Promoting Language Skills And Interaction In The Classroom Autistic Students Using Interactive Videos

Dawser ZINEDDINE
Lecturer And Researcher At Higher Institute Of Education And Continuing Training Of Tunis. Education, Cognition, ICT And Didactics Research.

Elassaad ELHARBAOUI
Lecturer And Researcher At The Higher Institute Of Childhood Executives (ISCE). University Of Carthage; Education, Cognition, ICT And Didactics Research. Unit/ISEFC (UR 16ES10), Environmental Biomonitoring.

Summary
This research evaluates the effectiveness of interactive videos in encouraging oral expression in children with autism spectrum disorders (ASD). Five children participated in a three-month intervention using interactive videos. Using a video analysis grid, we were able to measure the children's participation, the complexity of their grammatical structures, the diversity of their vocabulary and the number of times they spoke before, during and after the intervention. The results show that interactive videos provide multisensory stimulation that captures the attention of children with autism, encouraging them to engage more in discussions and ask questions independently. The learning environment based on interactive videos is perceived by these autistic children as more engaging and motivating, reducing anxiety related to participation and promoting a climate of positive interaction. This environment strengthens the students' confidence by allowing them to express themselves without direct pressure from the teacher, thus developing a sense of self-efficacy. Interactive videos also serve as triggers for social interactions, presenting scenarios or characters with which students can identify, prompting children to ask questions and interact with their peers. These findings suggest that interactive videos may be a valuable tool for intervention with children with autism. They provide an engaging and interactive learning environment that promotes practice and development of language skills.
Keywords: *Interactive videos, autism, speaking, language skills*

I.   Introduction

Autism spectrum disorders (ASD) are neurodevelopmental disorders characterized by persistent impairments in communication, social interactions, and repetitive behaviours. Approximately 1 in 68 children are diagnosed with ASD, showing a trend of increasing (Plusquellec *et al.,* 2016). These disorders include difficulties in verbal and nonverbal communication, as well as stereotyped behaviours (Dieye *et al.,* 2013). Children with autism experience significant barriers in acquiring language, participating in social interactions, and clearly expressing their thoughts and emotions (Lord *et al.,* 2020). These challenges can interfere with their social integration and daily life (Brake, 2024). Some research indicated that interventions based on interactive educational technologies can improve the language and social skills of children with autism (Constantinou, 2023; Machalicek *et al.,* 2010; Mercier, 2017). Visual and interactive tools, such as educational software and mobile applications, facilitate learning by providing structured and motivating environments (Belmonte *et al.,* 2016; Park, 2008; Swiezy, 2008). According to Dascalu & Garnier, (2015), the personalization of technological tools and the reinforcement of teachers' skills are crucial for the effectiveness of interventions with autistic students who have diverse cognitive needs. The diversity of digital tools and adapted teaching strategies also contribute to the development of children's communication skills (Bourgueil *et al.,* 2015). Interactive software improves language comprehension and production by enriching vocabulary and increasing self-confidence in children with autism (Delai, 2014; Deschamps *et al.,* 2019).

In this study, we report on a research in special education aimed at evaluating how interactive videos can improve oral expression in five Tunisian autistic children taken in a specialized center for autistic children in Msaken, "the Association for the Support and Departure of Autistic Children". The main part of the research work undertaken aims to measure the participation of these children, the complexity of their grammatical structures, the diversity of their vocabulary and the number of times they speak during educational interventions focused on the use of interactive videos as a teaching aid.

In this work, we begin with an explanation of the context of the research as well as a presentation of the main concepts, namely autism from a scientific and educational point of view, as well as new technologies, including interactive videos, in the care of children with ASD. Then, we explain the methods of collecting and analyzing the data recovered by using interactive video analysis grids. It is at the level of the part dedicated to the results that we present the main results of the research. At the level of the discussion and conclusion, we describe respectively the contributions and limitations of the research as well as the contributions of the results to the development of scientific knowledge on the development and school inclusion of autistic children, precisely the contributions of educational technologies focused on the use of interactive videos on the development of oral communication skills of children with ASD.

II. Theoretical Framework And Analysis Of Concepts

In this section, we will first present a description of autism and its educational management focused on the use of technological supports, namely interactive videos. Finally, we will describe the linguistic skills of autistic children.

Autism

Autism, according to the World Health Organization (WHO), is a pervasive developmental disorder (PDD) that manifests itself before the age of 3 years, affecting social interactions, communication and leading to restricted and repetitive behaviours. Recognized as a disability since 1996, early diagnosis (between 18 months and 4 years) is crucial to promote positive development, particularly through parental involvement (Zwaigenbaum *et al.,* 2019). The DSM-5[1] divides autism into three categories based on the degree of independence, but symptoms vary considerably from person to person, hence the name autism spectrum disorder (ASD)) (Volkmar & Reichow, 2013). Current diagnostic criteria are based on three main elements: impairments in social interaction, verbal and nonverbal communication, and a restricted range of activities and interests (Happe & Frith, 1996).

Autism is a multifunctional disorder with a strong genetic component estimated at 10 to 20% (Rylaarsdam & Guemez-Gamboa, 2019). Sensory peculiarities, such as hypersensitivities and hyposensitivities, affect various sensory systems and are present in 45 to 97% of autistic people (Ben-Sasson *et al.,* 2007). In addition, sensorimotor coordination disorders, impacting fine and gross motor skills, can hinder the development of social skills (Khoury *et al.,* 2020). Theories of autism include theory of mind, which suggests an impaired understanding of the mental world, and central coherence inconsistency theory, which proposes a fragmented perception of the world (Baron-Cohen *et al.,* 1985; Happé & Frith, 2006).

In summary, autism is a complex disorder whose assessment requires a multidisciplinary approach. A better understanding of the underlying mechanisms and specific characteristics of autistic children is essential to develop appropriate educational strategies (Petersson-Bloom & Holmqvist, 2022).

Autism and educational technologies

New technologies hold great promise for the management of ASD. They offer innovative tools for early diagnosis, interventions, independence and quality of life for autistic individuals (MacDonald *et al.,* 2009; Petersson-Bloom & Holmqvist, 2022). Research shows that children and adolescents with ASD have a strong interest in technologies and that they can provide benefits in addressing the challenges they face. Studies have also shown that technologies can be effectively integrated into mainstream and special education, targeting different areas such as writing, reading, sentence comprehension and construction, vocabulary, picture recognition, communication, reading comprehension, verbal expression and phonological skills (Ben-Sasson *et al.,* 2007). However, it is important to consider the individual needs of individuals with ASD, develop appropriate teaching strategies and ensure that teachers emphasise the uniqueness of each student (MacDonald *et al.,* 2009).

In this context of the various contributions of technologies in the education of autistic learners, it is essential to examine the integration and impact of these technological advances, such as interactive videos, can be very beneficial in helping autistic children (Zwaigenbaum *et al.,* 2019). These videos provide a visual and auditory experience that helps children better understand concepts and develop their social and communication skills. They also provide sensory stimulation, which can help them focus and stay engaged during lessons. They can also be used to teach a variety of subjects, such as mathematics, science, literature, and the arts. They can be tailored to the specific needs and interests of children with autism, such as including subtitles, audio descriptions, and navigation options (Nikopoulos & Keenan, 2004; Olçay Gül, 2016). Videos, interactive games, and tablet applications can have a positive impact on different aspects of the social development of children with autism. Interactive videos are technological supports that can support the learning and development of children with autism (Sutherland *et al.,* 2019). They are able to reduce disruptive behaviours and promote the engagement of autistic children in tasks (Sutherland *et al.,* 2019), especially since autistic

children show greater interest and better concentration when using fun and interactive multimedia activities such as interactive videos (Nikopoulos, 2007).

Additionally, these videos can strengthen social skills by showing realistic social situations. A better understanding of facial expressions and body language helps children grasp social rules and improve their nonverbal communication (Sutherland *et al.,* 2019). These tools also allow children to learn skills, which is especially helpful for those who have difficulty with unexpected changes (Petersson-Bloom & Holmqvist, 2022; Pry *et al.,* 2009). Interactive videos can also be used to assess children's progress, providing valuable information about their strengths and weaknesses. This data can then be used to adapt their intervention plan more effectively children (Zwaigenbaum *et al.,* 2019).

Indeed, the regular use of technologies such as interactive videos can promote the social inclusion of autistic children while improving their grammar, enriching their vocabulary and developing self-confidence when speaking (Sutherland *et al.,* 2019). These tools thus contribute to their development (Constantinou, 2023). In summary, interactive videos are valuable resources to help autistic children in the classroom (Petersson-Bloom & Holmqvist, 2022; Urrea *et al.,* 2024).. They facilitate the understanding of concepts, the development of social and communication skills, and make it possible to assess the children's progress while adapting their intervention plan (Pry *et al.,* 2009; Zwaigenbaum *et al.,* 2019)..

Language skills and autism

The fundamental language skills for effective communication are listening, speaking, reading, and writing. Listening, defined by Chomsky (1957), is passive and develops first. Speaking, according to, is active and essential for integrating linguistic structures (Bernhardt & Krashen, 1989; Sutherland *et al.,* 2019).

Written comprehension and written expression are artificial, dependent on writing systems (Sutherland *et al.,* 2019). For autistic people, language acquisition varies: nonverbal autism (often without language), verbal autism with significant delays, and Asperger's syndrome with a milder delay. Autistic children reach first words (38 months) and word combinations (52 months) later than normal children (11 and 17 months), Asperger's children (15 and 26 months), and blind children (19 and 25 months). The time to move from first words to combinations is also longer in autistic children (14 months) than in other groups (6 months) (Zwaigenbaum *et al.,* 2019).. This delay is linked to a slower acquisition of vocabulary, crucial for syntactic development, indicates that syntax develops after the acquisition of about 200 to 250 words, showing that language evolution is a complex process requiring interaction between vocabulary and syntax (Pinker, 1994).

III.   Methodology

Sample

This study was conducted within the "Association for Support and Departure of Autistic Children" in Msaken, founded in 2015 and specializing in welcoming autistic children. This center, which accommodates 15 children, is distinguished by its innovative teaching methods and an environment adapted to the needs of children with ASD. To constitute a relevant sample, we adopted a collaborative approach. We began with a three-week observation period, totaling 16 hours, involving all the center groups. This observation phase made it possible to collect essential information on the needs and abilities of each child, while promoting interaction and the creation of a climate of trust. Subsequently, in collaboration with the center's multidisciplinary team, including a psychologist, an occupational therapist, a speech therapist and several educators, we selected a group of five children (two girls and three boys) aged 6 to 10 years.

All were verbally autistic and had significant difficulties in oral expression. Selection criteria took into account their educational needs, as well as their availability and potential engagement in the proposed interventions.

Data collection and analysis

The aim of this research is to evaluate how interactive videos can help five children with autism spectrum disorder (ASD) improve their oral communication skills. To do this, we recorded nine teaching sessions, each lasting one hour.

The first session (S0) was conducted in a conventional manner, without using interactive videos, while the following seven (S1-S8) sessions incorporated these videos. To analyze the recordings, we used a content analysis grid that takes into account several parameters such as the number of speeches, the quality and complexity of the sentences, the initiative in communication and the reactions to the stimuli presented in the videos. After watching the videos several times to fully grasp all the details, we coded the children's verbal behaviours and interactions. The data thus collected were compiled and analyzed using SPSS software, using descriptive and statistical methods. To assess the impact of the interactive videos on the children's language skills, we calculated the mean and performed a Student t-test. These analyses allow us to determine whether the differences observed in communication skills between the first session (S0) without videos and the ninth session

(S8) with videos are significant.

Table 1 presents the different analysis criteria and their meanings based on the recordings of the eight sessions.

Table 1. Video recording analysis grid.

Criteria		Descriptions
Number of speaking engagements		The number of times the child spoke throughout the session can be considered an indicator of his or her level of engagement and participation.This quantitative measure provides important information about the frequency and quality of the child's contributions during the activity.
Use of language structures	**Grammatical structure**	II- Does the child use appropriate and complex grammatical structures according to his or her level of linguistic development? III- The concepts of "elaborated code" and "restricted code" are distinguished by the degree of predictability of the syntactic elements that structure the discourse. The daily use of one or the other of these codes has a significant impact on the process of socialization and social control, both at the individual level and within groups.
	Restricted code	IV- The "restricted code" is characterized by a simple syntactic structuring of discourse. Sentences are constructed using repetitive conjunctions and use few adjectives, adverbs or subordinate clauses. The absence of an extensive vocabulary and elaborate syntax, necessary for the expression of structured reflection, both orally and in writing, limits exchanges to impersonal, concrete, descriptive and narrative content. V- The restricted code also manifests itself nonverbally, through tone of voice, facial expressions, gestures and expressive accents. It is often transmitted unconsciously, by imitating the everyday language used in one's surroundings.
	Code elaborated	VI- The elaborated code requires a thorough knowledge of grammatical rules and an evolution in a family and social environment that favors its development. It is a way of organizing the elements of speech in a more complex way, using a grammatical and syntactic structure that emphasizes the meaning of statements and the nuanced use of language. By using prepositions, conjunctions, subordinate clauses and impersonal pronouns, as well as by carefully choosing adjectives and adverbs, the speaker can form structured and logical sentences. This allows him to express his feelings, emotions, ideas and experiences more finely. VII- The elaborate code generally develops in social environments where importance is given to verbal expression and nuanced communication. Its acquisition promotes better social integration and greater academic and professional success.
Participation	**Spontaneous participation**	Does the child ask questions independently? Does he also spontaneously comment on what he sees?
	Guided participation	The child only appears to respond when a question is directly addressed to him using his first name. This suggests that his attention and response are particularly stimulated when he is directly involved in the interaction.

Design of teaching-learning devices
Ordinary learning device
3.3 To establish a climate of trust with autistic students, the educator begins with a warm welcome. She then presents the theme of the first session (S0) on animals and their mode of movement in an engaging manner in order to capture the students' interest from the beginning. To assess their initial knowledge, the educator uses pictures of animals as a visual aid and asks open-ended questions about their names, how they move, and what they eat. This approach helps gather information about students' prior knowledge and encourages them to share what they already know. To encourage interactions, the educator presents animal figurines, providing a tangible medium that stimulates students' interest and curiosity. By handling the figurines, students are encouraged to share their personal experiences with the animals, thus facilitating exchanges between them. This step creates an interactive and collaborative environment where each student feels valued and encouraged to participate actively.

To close the session, the educator summarizes the key points covered, consolidating the learning achieved. She then announces the use of an animated video during the next session, arousing the interest of the students and motivating them to participate actively. The synthesis of the learning helps learners to structure their knowledge and to see the progress made. Students are invited to ask questions and express their enthusiasm for what comes next, fostering a collaborative environment and reinforcing the sense of community within the class. This approach prepares students for the rest of their learning and motivates them to fully engage in the activities to come.

Interactive video-based learning device
As part of this research on improving oral expression in autistic learners, the educator implemented an innovative teaching method using interactive animated videos. This approach was applied during the eight sessions (S1 to S8), each lasting approximately one hour, to provide students with knowledge about animals and their modes of movement. The educator ensured that a consistent and stable teaching approach was maintained

throughout the sessions. This consistency is crucial for the development of autistic learners' oral communication skills because it creates a predictable and secure environment. Each session began with an attractive introduction to the animated video, highlighting aspects that might interest the students. This initial step aimed to arouse curiosity and create positive anticipation, thus promoting active engagement among the learners. The video screening was not simply a passive viewing. It was punctuated by regular breaks, allowing the educator to check students' understanding, provide clarification if necessary, and stimulate reflection.By asking open-ended questions, the educator encouraged learners to express themselves, hypothesize, and construct their own interpretations. This interactive approach transformed students into actors in their learning, encouraging them to actively participate rather than simply being recipients of information.

At the end of each screening, a time for collective discussion was organized. Students were invited to share their impressions, questions and interpretations. These discussions helped consolidate learning, clear up any misunderstandings and create a classroom climate conducive to the construction of meaning. Beyond the simple transmission of knowledge, this phase encouraged the development of essential skills such as communication, argumentation and critical thinking. Learners learned to express themselves clearly, listen to others and construct coherent reasoning.

IV. Results

In this section, we will analyze the evolution of the frequency of speaking, the use of language structures and participation in class discussions among the five autistic children. This progress will be highlighted through a comparison of the results from the analysis of the video recordings of the nine French teaching sessions using a content analysis grid.
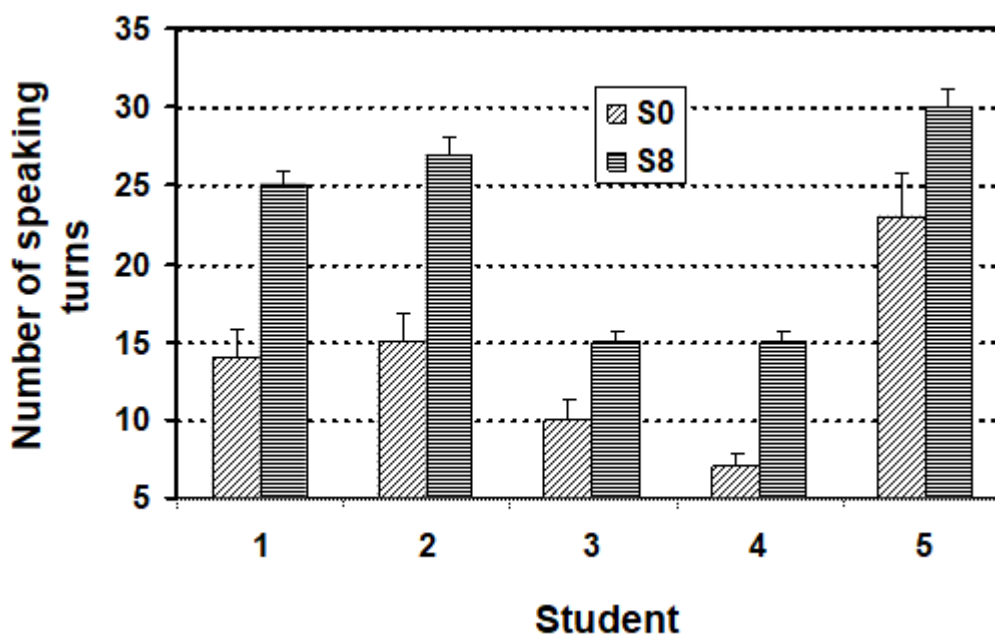

Figure 1. Effect of interactive videos on the evolution of the number of speaking turns of five autistic children between the first session (S0) without videos and the ninth session (S8). First intervention session (S0): without interactive videos; Eight intervention session (S8): with interactive videos.

Evolution of the number of times autistic students speak (S0 vs. S8)

The graph illustrates the change in the number of speaking engagements among five students between the first regular session (S0) and the last session (S8) with the integration of interactive videos into the teaching/learning system. Each student showed a significant increase in the number of speaking engagements in class: student 1 increased from 14 to 25 speaking engagements, student 2 from 15 to 27, student 3 from 10 to 15, student 4 from 7 to 15, and student 5 from 23 to 30. These results demonstrate a marked improvement in oral participation, with increases ranging from 5 to 12 speaking engagements. To statistically analyze the data in the graph and determine whether the intervention had a significant effect on the number of speaking engagements of the students between the first session (S0) and the last session (S8), we will use a paired-samples Student t-test. This test is appropriate because we are comparing the same students before and after the intervention. Since the calculated Student's t-value (6.67) is greater than the critical value (2.776), we can reject

the null hypothesis. This means that there is a statistically significant difference between the number of speaking engagements before and after the intervention. In summary, the statistical analysis shows that the use of interactive videos in the learning of autistic children had a significant effect on increasing the number of speaking engagements of these students.

The mean difference was 8.6 speaking times, and this increase was statistically significant at a significance level of $pr \leq 0.05$. This suggests that learning focused on the use of interactive videos was effective in improving the oral participation of autistic people.

Evolution of language structure in autistic students (S0 vs. S8)
Evolution of language structure (restricted code) of autistic students (S0 Vs S8)
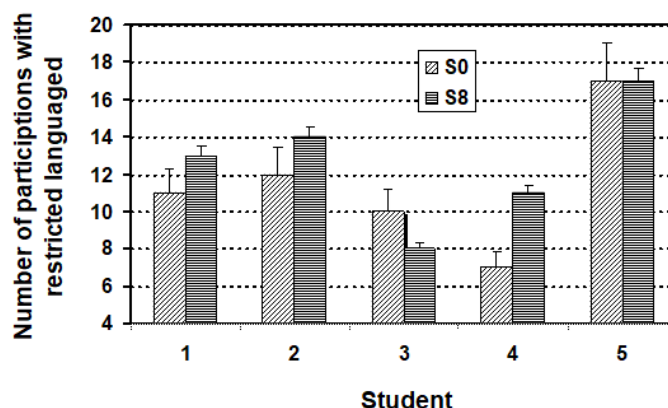

Figure 2. Evolution of language structures (restricted code) of autistic students between S0 and S8. First intervention session (S0): without interactive videos; Eight intervention session (S8): with interactive videos.

The graph shows a comparison of the performances of five students (student 1 to student 5) during sessions S0 and S8. The results reveal significant differences: students 1 and 2 show a notable improvement in S8, while student 3 experiences a decrease in his performances, which contrasts with the general trend observed. Student 4 shows an increase, going from 6 to 11 points, which indicates an improvement. In contrast, student 5 maintains constant scores between S0 and S8, which indicates a stability of his abilities. These observations highlight individual variations in the impact of interactive videos on student performance. The statistical analysis, with a calculated Student's t-value of 1.18, is less than the critical value of 2.776. Therefore, we cannot reject the null hypothesis, which means that there is no statistically significant difference between the number of participations using restricted coding language between sessions S0 and S8. In conclusion, the statistical analysis indicates that the intervention did not have a significant effect on the number of participations using restricted coding language among students. The mean of the differences is 1.2 participations, and this difference is not statistically significant at a significance level of 0.05. This suggests that the intervention did not have a notable impact on reducing the use of restricted coding language among students.

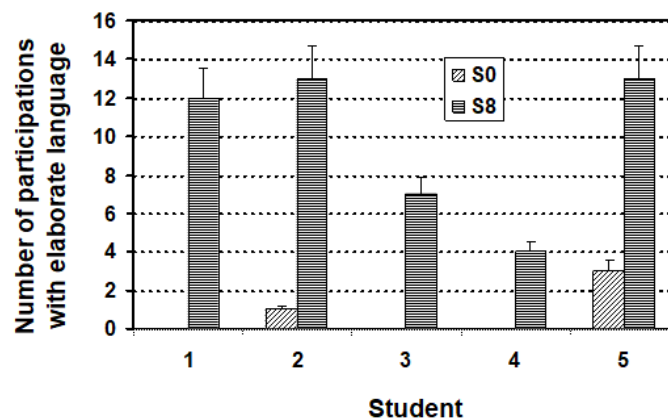*Evolution of language structure (elaborated code) of autistic students (S0 Vs S8)*

Figure 3. Evolution of language structures (elaborated code) of autistic students between S0 and S8. First intervention session (S0): without interactive videos; Eight intervention session (S8): with interactive videos.

Descriptive analysis revealed a significant increase in the number of participations with the use of complex and elaborate language between sessions S0 and S8. The average participation increased from 0.8 to 9.8, and each student showed a significant improvement. These results suggest that the intervention was effective in increasing students' oral participation, which used more complex and elaborate language. Indeed, students E2 and E5 showed remarkable progress, going from 1 to 8 interventions and from 3 to 13 interventions in elaborate language, respectively. During the S0 session without interactive videos, some students (E1, E3 and E4) did not use complex structures, but then acquired the ability to participate in the exchanges, sometimes using complex and elaborate sentences. The statistical analysis, with a calculated Student's t value of 5.84 greater than the critical value of 2.776, allows us to reject the null hypothesis. This means that there is a statistically significant difference between the number of participations with the use of complex and elaborate language before and after the intervention. Consequently, learning via interactive videos had a significant effect on the increase in the number of participations with the use of complex and elaborate language of autistic students. The average of the differences is 9 participations, and this increase is statistically significant at a significance level of 0.05. These results suggest that interactive videos, as teaching aids, are effective in improving students' oral participation and the development of more complex and structured language.

Evolution of the frequency of participation in class of autistic students (S0 Vs S8)

To assess the effect of interactive videos on the participation of autistic children in classroom discussions, we analyzed the frequency of their spontaneous participation. In this context, autistic children ask questions and comment on what they observe in an autonomous and spontaneous manner. We also examined guided participation, where the child reacts mainly when a question is directly asked using his or her first name. This indicates that his or her attention and response are particularly aroused by the interaction with the teacher. In the following sections, we will first present the evolution of the frequency of spontaneous participation, followed by that of guided participation of autistic children.

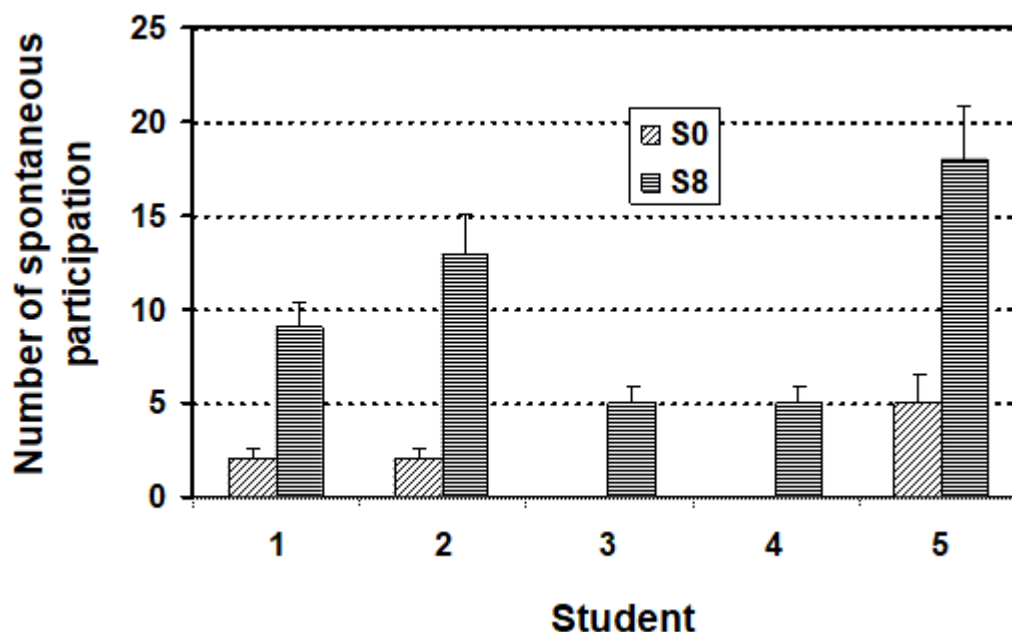*Evolution of the frequency of spontaneous participation of autistic students (S0 Vs S8)*

Figure 4. Evolution of the frequency of spontaneous participation of autistic students between S0 and S8. First intervention session (S0): without interactive videos; Eight intervention session (S8): with interactive videos.

While some students did not participate spontaneously at all in (S0) (students 3 and 4), they then acquired the ability to express themselves actively during social interactions (absence of spontaneous participation in S0 to 5 participations in S8). We note the notable increase in the number of spontaneous participations observed among students (E1, E2 and E5). We also noted that these students participated spontaneously at least twice during the learning session (S0) and five times per session at the end of the intervention (S8), which represented an increase of 150%. We note that student (E5) stands out from the other students by a remarkable increase in his interventions, the number of which was multiplied by more than three when moving from session (S0) to the last learning session (S8).

This descriptive analysis allowed us to record a notable increase in the number of spontaneous participations between sessions S0 and S8, since the average of participations increased from 1.8 to 10, and each student showed a significant increase. Since the calculated value of Student's t (5.06) is greater than the critical value (2.776), we can reject the null hypothesis. This means that there is a statistically significant difference between the number of spontaneous participations before and after the intervention. In summary, the statistical analysis shows that the use of interactive videos for the learning of autistic children had a remarkable effect on increasing the number of spontaneous participations of students in class discussions. The average of the differences is 8.2 participations, and this increase is statistically significant at a significance level of $pr \leq$ 0.05. This leads us to say that the learning of children with special needs through the use of didactic supports such as interactive videos was effective in improving the spontaneous participation of these students. These results are explained by the fact that the learning environment based on interactive videos favored the personal engagement of students, thus reducing the need for teacher interventions. Hence the students' extroversion in terms of their fluidity in formulating questions more autonomously reinforcing their confidence and their ability to interact.

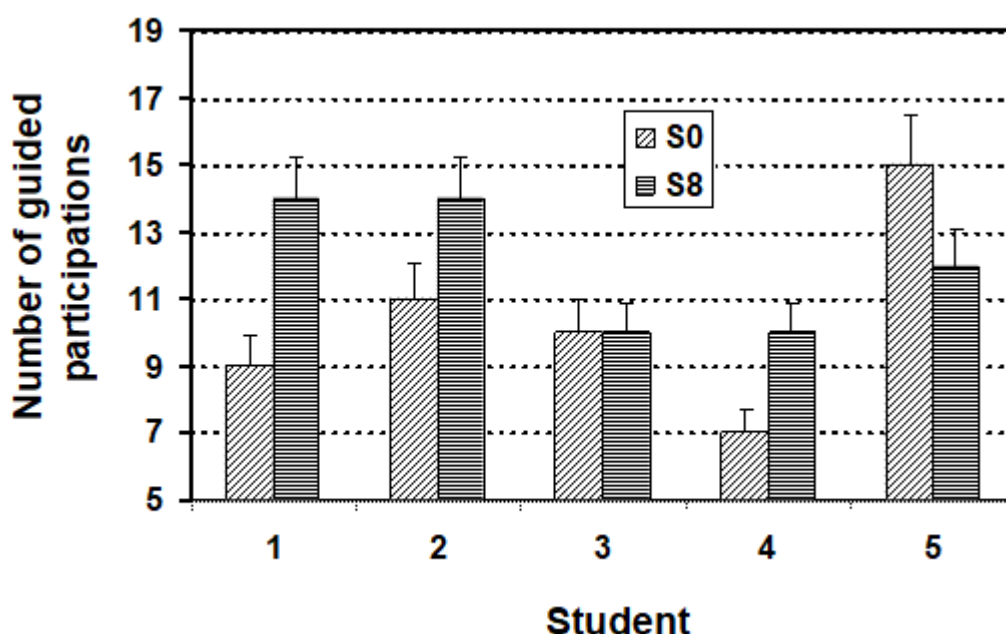*Evolution of the frequency of guided participation of autistic students (S0 Vs S8)*

Figure 5. Evolution of the frequency of guided participation of autistic students between S0 and S8. First intervention session (S0): without interactive videos; Eight intervention session (S8): with interactive videos.

Analysis of five students' guided participations during sessions S0 and S8 revealed mixed results. Student 1 increased his participations from 9 to 14, while Student 2 increased from 11 to 14. Student 4 also improved, increasing from 7 to 10 participations. In contrast, student 3 maintained a constant score of 10, and Student 5 decreased from 15 to 12 participations. The average number of guided participations between sessions S0 and S8 increased from 10.4 to 12, and the variability of participations decreased. These results show a general trend towards improvement in the number of guided participations for three students (E1, E2 and E4), with significant individual variations. The calculated Student's t value (1.15) is lower than the critical value (2.776) for a significance level of 0.05. This means that there is no statistically significant difference between the number of guided participations before and after the intervention. Indeed, by moving from S0 to the last learning session S8, the learning environment focused on the use of interactive videos could be motivating and reduced teacher intervention.

V.   Discussion

The aim of this study was to describe the design, testing and evaluation of the use of interactive videos as educational supports for the support of five autistic children in a special educational center. The impact of interactive videos on the development of language skills and participation in classroom discussions was highlighted by analyzing video recordings of eight classroom educational interventions. The analysis of these videos using an analysis grid highlighted the following results. The results of this study indicate that in the

absence of intervention tools such as interactive videos, and following the traditional teaching method, the number of times autistic children speak is very low. The language used by these children is mainly made up of limited code structures, and their participation is often encouraged rather than spontaneous. The introduction of interactive videos has had a positive impact on several aspects. Indeed, the use of these videos resulted in a significant increase in the average number of speaking engagements, suggesting that children are more likely to express themselves after viewing the content. After the first session, it is evident that there is a short-term effect, with children showing greater initiative to express themselves and using terms heard in the videos (Boucher *et al.,* 2013).

These observations highlight the effectiveness of interactive videos as a pedagogical tool to stimulate the oral expression of autistic children. The results show a notable improvement in the use of language structures after the intervention. This pedagogical tool seems to play a key role in improving the quality of participation, both in terms of simplified and elaborated language. Interactive videos provide rich stimuli and contexts that encourage autistic children to develop more complex language structures. Moving from session S0 to session S8, the learning environment focused on interactive videos was found to be motivating, reducing the need for teacher intervention. This allowed students to become more personally engaged by giving them the ability to ask questions more autonomously (Meiss *et al.,* 2015; Nadel *et al.,* 2022; Petersson-Bloom & Holmqvist, 2022). This autonomy in classroom discussions can be explained by several factors. Interactive videos provide multisensory stimulation that captures the attention of children with autism, prompting them to be more engaged in discussions (Shamir & Margalit, 2016). This learning environment is perceived as more engaging and motivating, reducing participation anxiety and fostering a climate of positive interaction. In addition, these didactic materials serve as triggers for social interactions by presenting scenarios or characters that students can identify with; this encourages them to ask questions and interact spontaneously with their peers, thus reinforcing their involvement in discussions (Garnier & Bourdon, 2021; Grossard & Grynszpan, 2015). In summary, the use of interactive videos has a significant impact on increasing spontaneous participation of autistic children, promoting their engagement and autonomy.

However, it is important to acknowledge some limitations of this educational intervention focused on the use of interactive videos, namely the significant individual variations in the impact of interactive videos. Some students showed notable improvements, while others maintained constant scores or even recorded a decrease. This variability may indicate that interactive videos are not equally effective for all children with autism, which raises questions about the adaptability of this educational method. The sample of five students is relatively small, which may limit the statistical power of the analysis. A larger sample could reveal significant differences. The duration of the intervention, in turn, may not be sufficient to observe significant changes. A longer period of exposure to interactive videos may be necessary to fully evaluate their effects on the development of language and social skills in children with autism.

Although the study measured the frequency of participation, it did not necessarily consider the quality of that participation. Further research could explore not only the number of turns, but also the complexity and relevance of student contributions to better assess the impact of interactive videos. Finally, the learning environment and teacher support may also influence the results. The lack of control over other contextual variables could affect the validity of the conclusions drawn from this study.

VI. Conclusion

In an empirical study conducted over a three-month period in a center for autistic children, we directly observed teaching sequences incorporating interactive videos. This analysis, focused on eight teaching sessions, aimed to evaluate the impact of these videos on the development of language and communication skills of five autistic children. We compared the effects of interactive videos with those of conventional teaching methods. Analysis of the data collected and the associated statistics revealed significant differences between the two approaches. Interactive videos were particularly effective for learning advanced linguistic structures, as evidenced by notable improvements in the use of complex language structures. In addition, interactive videos provide an immersive learning experience through captivating visual and auditory stimuli. They present clear linguistic models and immediate feedback and introduce children to varied social contexts. These features not only promoted the development of spontaneous speaking skills, but also contributed to a better understanding of the nuances of language.

The intervention had a positive impact on children's social interaction. Indeed, the scenarios and characters in the videos allowed children to identify with and engage more actively in the discussions. This not only increased their participation, but also reduced the need for constant guidance from teachers, which is often necessary for children with special needs. By creating a more autonomous and interactive learning environment, the videos encouraged increased participation and better social integration of children in the group.

This study highlights the added value of interactive videos as innovative educational tools. They not only allow the development of complex language skills, but they also promote richer and more autonomous

social interaction. These results suggest that the integration of interactive videos into educational practices could offer significant benefits for teaching autistic children, enriching their learning experience and facilitating their social integration.

References

[1]   Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does The Autistic Child Have A "Theory Of Mind" ? Cognition, 21(1), 37–46. Https://Doi.Org/10.1016/0010-0277(85)90022-8.

[2]   Belmonte, M. K., Weisblatt, E. J., Rybicki, A., Cook, B., Langensiepen, C. S., Brown, D. J., Dhariwal, M., Saxena-Chandhok, T., & Karanth, P. (2016). Can Computer-Assisted Training Of Prerequisite Motor Skills Help Enable Communication In People With Autism? Proceedings - 2016 International Conference On Interactive Technologies And Games: Edurob In Conjunction With ITAG 2016, ITAG 2016. Https://Doi.Org/10.1109/Itag.2016.10.

[3]   Ben-Sasson, A., Cermak, S. A., Orsmond, G. I., Tager-Flusberg, H., Carter, A. S., Kadlec, M. B., & Dunn, W. (2007). Extreme Sensory Modulation Behaviors In Toddlers With Autism Spectrum Disorders. The American Journal Of Occupational Therapy, 61(5), 584–592. Https://Doi.Org/10.5014/AJOT.61.5.584.

[4]   Bernhardt, E. B., & Krashen, S. D. (1989). Second Language Acquisition And Second Language Learning. The Modern Language Journal, 73(4), 483. Https://Doi.Org/10.2307/326882.

[5]   Bourgueil, O., Regnault, G., & Moutier, S. (2015). Création D'outils Numériques Pour Personnes Avec Trouble Du Spectre De L'autisme : De La Recherche A La Pratique, Et Vice Versa. Enfance, 1(1), 111–126. Https://Doi.Org/10.4074/S001375451500107X.

[6]   Brake, J. (2024). "My Struggles Are Largely Sensory Processing: "The Sensory World Of Autistic People. Journal Of Human Behavior In The Social Environment. Https://Doi.Org/10.1080/10911359.2024.2382108.

[7]   Chomsky, N. (1957). Syntactic Structures. Https://Www.Ling.Upenn.Edu/Courses/Ling5700/Chomsky1957.Pdf.

[8]   Constantinou, G. (2023). Les Outils Numériques Educatifs Développent-Ils L'apprentissage Du Français Des Enfants Autistes? Search. Ebscohost. Com. Https://Search.Ebscohost.Com/Login.Aspx?Direct=True&Profile=Ehost&Scope=Site&Authtype=Crawler&Jrnl=19619359&AN=173382948&H=Buul8%2Fbt2423UoiFN61ggrXwJ9%2ftrr0brdek3m7nb0tvpoczrgijk3xlfll1pt04gf4bau%2bxygnaoiw77zy%2bkg%3D%3D&Crl=C.

[9]   Dascalu, C.-M., & Garnier, P. (2015). Le Défi Des Outils Numériques Dans La Scolarisation Des Elèves Avec Autisme : Entre Les Besoins Cognitifs Des Elèves Et Les Approches Pédagogiques Des Enseignants. Http://Journals.Openedition.Org/Ree, 23(23). Https://Doi.Org/10.4000/REE.6748.

[10]   Delai, P. (2014). Utilisation Des TIC Dans Le Domaine De L'autisme Pour Favoriser La Communication Et La Reconnaissance Des Emotions. Https://Sonar.Ch/Global/Documents/309873.

[11]   Deschamps, L., Cilia, F., & Vandromme, L. (2019). Le Projet Musique, Autisme Et Interaction Numérique (MAIN). Premiers Résultats. Https://Normandie-Univ.Hal.Science/Hal-02371778.

[12]   Dieye, N., Delvenne, V., Reis, J., & Brux, J. S. (2013). Détection Précoce, Diagnostic Et Prise En Charge Des Troubles Du Spectre De L'autisme. Amub-Ulb.Be. Https://Www.Amub-Ulb.Be/System/Files/Rmb/Publications/2023-09/RMB2023-44-4_DIEYE.Pdf.

[13]   Duee, C., & Martin, J. (2021). Immersive Learning Of French As A Foreign Language: Potential Of Applications And Edutainment Scenario. ANALES DE FILOLOGIA FRANCESA, 29, 183–199. Https://Doi.Org/10.6018/Analesff.483991.

[14]   Garnier, P., & Bourdon, P. (2021). Usage Du Numérique En Education Chez Les Enfants Avec Autisme. Https://Hal.Science/Hal-03215696.

[15]   Grossard, C., & Grynszpan, O. (2015). Entraînement Des Compétences Assistées Par Les Technologies Numériques Dans L'autisme : Une Revue. Enfance, 1(1), 67–85. Https://Doi.Org/10.3917/ENF1.151.0067.

[16]   Happe, F., & Frith, U. (1996). The Neuropsychology Of Autism. Brain, 119, 1377–1400. Https://Academic.Oup.Com/Brain/Article/119/4/1377/327396.

[17]   Happé, F., & Frith, U. (2006). The Weak Coherence Account: Detail-Focused Cognitive Style In Autism Spectrum Disorders. Journal Of Autism And Developmental Disorders, 36(1), 5–25. Https://Doi.Org/10.1007/S10803-005-0039-0/TABLES/1.

[18]   Khoury, E., Carment, L., Lindberg, P., Gaillard, R., Krebs, M. O., & Amado, I. (2020). Aspects Sensorimoteurs Et Motricité Manuelle Dans Les Troubles Du Spectre Autistique : Une Revue De La Littérature. L'Encéphale, 46(2), 135–145. Https://Doi.Org/10.1016/J.ENCEP.2019.11.005.

[19]   Lord, C., Brugha, T., Charman, T., Cusack, J., Dumas, G., Frazier, T., Jones, E. J., Jones, R., & Pickles, A. (2020). Autism Spectrum Disorder. Nature Reviews Disease Primers, 2020(1), 5. Https://Doi.Org/10.1038/S41572-019-0138-4ï.

[20]   Macdonald, R., Sacramone, S., Mansfield, R., Wiltz, K., & Ahearn, W. H. (2009). Using Video Modeling To Teach Reciprocal Pretend Play To Children With Autism. Journal Of Applied Behavior Analysis, 42(1), 43. Https://Doi.Org/10.1901/JABA.2009.42-43.

[21]   Machalicek, W., Sanford, A., Lang, R., & Rispoli, M. (2010). Interventions En Alphabétisation Pour Les Elèves Ayant Des Handicaps Physiques Et Développementaux Qui Utilisent Des Dispositifs De CAA Assistée : Une Revue Systématique. Du Développement Et …. Https://Link.Springer.Com/Article/10.1007/S10882-009-9175-3.

[22]   Meiss, E., Tardif, C., Arciszewski, T., Dauvier, B., & Gepner, B. (2015). Effets Positifs D'une Exposition A Des Séquences Vidéo Ralenties Sur L'attention, La Communication Sociale Et Les Troubles Du Comportement Chez 4 Enfants Autistes Sévères : Une Etude Translationnelle Pilote. Neuropsychiatrie De l'Enfance Et De l'Adolescence, 63(5), 302–309. Https://Doi.Org/10.1016/J.NEURENF.2015.01.004.

[23]   Mercier, C. (2017). La Construction Et Les Effets De L'appropriation D'un Outil Numérique Auprès Des Enfants Avec Autisme En IME: Interactions En Situation D'apprentissage En Lien Avec L'. Https://Hal.Science/Tel-01610966/.

[24]   Nadel, J., Grynszpan, O., & Martin, J.-C. (2022). Autism And Socially Interactive Agents. The Handbook On Socially Interactive Agents, 437–462. Https://Doi.Org/10.1145/3563659.3563673

[25]   Nikopoulos, C. K. (2007). Use Of Video Modeling To Increase Generalization Of Social Play By Children With Autism. The Journal Of Speech And Language Pathology – Applied Behavior Analysis, 2(2), 195–212. Https://Doi.Org/10.1037/H0100222.Nikopoulos, C. K., & Keenan, M. (2004). Using Video Modeling To Teach Complex Social Sequences To Children With Autism. Journal Of Autism And Developmental Disorders, 37(4), 678–693.

[26]   Olçay Gül, S. (2016). Kuram Ve Uygulamada Eğitim Bilimleri Educational Sciences: Theory & Practice The Combined Use Of Video Modeling And Social Stories In Teaching Social Skills For Individuals With Intellectual Disability. 16(1), 83–107. Https://Doi.Org/10.12738/Estp.2016.1.0046

[27] OMS. (2013, March 29). Principaux Repères Sur L'autisme. Https://Www.Who.Int/Fr/News-Room/Fact-Sheets/Detail/Autism-Spectrum-Disorders

[28] Park, C. C. (2008). Growing Up With Autism: Working With School-Age Children And Adolescents. Psychiatric Services, 59(7), 818–818. Https://Doi.Org/10.1176/APPI.PS.59.7.818

[29] Petersson-Bloom, L., & Holmqvist, M. (2022). Strategies In Supporting Inclusive Education For Autistic Students—A Systematic Review Of Qualitative Research Results. Autism & Developmental Language Impairments, 7. Https://Doi.Org/10.1177/23969415221123429

[30] Pinker, S. (1994). How Could A Child Use Verb Syntax To Learn Verb Semantics? Lingua, 92(C), 377–410. Https://Doi.Org/10.1016/0024-3841(94)90347-6

[31] Plusquellec Pierrich, Paquette Daniel, Thomas Frédéric, & Raymond Michel. (2016). Les Troubles Psy Expliqués Par La Théorire De L'évolution: Comprendre Les Troubles De La Santé Mentale Grâce A Darwin. In Books.Google.Com. Https://Books.Google.Com/Books?Hl=Fr&Lr=&Id=Dvk_DQAAQBAJ&Oi=Fnd&Pg=PA201&Dq=+1%25+De+La+Population+Mondiale+Pourrait+Recevoir+Le+Diagnostic+D%E2%80%99autisme.&Ots=C88b51lryr&Sig=9a53d19xivvesng0bbgojk5hhmk

[32] Pry, R., Petersen, A. F., & Baghdadli, A. (2009). Developmental Changes Of Expressive Language And Interactive Competences In Children With Autism. Research In Autism Spectrum Disorders, 3(1), 98–112. Https://Doi.Org/10.1016/J.RASD.2008.04.005

[33] Rylaarsdam, L., & Guemez-Gamboa, A. (2019). Genetic Causes And Modifiers Of Autism Spectrum Disorder. Frontiers In Cellular Neuroscience, 13. Https://Doi.Org/10.3389/FNCEL.2019.00385

[34] Shamir, Adina., & Margalit, Malka. (2016). Technology And Students With Special Educational Needs : New Opportunities And Future Directions.

[35] Swiezy, N. (2008). Growing Up With Autism: Working With School-Age Children And Adolescents. Journal Of The American Academy Of Child & Adolescent Psychiatry, 47(11), 1355–1356. Https://Doi.Org/10.1097/01.CHI.0000314038.31103.9D

[36] Urrea, A. L., Fernández-Torres, V., Rodriguez-Ortiz, I. R., & Saldaña, D. (2024). The Use Of Technology-Assisted Intervention In Vocabulary Learning For Children With Autism Spectrum Disorder: A Systematic Review. Frontiers In Psychology, 15. Https://Doi.Org/10.3389/FPSYG.2024.1370965Volkmar, F. R., & Reichow, B. (2013). Autism In DSM-5: Progress And Challenges. Molecular Autism, 4(1), 1–6. Https://Doi.Org/10.1186/2040-2392-4-13/METRICS

[37] Zwaigenbaum, L., Brian, J. A., & Ip, A. (2019). Le Dépistage Précoce Du Trouble Du Spectre De L'autisme Chez Les Jeunes Enfants. Paediatrics & Child Health, 24(7), 433. Https://Doi.Org/10.1093/PCH/PXZ120