Korea, 2023b). Therefore, it becomes necessary to develop mobile applications that support interventions for Greek-speaking students with ASDs and are personalized to their specific preferences and educational needs, following the principles established by the TISIPfSENs/ASDs pedagogical tool. These applications can be used in conjunction with 3D cognitive rubber-band machines under the guidance of the teacher, whose role is not replaced by the application during the intervention (Christakis, 2011; Drossinou Korea, 2017, 2020).

5. Research purpose – Research questions

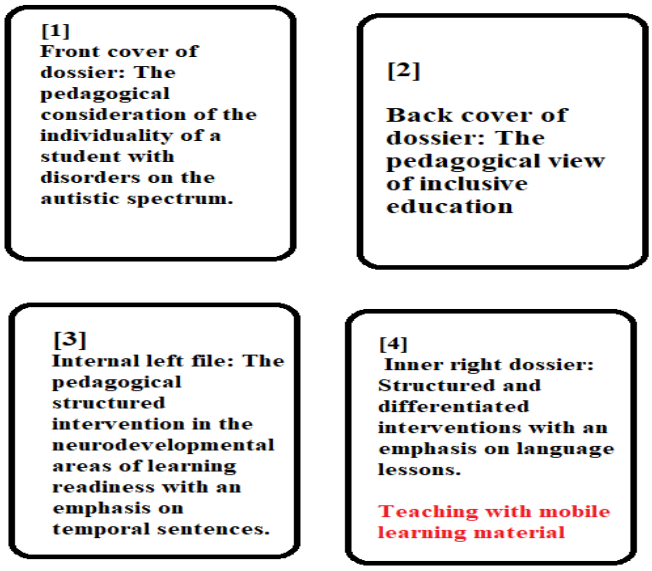
The purpose of the study is to design a personalized, didactically differentiated application template. This template will serve as the foundation for the creation of other relevant mobile phone applications by teachers, specifically philologists, to support similar interventions for students with ASDs. The research questions aim to investigate whether philologists can create digital mobile phone applications in accordance with the pedagogical tool TISIPfSEN with emphasis to ASDs.

6. Method

In this paper, the research team explored platforms for constructing websites optimized for mobile phones to develop a structured, differentiated “application.” The Wix platform was selected, allowing the creation of mobile phone websites that resemble applications or programs. As observed during the search and testing process, the philologist can relatively easily produce a “mobile application.” Users are afforded the flexibility to arrange and position objects, such as pedagogically differentiated and structured educational materials with images and text, in a manner akin to a PowerPoint presentation. The addition of differentiated materials and

objects was initially done in the desktop version (Desktop Wix Editor), with the subsequent structuring of the application taking place in the mobile version (Mobile Editor) (Drossinou Korea, 2023a).

The app's design followed a structure similar to that of three-dimensional "conventional" cognitive machines, with particular emphasis on the dossier, which serves as a differentiated material used in interventions with students with ASDs, following the TISIPfSENs/ASDs framework for teaching methodology (Drossinou Korea, 2017).



Picture 3. Parts of a three-dimensional – "conventional" cognitive machine: structured teaching dossier

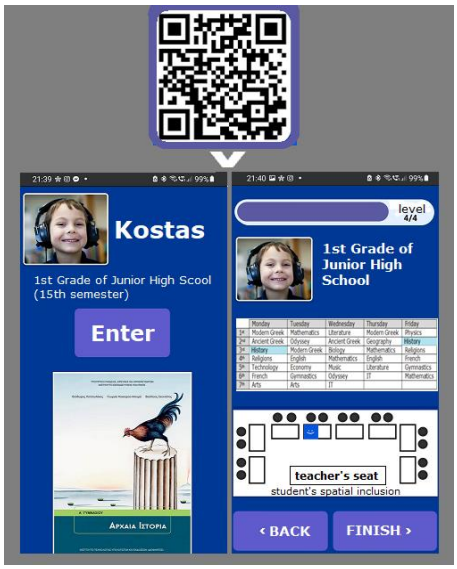
According to TISIPfSENs/ASDs, the folder's cover features the cover of the book to be used for the intervention, in this case, the 1st-grade high school history book. It also includes the name and photo of the student, along with their favorite object, which, in this case, is headphones. On the back cover, you'll find the weekly timetable, color-coded to indicate the days and times for the history lessons, followed by a diagram showing the student's spatial integration in the classroom. All images are designed as movable cards to provide multisensory stimuli to the student, involving touch, sight, hearing, and more. The entire folder is designed in the student's favorite color, which is blue. The left cover contains movable cards with the date, clocks indicating the start, end, and duration of the intervention, along with multisensory exercises featuring learning readiness activities. On the right cover, you'll find activities involving visual conceptual facilitators. Finally, in the upper outer "ear" on the right cover of the binder, the intervention goal is placed, followed by the teaching intervention steps on the inner "ear" using movable cards. On the right inside cover of the binder in the lower "ear," cards for verbalizing the student's feelings are positioned (Drossinou Korea, 2020, 2022).

7. Results

This structure was applied in the designed application (https://pan-alexopoulos.wixsite.com/website-9). The digital mobile version introduces several innovations to provide the student with a clear sense of the digital space on mobile devices. Notably, buttons such as "enter," "back," and "next" have been included. Additionally, a progress bar with four stages - levels has been incorporated, enabling the student to track their interaction with the dossier. It's

important to note that the student won't have the dossier open in front of them as in the conventional version. The application features clear fonts and smooth movements to prevent confusion, while the teaching objectives, steps, clocks, and movable cards retain the same order as in the 3D "conventional" folder. All images are interactive to engage the student through touch.

The mobile phone application serves as a complement to the conventional cognitive machine with the dossier, where each step of targeted intervention implemented with conventional differentiation is followed by another step involving digital intervention. The student's favorite color (blue), a single large-size font, their name, photo, and the course book cover have been transferred to the front page (home page) of the application. The first level denotes individuality and differentiation (the [I] from the acronym of the pedagogical tool T[I]SIPfSENs/ASDs.



Picture 4. Differentiation with mobile phone: front and back cover

On the back page according the fourth level of TISIPfSENs/ASDs teaching methodology of these application, used the cards with the weekly timetable and spatial integration were arranged following the conventional differentiation structure. On the fourth level is placed the diagram of student's spatial integration in the classroom, with its seat in a different colour, in order to promote the student's integration (the second letter [I] from the acronym of pedagogical tool TISIPfSENs/ASDs. Specifically, at the "first level," rotating movable cards with arrows (< >) were positioned to allow the student to select the correct time calculation method with the clock. Subsequently, cards featuring visual conceptual aids and multisensory exercises, along with experiential learning readiness activities, were introduced through pop-up cards for the concepts of listening, seeing, pointing, and writing. Finally, the top section details the teaching objectives and their step-by-step implementation (located in the top "ear" of a conventional folder).

Moving on to the "second level" of the application, movable cards with a social story, in accordance with TISIPfSENs/ASDs, were interspersed with arrows (< >) on the right inner leaf of the conventional folder. Notably, the first card was left blank to pique the student's curiosity.

Lastly, in the "third level," the student will discover cards for verbalizing emotions, each representing expressions such as *happy*, *sad*, and *indifferent*.

Finally, an innovation that has been added is the rewarding of the student upon completion of the levels. This is personalized T-[I]-SIPfSENs/ASDs ("Bravo Kostas") and encourages the student to continue the effort.

8. Research limitations – Suggestions

The present-designed application is only accessible through a hyperlink, necessitating an internet connection, and it cannot be installed as a "program" application on a mobile phone or computer. This application was developed based on a case study in the laboratory course "Educational Integration and Teaching Social Skills to Students with Autism" (course code: 13E75_18) within the Department of Literature at the University of Peloponnese, Greece. Its purpose was to showcase an application as a model for other interventions. Therefore, testing by more philologists is expected.

9. Discussion – Conclusions

The first conclusion indicates that a literacy educator can create "digital cognitive machines" using a mobile phone application for a student with ASD, adhering to the pedagogical principles that underlie the structuring and differentiation of instruction with TISIPfSENs/ASDs (Drossinou Korea & Alexopoulos, 2022).

The second conclusion demonstrates that the application can be designed by constructing a mobile website through the Wix platform, facilitating interventions in teaching social skills with digital cognitive tools for a student with ASDs (Drossinou Korea & Alexopoulos, 2023).

The third conclusion emphasizes that the app to be developed can follow the structure of the conventional 3D dossier, incorporating some innovations as presented in the app-template for other differentiated digital material constructions (Kagohara et al., 2013).

The fourth conclusion suggests that the combined use of the conventional dossier and the mobile phone application can be implemented without replacing the 3D differentiated pedagogical materials (Vygotsky, 1978; Synodinou, 2007; Christakis, 2011).

Finally, the fifth concluding point of this paper highlights those endeavors, such as the one involving "digital cognitive machines" through a mobile phone application for a student with ASDs, can aid interventions by addressing specific aspects of the teaching goal. Importantly, these efforts do not undermine human and physical interaction and do not replace the teacher's role.

Therefore, this research demonstrates that teachers can utilize digital tools, such as Wix, to create accessible websites and mobile phone applications for students with ASDs. To fully personalize the digital materials provided to students, it is crucial for the teacher-philologist to appropriately adapt them. This can only be achieved if the teacher actively participates in the application's design process, considering the student's background, learning profile, and preferences, in accordance with TISIPfSEN. In particular, Greece, as previously mentioned, faces a shortage of Greek-language accessible personalized mobile apps for students with ASD. It is precisely this gap in the literature that this research aims to address by presenting the design of a model website application for further interventions with students with ASD. Furthermore, considering the benefits and risks outlined in the literature, this research suggests the combined use of 3D "traditional" personalized pedagogical materials and digital applications.

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The authors declare no competing interests.

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