Differential Analysis of Four Teaching-Learning Models Applying to Students with Autism Spectrum Disorder

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ABSTRACT

Conceptually, autism spectrum disorder is shaped a disability linked to neurodevelopmental developmental disorders, regarding to the information transmission through the functional system of gamma-aminobutyric acid or GABAergic system, which is observed throughout deficits in the communication area, social interaction and restrictive behaviours, as defined by the International Classification of Diseases (DSM-5) of the American Psychiatric Association (2013) (APA).

This study analyzed the implementation of greater or lesser intensity in applying regarding four teaching-learning models will be able encourage the overall development of this diagnostic group. Results showed that educational models based on projects, through the higher intensity of cooperative learning among peers, combined with a partial support process, increased the cognitive and curricular development of this population, which, in fact, was observed in the critical levels of significance tested through Kruskal-Wallis Test analysis.

KEY WORDS: Autism Spectrum Disorder, Educational Models, Deductive and Relational Abilities, Mechanical and Meaningful Memory.

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I. INTRODUCTION

Currently, from the most official conceptual perspective, indicated by the international classification of diseases DSM-5, autism spectrum disorder (ASD) is a disability related to neurodevelopmental disorders, on the symptomatic basis of deficits in social communication and alterations in the development of restrictive and repetitive behaviours and interests, which, according to the DSM-5, corresponding to differences in intensity, with 1 being the mildest level and 3 the level of maximum intensity of the disability (American Psychiatric Association, 2013), whose prevalence incidence data, according to the Center for Disease Control and Prevention (CDC), has been assessed as around 1/44 persons born, proportionally of 4 males/1.5 females (Brown, Matson, Callahan & Tevis, 2023; Maenner et al., 2021).

The specified symptomatic process involved all areas of adaptive development to the social environment, regarding to the basic development of everyday activities, which ensured their socio-personal suitability, affecting, obviously, the development of the common daily life skills, as well as the capacity of functional socialisation within the social context, even if this context is well-known (Baghdadli et al., 2018; Mitchell et al., 2011; Sparrow et al., 2016), both in social formal environmental contexts, and in interaction with their peers (Shic et al., 2011). Therefore, although there aren't many studies on this subject, the socialisation processes and competences to acquiring life skills conformed to a specific symptomatic interactive combined process (Franchini et al., 2018; Ventola et al., 2014). Thus, the specific levels of behavioural competence deficits form a specific symptomatic whole that is differential in its own right in association with other cognitive disabilities, but even regarding to the intellectual- cognitive disability itself (Cook & Oliver, 2011), that its co-occurrence is highlighted of the shaping of this disorder (Matson, Hess, Sipes, & Horovitz, 2010; Matson, Boisjoli & Wilkins, 2010).

Patriquin et al. (2016) analyzed the contributing factors on adaptive deficits and found that neural activity, which link information at the cognitive level, through the brain's process of informational connectivity regarding to contextual events and information previously in the permanent memory, whose nodal deficit is found more specifically in the amygdala, where the level of connectivity might differ according to the region and the specific connection affected, whereby there might be a high heterogeneity in the connective nodal processing of information neurotransmission nodal processes via gamma-aminobutyric acid (GABAergic system), halving of the relational association of information networks influencing each brain region.

These research studies shown advanced in theoretical defining concepts of this disorder, that, in besides the formal behavioural criteria which can be observed objectively, it's required consider the symptomatic group provided by cognitive-executive function, which involved the set of perceptual-cognitive processes involved over bio-neurological development to explain the academic, social and emotional data identified (Best et al., 2011; Weismer et al., 2018; Pellicano et al., 2017; Vogan et al., 2018); as well as, the deficits found in the most complex cognitive measures of induction, deduction, active planning and the development of cognitive relations between concepts among perceived contextual information and other previously learned or shared information (Holland & Low, 2010; Unterrainer et al., 2016), as demonstrated in the applied research tasks with the Tower of Hanoi Test by Larson, Gangopadhyay, Prescott, Kaushanskaya & Weismer (2020) and other assignments are related to different higher-order psychological processes (Gangopadhyay et al., 2018; Williams et al., 2016).

These conceptual insights had the people with ASD showed greater deficits in autonomously establishing mediated processes between perceived information and prior content, and when they are able to do it, they exhibited a cognitive overload that disrupts the fluency of the subsequent attentional and perceptual processes, which lowers their ability to adjust to contextual learning situations (Williams et al., 2012). Wallace et al. (2009) corroborated these data through studies based on cognitive mediating processes compared between students with and without ASD, in which individuals with ASD are much less accurate at conceptual mediation and consequently performed worse at higher order tasks in school, even when students with ASD had the same cognitive ability, as said by Hill (2004), students with ASD are influenced by degree of components related to high perseverance and inflexibility levels.

The inflexibility and structural perceptual-cognitive rigidity that fallen executive abilities may help to better understand the functional level of people with ASD (Leung & Zakzanis, 2014), there's a strong functional interaction between the linguistic functions and the executive-cognitive functions themselves, mainly in connection with the planning assignments in anticipation processes, in which language, properly, becomes a form of inter-informational mediation of greater impact than any other communicative alternative, especially, as argued and validated Diamond (2013), when dealing with highly complex cognitive assignments or homework that involved extensive coordination between inhibition skills and the process of psycho-social behaviour change.

These contributions required the consideration of processes to implement cooperative interventions, both between peers and between subgroups within general educational contexts, that facilitated opportunities for participants with ASD to promote positive interactions, according to specific needs previously assessed in this regard, by encouraging opportunities to interact socially with peers in as regular a learning environment as possible, in which the most advanced models relating to implemented peer-mediated interventions planning (Martinez, Waters, Conroy & Reichow, 2021). Such programmes should be implemented in regular socio-educational contexts, which form the social setting that have been their own to pick up functional learning experiences in them and, precisely for this reason, students with ASD could be meaningful by working memory (Brown & Conroy, 2011; Guralnick, 2010).

Thus, the psycho-social participation of students with ASD encouraged the successful development of skills in which are functionally impaired, like initiating actions with peers or being able to answering with other people's initiatives within a small working group (Whalon, Conroy, Martinez & Werch, 2015; Zhang & Wheeler, 2011); otherwise, there's a threat that students with ASD will become socially isolated and show further disabilities (Brown & Conroy, 2011; Koegel, Kuriakose, Singh & Koegel, 2012).

Therefore, the **main aim** this study was founded to analyse which educational method(s) used at the regular educational level by teachers eased most significantly regarding to learning mode and, consequently, allow describing the acquisition of higher complex abilities in students with ASD within the mainstream educational setting.

II. METHOD

Research design

Research design is based on the analysis of a structured surveys carried out in those childhood education, primary and secondary schools that included students with ASD within their classrooms. The dynamic variables, both dependent variables (DV) and independent variables (IV) or factors of this analysis have been quantified on a continuum of intensity from 1 (not found) to 5 (found highly intensity). The analysis has been based on the idea that educational centres don't use a specific methodology exclusively for the attention of students, but, on the contrary, two or more methodologies are combined in such a way as to provide the best possible educational response, both for students in general and, specifically, to students with ASD.

Participants

A total of 42 students with ASD from 39 schools of different educational settings participated in this study analysis. General features of students with ASD, among others, included the following, 25 students have had a diagnosis of level 1 given (59.5%), 10 of level 2 (23.8%) and 7 of level 3 (16.7%); 37 are male (88.1%) and 5 are female (12%). Regarding the school year or step, 9 students with ASD belonged to kindergarten (21.4%), 14 to primary school (33.3%) and 19 to secondary school (45.2%). Their ages included a total of 12 students in

the 3-6 years age group (28.6%), 17 students in the 7-12 years age group (40.5%) and 13 students in the 13-17 years age (31.0%). The comorbidity processes associated with the ASD main diagnosis have also been analyzed, of which, 10 students don't present specific associations with other needs (23.8%), 10 are associated with mild intellectual cognitive deficits (23.8%), 16 students shared the ASD main diagnosis with attention deficit hyperactivity disorder (38.1%), 2 students shared the ASD main diagnosis with schizotypal behaviours (4.8%), 2 students related the disorder with epileptic components of different intensities level (4.8%) and, finally, another 2 students were associated with schizotypal behaviours (4.8%) and, in the last case, 2 students were associated with schizotypal behaviours (4.8%), 2 students were associated with epileptic components (4.8%) and, finally, 2 students were associated with schizotypal behaviours (4.8%), 2 students were associated with schizotypal behaviours (4.8%), 2 students were associated with epileptic components (4.8%) and, finally, 2 students were associated with schizotypal behaviours (4.8%), 2 students were associated with epileptic components (4.8%). 1%), 2 students were associated with schizotypal behaviours (4.8%), 2 students are associated with epileptic components of different levels of intensity (4.8%) and, finally, another 2 students are associated with other specific needs way (4.8%), which are specified as 1 asthmatic process and 1 food allergy process (4.8%).

The methodology applied constitutes the fundamental dynamic DV of this study, which, in relation to the use of medium intensity, has observed percentages relating to the *masterly* methodology in 14.3% of these educational situations, the *cooperative* methodology in 28.6%, the application of part-time special support (*partial-special*) at 23.8% and a methodology web-based on total special attention (*total-special*) in 4.8% of the educational settings.

Variables

Variables for the analysis are subdivided into 9 factors or IVs and 4 DVs.

Regarding the IVs, it's needed differentiate between those fixed variables (n= 5) and category ordinal variables (n= 4), which precisely have shaped the four teaching basic methodologies analyzed, being a total (N= 9):

IV fixed:

 \checkmark Level: level or degree of the disorder following the International Classification of Diseases (ICD) and Diagnostic Manual DSM-5.

✓ Sex: gender-related condition of study participants.

✓ *Course*: grade or school stage to which pupils with ASD belonged.

 $\checkmark \qquad Age: years-old of participants with ASD.$

 \checkmark *Comorbidity*: other specific disabilities or needs specifically related to the primary diagnosis of ASD are identified.

IV teaching-learning methodologies:

The following four methodologies way have been analyzed in between the differences the intensity regarding their application at school level, being level 1 (not applied) and level 5 (very intensively applied):

 \checkmark *Mastery*: magisterial-teaching by the regular teacher, with or without the support of specialised teaching staff.

 \checkmark *Cooperative*: using of co-operative learning-based teaching methods, through project work in small groups of 4-5 students within the regular group, with or without the support of the school's specialist teaching staff.

 \checkmark *Partial-special*: partial support from support teaching staff, either in the regular classroom or with partial attention in the specific setting, according to the legally established times.

 \checkmark *Total-special*: full time schooling in the specific special education class created for this effect within the regular school.

The DVs corresponding to analysis of perceptual-cognitive domains acquired by students with ASD based on the following measures:

 \checkmark *Mechanical-memory*: ability to achieve contents acquisition in a mechanical and repetitive memory, with a low meaning regarding to learned informative process.

 \checkmark *Meaning- memory*: capacity to remember the information gathered with an enhanced component of meaning given of information content.

 \checkmark *Cognitive- deduction:* development to individual's ability to deduce from concrete information learned and, consequently, contribute one's own complementary input to the information previously learnt.

 \checkmark *Cognitive- relationships*: competence to establish relationships between incoming new information learning and other previously learnt information it had a highly curricular relational nodes relevance.

Data análisis

Owing to small sample size, data has been analyzed through non-parametric tests, specifically regarding analysis H of Kruskal-Wallis (K-W). However, this analysis has been previously supported by reliability analysis of the

Cronbach' Alpha, as well as the analysis of the data *frequencies* and their *percentages* corresponding. Also, the *correlational* analysis between the DVs and their factors has lastly been studied.

Ethical standards

Throughout the project, all ethical standards have been followed with relation the total confidentiality of persons and educational institutions, as well as all measures related the corresponding rights and permissions have been taken into account.

III. RESULTS

Reliability analysis

The analysis to all variables studied as a whole allowed to achieve the reliability analysis throughout *Crobanch' Alpha Test*= -.13, for a total Σ_n = 42 participants with ASD (13 items). Logically, being a small sample it's very difficult find an assume statistical parameter of normality and homoscedasticity to get a parametric statistical analysis, therefore, the non-parametric statistical analysis has been assessed.

Analysis of educational methods applied

Data were analyzed through non-parametric K-W Test, which is a highly alternative proportionally very similar to parametric *one-factor-ANOVA-Test* for *j* samples analysis independently stratified samples, aiming to find the critical level of expected influencing factors on the study's DVs.

Table 1: Kruskal-Wallis Test.												
FACTORS	DEPENDENT VARIABLES											
	mechanical-memory			meaning-memory			cognitive-deduction			cognitive-relationships		
	Chi ²	df	Sig.	Chi ²	df	Sig.	Chi ²	df	Sig.	Chi ²	df	Sig.
level	7.53	3	.06	6.73	4	.15	6.11	4	.19	8.59	4	.07
sex	9.04	3	.03	6.53	4	.16	11.21	4	.02	12.63	4	.01
course	1.21	3	.75	9.85	4	.04	13.74	4	.00	6.31	4	.17
age	1.23	3	.74	6.43	4	.17	11.77	4	.02	3.97	4	.41
comorbidy	8.03	3	.04	13.29	4	.01	9.55	4	.05	18.64	4	.00
masterly	9.20	3	.03	8.55	4	.01	5.52	4	.24	7.85	4	.10
cooperative	19.05	3	.00	33.26	4	.00	34.86	4	.00	31.31	4	.00
Partial-special	12.57	3	.01	11.61	4	.02	15.59	4	.00	9.42	4	.05
Total-special	10.50	3	.01	3.70	4	.45	1.77	4	.77	2.05	4	.72

Data found are shown grouped in Table 1.

Data have shown the following conclusive analysis, which hierarchically in order of importance are given:

1. The combined application of a teaching-learning methodology based on the cooperative learning model (*cooperative*) more highly than other models applied, with or without specific support, has influenced positively all the study DVs, both mechanical (*mechanical-memory*) and meaningful memory (*meaning-memory*), but mostly importantly, it's facilitated significant improvements in deductive (*cognitive-deduction*) and relational cognitive (*cognitive-relationships*) processes in students with ASD.

2. Variable relating to the support of therapeutic pedagogy and/or hearing and speech teachers part-time (*partial-special*) influenced positively on three study factors, like these significant critical levels have been found in mechanical memory (*mechanical-memory*), meaningful memory (*meaning-memory*), and cognitive deduction processes (*cognitive-deduction*), However, influenced on the development of meaningful nodes or relationships between concepts has not been found (*cognitive-relationships*) although it's been at significant statistical limit (sig=.05), hence it can be concluded their impact on this variable is very much higher than when other teaching methods are used most intensively.

3. When application of an expository or magisterial methodology (*masterly*) has been more intensive, has differentially influenced over mechanical memory-related variable (*mechanical-memory*) and also meaningful memory development (*meaning-memory*), but it has not affected the variables relating to complex cognitive components, both to deductive cognitive (*cognitive-deduction*), as in relational-nodal variables between concepts (*cognitive-relationships*).

4. Comorbidity differentially shaped the factors related to memory development with significance (*meaning-memory*), in which data have been found at the significant limit regarding the cognitive deductive process factor (*cognitive-deduction*) (sig= .05). Within the values of comorbid processes associated with the ASD disorder, in this study have been analyzed the interactive presence of attention deficit and hyperactivity disorder, in which specified in 16 cases (38.1%), followed by cognitive-intellectual deficits (10 cases, 23.8%), 10 other cases have no associated deficit components (23.8%). Finally, other associations were found regarding the schizotypy variable (2 cases, 4.8%), as for epilepsy and others. Two cases of the variable others were associated with asthmatic-type diseases (n= 1) and other to food deficits from non-specific allergies (n= 1).

5. Sex factor differentially influenced all DVs, but acquisition of meaningful memory capacity (*meaning-memory*) (sig=.16).

6. *Course* variable focused differentially on meaningful memory capacity (*meaning-memory*), as well as in the competence to engage cognitive deductive processes. (*cognitive-deduction*).

7. Age variable (*age*) influenced differentially the competence to develop deductive-cognitive processing (*cognitive-deduction*).

8. The increased emphasis on full-time special care-based methodology (*total-special*) justly differentially influenced the factor relating to the development of mechanical or repetitive memory (*mechanical-memory*).

IV. CONCLUSION

According data found from this study and regarding with the highest precautions the conclusions owing the small sample size of the analysis involved, it could be concluded that higher intensity of a cooperative methodology improved significantly the mechanical and meaningful memory capacity of students with ASD, but, above all, it has significantly facilitated the creation of more complex cognitive processes, which refer to the creation of deductive cognitive processes, which are autonomously developed from previously processed information, and it has also improved the ability to elaborate relational processes between newly perceived content and previously achieved learning. Moreover, this methodology has facilitated the development of DVs significantly if it was accompanied by a specific mediated support process, properly adapted to needs of students with ASD, correlating with the acquisition of deductive perceptual-cognitive processes, but its application has been indifferent to the development of relational cognitive processes.

It's noteworthy that effects of improvements regarding the increased intensity of cooperative learning with or without specific support have been independent of the disorder level; however, it is highly related to the type of comorbidity associated with the degree or level of the disorder, which decisively influenced the four analysis factors.

The increased intensity of the magisterial methodology justly significantly influenced the ability to achieve knowledge acquisition, both mechanically and meaning, but was not linked to development of higher cognitive processes (cognitive deduction and perceptive-cognitive relationships between concepts).

The decision regarding the measurement of the values of teaching-learning methodologies has been made in terms of intensity owing the consideration of methodological interaction as the most frequently used way within educational institutions; but also because these methodologies are thought to be closely inter-related, whereby the combined application of these methodologies achieved a higher of significant level in explaining the differences found on the factors or IVs of this study, as shown by Pearson Correlation (r) data; therefore, e. g., *masterly* was highly positively correlated with *cooperative* (r= -.49, sig= .00), and *partial-special* (r=.59, sig= .00); However, this relationship was not observed with *total-special* variable (r=-.00, sig= .97). Even *total-special* variable just significantly influenced the acquisition of mechanical or repetitive memory ability; therefore, an exclusively special full-time methodology doesn't seem to be the most suitable answer to the specific needs of people with ASD independently of disorder level.

Moreover, the *cooperative* method positively correlates with *partial-special* (r=-.44, sig= .00), which has confirmed the method based on cooperative project development with mediated support has proved to be an excellent educational response to students with ASD.

Obviously, there's need for further study regarding this subject, but it was clearly demonstrated by data found of cooperative learning methodology, based to development of curricular projects and well supported by specialist teaching staff within the educational regular setting, the greatest statistical goodness in this study was found, both with regard to improvement of the simplest components, relating to the input level of information, and on acquisition of complex cognitive processes that require the setting up of interneural interactive processing. It's justly this way that autonomous cognitive deductions and meaningful relations between different learning

subjects can be made, which is also partly owing to the inter-group interaction involved along the whole process of shared learning. In doing thus, it's possible facilitate the activity the cerebral-neural-nodal components, whose development has been found severely impaired in people with ASD.

Therefore, in a cooperative-active context, the student with ASD will have the opportunity to perceive the contributions of others through their own concrete and functional practice, incorporate them and generate a cluster of neuro-nodal networks which facilitate the capacity to elaborate cognitive deductions and relationships about the own learned processing, as well as allowed the developmental capacity to elaborate relationships between contents, which will be greater or lesser in depth according to several other specific elements involving the person with ASD, especially those components that're correlated with the existing the associated comorbidity level.

V. DISCUSSION

In fact, as the studies of Wylie, Tregellas, Bear & Legget (2020), there's a highly functional connectivity between the symptom clusters that shaping this ASD, as it has been shown by specific test of the Observation Scale for Autism Diagnosis-2 (Rutter, DiLavore & Risi, 1999), that have indicated the importance of bio-genetic approaches to be taken account the ASD conceptual approach and, subsequently, with the specific processing systems that are interacting throughout the teaching-learning continuum processes.

In this sense, right temporoparietal function is related to many functional systems of social processing, including those conceptual considerations that overlie the theoretical assumptions of Theory-of-Mind (Hernandez et al., 2015; Kana et al., 2014; Krall et al., 2015), However, this conceptual theory justly is not able to explain the whole specific symptomatology of people with ASD, as the development the right temporo-parietal function isn't justly a specific and differential element, but, instead, there's a systemic network of relationships with other ASD specific symptoms, such as attentional impairments, jointly attended performance activities, the levels of activity on practice or also the contribution of interactive-facial processing on communication processing, demonstrating that multiple active psycho-socio-cognitive process systems are linked to the functional executive functioning process.

The most remarkable associated symptomatology in the specific functionality of people with ASD is linked to specific deficits relating to evident deficits in informational networking capacity, which is envelope to functional system of the brain component insula, which sets up the associative region between the perceived knowledge, that Craig (2009) integrating within the competence of sensory information at multimodal level.

In synthesis, all these components, which are related to the brain context at social level, interactive with specific cognitive elements, such as empathy, the ability to empathise, understanding of emotions, interactive skills, which logically have a bearing on the observed levels of impaired social interaction in people with ASD which, itself, would provide the basic starting point for the basic diagnostic process of this disorder (Singer, 2006).

These contributions showed that sensory connectivity impairment between external and internal information could be responsible for the specific needs of emotional interchange among emotional states occurring during behavioural and social interactions and the occurrence of specific sensory hyperactivity, but, above all, the most complex cognitive actions of the brain system (Green et al., 2016).

For this reason, the presence of interactive cooperative contexts, in which participants with ASD could pick up stimuli, which will be conducive to meaningful relational learning, facilitates active participation within a given group, This is enhanced by the contribution of a curricular and social mediator, who might be a regular teacher, a specialist teacher and/or a student-tutor appointed for this function throughout the development of the cooperative group project within the psycho-socio-school context.

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