

ARTICLE

## AUTISM SPECTRUM DISORDER AND LEARNING: BELIEFS AND KNOWLEDGE OF SPECIALIZED EDUCATIONAL ASSISTANCE TEACHERS<sup>1</sup>

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**ABSTRACT:** This study aims to analyze the beliefs and knowledge of specialized educational assistance teachers about the clinical characteristics of Autism Spectrum Disorder and its influence on learning. The cross-sectional study was conducted in two stages. The first stage is descriptive, with exploratory data analysis, and the second with an almost experimental pre- and post-test type design. The participants were 65 Special Education teachers, men, and women, currently working in the state schools of Pernambuco in the *Sertão do Médio São Francisco* Region. We used a structured questionnaire as a data collection instrument based on the Diagnostic and Statistical Manual of Mental Disorders 5th edition criteria and following the Guidelines of Special Education for Specialized Educational Care in K-12 education (special education modality). The results show that teachers have knowledge gaps about the disorder's clinical manifestations. Furthermore, they have difficulties regarding individualized assessment, preparation of the individual development plan, and implementation of pedagogical strategies and interventions.

**Keywords:** autism spectrum disorder, mainstreaming education, special education, learning.

### TRANSTORNO DO ESPECTRO AUTISTA E APRENDIZAGEM: CRENÇAS E SABERES DO PROFESSOR DO ATENDIMENTO EDUCACIONAL ESPECIALIZADO

**RESUMO:** O presente estudo objetiva analisar crenças e saberes dos professores do Atendimento Educacional Especializado sobre as características clínicas do Transtorno do Espectro Autista e sua influência na aprendizagem. O estudo de corte transversal foi realizado em duas etapas, sendo a primeira descritiva, com análise exploratória de dados e a segunda com delineamento quase experimental do tipo pré e pós-teste. Participaram 65 professores do Atendimento Educacional Especializado, ambos os sexos, em efetivo exercício nas escolas da rede estadual de Pernambuco da região do Sertão do Médio São Francisco. O instrumento aplicado na coleta de dados foi elaborado no formato de questionário

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estruturado, com base nos critérios do Manual de Diagnóstico e Estatístico de Transtornos Mentais 5ª edição e segundo as Diretrizes Operacionais para o Atendimento Educacional Especializado na educação básica, modalidade educação especial. Os resultados mostram que os docentes apresentam lacunas de conhecimento sobre as manifestações clínicas desse transtorno, além de dificuldades, tais como avaliação individualizada, elaboração do plano de desenvolvimento individual e desenvolvimento de estratégias e intervenções pedagógicas.

**Palavras-chave:** transtorno do espectro autista, inclusão escolar, educação especial, aprendizagem.

## **TRASTORNO DEL ESPECTRO AUTISTA Y APRENDIZAJE: CREENCIAS Y CONOCIMIENTOS DEL PROFESOR DEL SERVICIO EDUCATIVO ESPECIALIZADO**

**RESUMEN:** Este estudio objetiva analizar creencias y conocimientos de los profesores del Servicio Educativo Especializado sobre las características clínicas del Trastorno del Espectro Autista y su influencia en el aprendizaje. El estudio transversal fue realizado en dos etapas, siendo la primera descriptiva, con análisis exploratorio de datos, y la segunda, con diseño casi experimental de tipo pre y post test. Participaron 65 profesores del Servicio Educativo Especializado, de ambos sexos, en ejercicio efectivo en las escuelas de la red estatal de Pernambuco, en la región del Sertón del Medio São Francisco. El instrumento aplicado en la recolección de datos fue elaborado en el formato de un cuestionario estructurado, basado en los criterios del Manual Diagnóstico y Estadístico de los Trastornos Mentales 5ª edición y de acuerdo con las Directrices de Educación Especial para el Servicio Educativo Especializado en la educación básica, modalidad de educación especial. Los resultados muestran que los profesores tienen carencias en sus conocimientos sobre las manifestaciones clínicas de este trastorno, así como dificultades como la evaluación individualizada, la preparación de planes de desarrollo individual y el desarrollo de estrategias e intervenciones pedagógicas.

**Palabras clave:** trastorno del espectro autista, integración escolar, educación especial, aprendizaje.

## **INTRODUCTION**

Understanding the learning process of students with Autism Spectrum Disorder (ASD) means taking different paths in some aspects such as valuing the medical diagnosis and its interference with the teacher's behavior and self-efficacy, criticizing the function of this valuing and the importance of affection between the teacher and the student (RODRIGUES; ANGELUCCI, 2018).

Education contributes significantly to the mental, intellectual, social, and emotional development of children and young people. Therefore, understanding their individual and specific characteristics should not be seen as a negative condition that must be “treated”, but rather as a basis and justification for adapting the teaching-learning process (UNESCO, 1994). Learning is considered a complex and dynamic process, resulting from the interaction of neuronal structures with the environment which, when processing different information, generates behaviors that involve cognitive, affective, and social processes (SOUSA; ALVES, 2017; FERNANDES *et al.*, 2015).

ASD is a neurodevelopmental disorder with peculiar phenotypic manifestations. It is characterized by persistent deficits in social communication in multiple contexts and the presence of restricted and repetitive behaviors, interests, and activities (AMERICAN PSYCHIATRIC ASSOCIATION, 2013).

Recent studies (MAENNER *et al.*, 2021; MAENNER *et al.*, 2020; MÁLAGA *et al.*, 2019; BAIO *et al.*, 2018) point to an exponential growth in the number of ASD diagnoses, configuring it as a disorder of most prevalent neurodevelopment in the world. Despite this, there is heterogeneity in prevalence rates in some countries (BAIXAULI *et al.*, 2020; SCHMIDT *et al.*, 2016) such as the USA, which has an incidence of 1/44 children with ASD (MAENNER *et al.*, 2021), while European countries

such as Spain and Portugal exhibit rates of 1/100 and 1/806, respectively (MÁLAGA *et al.*, 2019; MORALES-HIDALGO *et al.*, 2018).

Countries in South America, such as Brazil and Chile, do not yet present large-scale studies that provide data on the prevalence of the disorder (ROCHA *et al.*, 2019; LAMPERT -GRASSI, 2018). However, in Brazil, the educational indices have had a notable increase in the number of students with disabilities enrolled in regular classrooms in recent years. In ASD, data from the National Institute of Educational Studies and Research Anísio Teixeira (INEP-*Instituto Nacional de Estudos e Pesquisas Educacionais*) indicate a growth of 37.28% in the number of enrollments of these students in regular schools, between 2017 and 2018 (GROSSI; GROSSI; GROSSI, 2020).

In the State of Pernambuco, data from the Pernambuco Educational Information System (SIEPE-*Sistema de Informação Educacional de Pernambuco*) reveals that 6,375 students with disabilities were enrolled for the 2020-2021 cycle. In state schools, located in the *Sertão do Médio São Francisco* Region, 373 enrollments were made in this cycle, and 67 were students with ASD (PERNAMBUCO, 2021). The increase in these educational indicators must be monitored by public policies on inclusive education to increase human resources and teaching materials aimed at the education of these children (BAIXAULI *et al.*, 2020).

Given this context, it is relevant to think about the integration of teaching knowledge into the learning of these people. Thus, pedagogical strategies must be guided by evidence-based practices to direct interventions, both in the regular classroom and in specialized educational services (SEA) (NUNES; SCHMIDT, 2019). In this way, the school process consists of a contemporary challenge for the school that following the current inclusive policy, must expand the access and the permanence and full development of students in educational environments (SCHMIDT *et al.*, 2016).

School inclusion is supported by the current legislation through official documents such as the National Policy on Special Education from the Perspective of Inclusive Education - *Política Nacional de Educação Especial na Perspectiva de Educação Inclusiva* (BRASIL, 2008), Basic Operational Guidelines for Specialized Educational Assistance - *Diretrizes Básicas Operacionais para o Atendimento Educacional Especializado* (BRASIL, 2009), National Protection Policy of the Rights of Persons with Autism Spectrum Disorder - *Política Nacional de Proteção dos Direitos da Pessoa com Transtorno do Espectro Autista* (BRASIL, 2012) and Brazilian Law for the Inclusion of Persons with Disabilities - *Lei Brasileira de Inclusão da Pessoa com Deficiência*, nº 13,146/2015 (BRASIL, 2015). Such documents, in theory, include students with ASD among the target audience and ensure SES during regular classroom hours. In addition, they agreed that the SES must be carried out by a qualified professional, with specific training to teach from an inclusive perspective.

Among the duties defined for these professionals, the first is to identify, develop, produce, and organize services, pedagogical and accessibility resources, in addition to promoting strategies considering the specific needs of students, as well as developing and executing the individual development plan (BRASIL, 2011; BRAZIL, 2009).

The SEA teacher is the foundation for the learning process of students with ASD, playing an important role in school inclusion. It constitutes a pedagogical complement based on the specificity of each disability and acts as a collaborative agent in the school community (CAPUZZO; SAMPAIO; IRIGON, 2019). The teacher's knowledge about the specificities of ASD, regarding its clinical manifestations and the impact they have on learning, is relevant to the teaching process and pedagogical intervention of these students (BARBOSA; FUMES, 2017).

Recently, in education, ASD has been highlighted in several studies (VICARI; RAHME, 2020; PONCE; ABRÃO, 2019; SANTOS; ELIAS, 2018; SCHMIDT *et al.*, 2016), with research objects directed towards the concepts of educational inclusion and the school process (CAMARGO *et al.*, 2020; CAPUZZO; SAMPAIO, 2019; PIMENTA, 2019; WUO, 2019); reflections on teaching activity (BARBOSA; FUMES, 2017); use of technologies in learning (SOUZA; SILVA, 2019; BRASILIENSE *et al.*, 2018; DANIELS *et al.*, 2018); and use of behavioral interventions at school (REMYNGTON *et al.*, 2019; PARSONS *et al.*, 2018; SUN; VARANDA; FERNANDES, 2017).

Due to the broad scientific production addressing ASD, it appears to be a lack of data on the SES teacher's knowledge about the clinical characteristics of the disorder (CAPUZZO; SAMPAIO; IRIGON, 2019; CANABARRO; TEIXEIRA; SCHMIDT, 2018; SILVA; FONSECA; BRITO, 2018;

BARBOSA; FUMES, 2017), a fact that does not fit with the importance of SEA in the school inclusion process and the teaching-learning of students with ASD.

From this perspective, this study aims to analyze beliefs and knowledge of Specialized Educational Service teachers about the clinical characteristics of Autism Spectrum Disorder, described in the Diagnostic and Statistical Manual of Mental Disorders 5th edition (*Manual Diagnóstico e Estatístico de Transtornos Mentais 5ª edição*), and their influence on learning to respond to the following questions: (1) what is the professional and academic profile of the SEA teacher at schools in the state network of Pernambuco in the *Sertão do Médio São Francisco* Region? (2) what is the level of specific knowledge of SEA teachers about the clinical characteristics of ASD and its influence on learning? (3) what is the effect of a refresher course on the SEA teacher's knowledge about the clinical characteristics of ASD and its influence on learning?

## METHODOLOGY

### Study design

This is a cross-sectional study carried out in two stages. The first is a descriptive study with exploratory data analysis and the second is a quasi-experimental design of the pre- and post-test type. In this way, there is research of an applied nature, with a quantitative approach, which uses a systematic, objective, and rigorous strategy to generate and refine knowledge (BURNS; GROVE, 2005).

The first stage shows a descriptive, exploratory design that aims to present the sample profile (KAUARK; MANHÃES; MEDEIROS, 2010). The design is used to “describe, differentiate or examine associations, rather than looking for relationships between variables, groups or situations” (SOUSA; DRIESSNACK; MENDES, 2007). In the second stage, the design did not have a random distribution of participants across treatments or control groups. There was a comparison with the same individuals at two moments, before and after the pedagogical intervention (SELLTIZ; WRIGHTSMAN; COOK, 1987).

This study followed the ethical determinations for research with human beings contained in Resolution 466/2012 CNS/MS and Circular Letter 01/2021/CONEP/SECNS/MS. Its research protocol was submitted for analysis by the Ethics Committee, obtaining a substantiated opinion of approval and release for data collection (4,638,533). Due to the COVID-19 pandemic, caused by SARS-CoV-2, both stages were carried out remotely through the Google Meet platform.

### Target population and sample

The target population of the study (N=68) was represented by all SEA teachers currently working in schools in the state network of Pernambuco in the *Sertão do Médio São Francisco* region. The sampling was non-probabilistic and consecutive, that is, it resulted from the enrollment of the entire accessible population during the research development period (HULLEY *et al.*, 2008), resulting in a sample consisting of 65 participants.

The inclusion criteria were SEA teachers of both genders who serve or may serve students with ASD, with a permanent employment relationship or even a temporary contract, and who have been in full professional activity for at least the last 6 months. Teachers on leave due to any nature (medical, maternity, premium, and unpaid leave) and teachers who work in Indigenous schools were not included. The exclusion criteria were non-participation in all stages of the research, incomplete completion of the instruments, and withdrawal from participation at any stage and for any justification.

### Research instrument

The instrument applied in data collection was prepared in the format of a questionnaire based on the criteria of DSM 5 (AMERICAN PSYCHIATRIC ASSOCIATION, 2013) and according to the Operational Guidelines for Specialized Educational Assistance (*Diretrizes Operacionais para o Atendimento Educacional Especializado*) in basic education (BRASIL, 2009). The objective was to outline the sample

profile and investigate the level of knowledge of SEA teachers about the clinical characteristics of ASD and its influence on learning.

The questionnaire is structured in two parts and contains thirty-five questions that allow only one possible answer. The first part of the instrument was called General Information and contained eighteen questions relating to personal data, professional profile, work infrastructure, and continuing training. The number of alternatives varies between two and five depending on the question presented. The second part, called Specific Knowledge, contains seventeen questions referring to the clinical characteristics of ASD, its influence on learning, and the pedagogical strategies adopted. These questions require dichotomous answers such as “YES” and “NO”.

## Research Operationalization

The research was operationalized in the following stages:

- • Stage 1 – Meeting with the Inclusion, Human Rights and Citizenship Center of the *Sertão do Médio São Francisco* Region to present the research project;
- • Stage 2 – Meeting with all SEA teachers, presenting the research project, and inviting participation. Those who voluntarily accepted were sent the Informed Consent Form and the electronic form with the General Information questionnaire;
- • Stage 3 – Pre-intervention phase, with sending of the Specific Knowledge questionnaire, followed by pedagogical intervention through a refresher course on the clinical characteristics of ASD and its influence on learning. After the intervention, the instrument was reapplied;
- • Stage 4 – Data analysis;
- • Stage 5 – Preparation of didactic-pedagogical material based on the analyzed data;
- • Stage 6 – Return of the research, with delivery of the teaching pedagogical material to the SEA teachers.

## Data Analysis Plan

As the forms were completed, the data collected was automatically transported by the Google Forms platform to a Google Docs spreadsheet. Then, the data were reviewed and reorganized twice in a Microsoft® Office Excel® 2016 database (Microsoft Corporation, Redmond, WA, USA, version 16.0.14228.20000), with automatic consistency and amplitude checking. The processing of descriptive and inferential analyses was carried out using the statistical program SPSS version 25.0 (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.). All tests were carried out assuming a 95% confidence interval and a 5% significance level.

To describe the results obtained, exploratory and/or factorial analysis was carried out. For the quantitative variable age (in years old), the analysis was carried out by observing the mean and standard deviation. For categorical variables, absolute and percentage frequencies were calculated and presented in tables.

The main statistical tests carried out were:

- • Kolmogorov-Smirnov: to test the assumption of normality of the age variable;
- • Phi coefficient: to test the correlation between the nominal dichotomous variables “level of academic training”, “to have specific training to assist ASD” and “to serve or have already served students with ASD” and the variables “Do you know what all the characteristics are ASD clinics?”; “Do you feel capable and confident in helping students with ASD?”; “Do you consider your training adequate and sufficient to serve students with ASD?” and “Characteristic of ASD that believes it is more capable of intervening and contributing to the student’s development”;
- • McNemar test: to check whether there was a difference in the proportions of “yes” answers between the pre-intervention (T0) and post-intervention (T1) pedagogical assessment moments.

## RESULTS AND DISCUSSION

Pedagogical knowledge based on the principles of neuroscience supports teaching action since understanding brain functioning favors a better understanding of the neural processes through which learning occurs, and consequently improves didactic transposition (CARVALHO, 2010). Based on this assumption, this study analyzed beliefs and knowledge of SEA teachers about the clinical characteristics of ASD and its influence on learning, to outline the professional and academic profile of SEA teachers in schools in the state network of *Região do Sertão do Médio São Francisco* in Pernambuco; verify the specific knowledge of these teachers on the topic; and, finally, analyze the results of a refresher course offered to teachers participating in the research.

Therefore, seeking to fulfill these objectives, 68 SEA teachers who work in schools in the state network of *Sertão do Médio São Francisco* were contacted and invited to participate in the research. Among them, 65 teachers met the eligibility criteria and signed their informed consent form. Only 3 teachers were not included in this research due to paid leave.

### Professional and academic profile of the SEA teacher's at schools in the state network of Pernambuco in the *Sertão do Médio São Francisco Region*

In this study, the final sample was made up of 65 education professionals, with an average age of  $43 \pm 9$  years, fully active in the last 6 months at SEA, with a permanent employment relationship or a temporary contract. There was no sample loss, all teachers participated in both stages of collection, which consisted of answering the questionnaires and participating in the refresher course.

The sample is characterized by a predominance of females ( $n=60$ ; 92.3%), time working in the SEA between 1 and 10 years of work ( $n=48$ ; 74%), and level of *lato sensu* academic training ( $n=52$ ; 80%). All teachers believe in the relevance of having in-depth knowledge about ASD and around 54% ( $n=35$ ) do not consider the quantity and quality of ongoing training on the topic, offered in the *Sertão do Médio São Francisco* region, to be satisfactory. Table 1 shows the distribution of absolute and relative frequencies of sociodemographic variables and working life characteristics of the interviewed professionals.

Regarding the level of academic training, we verified that a small portion of the sample ( $n=10$ ; 15.3%) does not meet the prerequisite established by the National Policy on Special Education from the Perspective of Inclusion (*Política Nacional de Educação Especial na Perspectiva da Inclusão*) (BRASIL, 2008) and by Resolution 04/2009 (BRASIL, 2009), that is, they do not have a higher education degree to practice teaching ( $n=1$ ; 1.5%) or they do not have a *lato sensu* specialization course in the special education, specialized educational services or similar ( $n=9$ ; 13.8%). This finding may indicate fragility in the monitoring and inspection of school environments by the competent public body, in addition to suggesting the insufficiency of training subsidies allocated to SEA (SILVA; TARTUCI; DEUS, 2015).

Regardless of the specialization course in the area, most interviewees ( $n=51$ ; 78.5%) stated that they did not have specific training courses on ASD. In contrast, the National Policy for the Protection of the Rights of People with Autism Spectrum Disorder (*Política Nacional de Proteção aos Direitos da Pessoa com Transtorno do Espectro Autista*) determines that the Union, States, and Municipalities encourage the training of professionals specialized in caring for people with ASD, in addition to the participation of parents and guardians (BRASIL, 2012).

In this context, the offer of courses and training must be widely disseminated, with mandatory participation for the school community, especially for SEA teachers. Understanding the phenotypic characteristics of ASD should be a prerogative for all professionals who work directly or indirectly with this school population, not as a form of discrimination based on labels, but as an important tool in establishing appropriate pedagogical procedures aimed at the individuality of the student.

In the view of the teachers interviewed regarding their knowledge of the clinical characteristics of ASD, most of them ( $n=50$ ; 77%) say they do not know them completely. A similar finding was found in the study by Alharbi et al. (2019), in Saudi Arabia, who assessed knowledge about ASD in 248 regular teachers. The authors highlighted that there is an undoubted need for teacher training regarding the specificities of ASD and support strategies. They conclude that a lack of knowledge can

negatively impact both the student's management in school spaces and the use of educational tools aimed at learning.

Regarding the perception of safety in serving students with ASD, most teachers (n=43; 66.2%) do not feel capable and safe to work with this population and 83.1% (n=54) do not consider their adequate and satisfactory training to serve these students. Despite this, 63.1% (n=41) stated that they serve them or have already served them. Therefore, the teacher's day-to-day experience does not provide a feeling of pedagogical capacity and security to perform their duties with these people.

The findings confirm the study by Schmidt *et al.* (2016), in which they confirm that the SES teacher's feeling of insecurity is related to the poor quality of continuing education. Also, Carvalho Filha *et al.* (2021) state that the greater the SES teacher's level of experience, the greater their ability to plan and execute pedagogical interventions. Therefore, it becomes essential to give a new meaning to teaching practice, which must be aligned with consistent theoretical knowledge, based on scientific evidence. Furthermore, it is important to consider the teacher's perspective on the student's individuality, potential, and difficulties (SANINI; BOSA, 2015).

Therefore, the importance of teachers knowing how to follow paths that facilitate the teaching-learning process is understood, strengthening their perceptions about their ability to intervene pedagogically. To this end, in this research teachers were questioned about their perception of being able to intervene pedagogically on the specificities of the characteristics of ASD and contribute to the student's development.

The results show that 54% (n=35) of teachers feel more able to intervene in the clinical characteristic of social interaction deficit; followed by around 34% (n=22) who claim the ability to intervene in the communication deficit. Regarding the perception of difficulties in pedagogical intervention, some teachers (n=20; 30.8%) claim inability to intervene in sensory processing dysfunctions; while others declare difficulties in intervening in communication deficits (n=20; 30.8%), restricted and repetitive behaviors (n=13; 20%) and deficits in social interaction (n=12; 18.5%).

**Table 1** – Frequency distribution of the characteristics of the study sample related to teaching professional practice in Specialized Educational Services (n=65).

<b>Variables</b>	<b>n (%)</b>
<b>Gender</b>	
Female	60 (92.3)
Male	5 (7.7)
<b>Higher level of academic training</b>	
Average normal (former teaching)	1 (1.5)
Higher (undergraduate)	9 (13.8)
Postgraduate Lato sensu	52 (80.0)
Postgraduate Stricto sensu	3 (4.6)
<b>Time working at SES (in years)</b>	
1 to 5	25 (38.5)
6 to 10	23 (35.4)
More than 10	17 (26.2)
<b>Specific training to assist students with ASD</b>	
Yes	14 (21.5)
No	51 (78.5)
<b>Serves or has served students with ASD</b>	
Yes	41 (63.1)
No	24 (36.9)
<b>Know what all the clinical characteristics of ASD are</b>	
Yes	15 (23.1)
No	50 (76.9)

Feel capable and confident in helping students with ASD	
Yes	22 (33.8)
No	43 (66.2)
Considers their training adequate and sufficient to serve students with ASD	
Yes	11 (16.9)
No	54 (83.1)
Characteristic of ASD who believe they are better able to intervene and contribute to the student's development	
Communication deficit	22 (33.8)
Deficit in social interaction	35 (53.8)
Restricted and repetitive behaviors	4 (6.2)
Dysfunction in sensory processing	4 (6.2)
Characteristic of ASD who believe they are have more difficulty to intervene and contribute to the student's development	
Communication deficit	20 (30.8)
Deficit in social interaction	12 (18.5)
Restricted and repetitive behaviors	13 (20.0)
Dysfunction in sensory processing	20 (30.8)

Source: Prepared by the authors (2021).

Considering the level of academic training as one of the preponderant factors that ensure, or should ensure better professional performance, we sought to determine whether there are relationships between the level of training and the answers to the questions: “Do you know what all the ASD clinical characteristics of the patient are?”; “Do you feel capable and confident in helping students with ASD?”; “Do you consider your training adequate and sufficient to serve students with ASD?”; and “Characteristic of ASD that believes it is more capable of intervening and contributing to the student's development”.

The correlation analysis showed no significant relationships ( $p>0.05$ ) between the level of academic training, the teacher's knowledge about the clinical characteristics of ASD, and their perception of capacity, safety, and/or sufficiency in providing care to students with ASD. Similarly, the fact of having specific training to care for ASD did not show a significant relationship ( $p>0.05$ ) with knowledge about its clinical characteristics, nor with the perception of capacity, safety, and/or sufficiency in providing care to the student.

On the other hand, serving or having already served students with ASD showed direct and significant relationships with the SEA teacher's perception of knowing the clinical characteristics ( $\varphi=0.27$ ;  $p=0.031$ ) and feeling capable and confident in serving students ( $\varphi=0.28$ ;  $p=0.025$ ). This apparent perception can be directly related to professional experience, which can increase the level of knowledge, highlighting the feeling of competence in serving the student (ALHARBI *et al.*, 2019).

In contrast, serving or having already served students with ASD was not related to considering one's academic training as adequate and sufficient to intervene pedagogically ( $p=0.158$ ) nor to the perception of aptitude to intervene and contribute to student development in the face of a given clinical characteristic ( $p=0.351$ ). This result may be associated with the low quality of training (CANABARRO; TEIXEIRA; SCHMIDT, 2018) and the teacher's difficulty in generalizing experiences in SES due to the diversity of clinical manifestations evidenced in this audience (SCHMIDT *et al.*, 2016; RUBLE; USHER; MCGREW, 2011).

### **Specific level of knowledge of SEA teacher's from schools in the state network of Pernambuco in the *Sertão do Médio São Francisco* Region about the clinical characteristics of ASD and its influence on learning**

By recognizing that the teaching-learning process is interdependent on brain neural processing, several authors (FERREIRA; GONÇALVES; LAMEIRÃO, 2019; DELDUQUE, 2016;



ARAÚJO, 2011; CARVALHO, 2010) assert that teaching knowledge, based on scientific evidence, must be supported by neuroscience studies. Araújo (2011) highlights the importance of in-depth knowledge about learning mechanisms, such as the neural circuits of receptive and expressive language, social skills, and reading acquisition.

Regarding ASD, DSM 5 points out that clinical characteristics such as social communication deficits and the presence of restricted and fixed behaviors, lead to functional impairments in social and academic areas, with a negative impact on learning (AMERICAN PSYCHIATRIC ASSOCIATION, 2013). Thus, several studies (CHANG *et al.*, 2018; LOPATA *et al.*, 2018; PARSONS *et al.*, 2018; CUNHA, 2017; OSWALD *et al.*, 2016; REIS; PEREIRA; ALMEIDA, 2016; BRADY *et al.*, 2015; KAMPS *et al.*, 2015) have investigated the probable relationship between the clinical characteristics of ASD and respective impairments in learning.

Regarding communication, Brady *et al.* (2015) and Kamps *et al.* (2015) highlight that such difficulties can compromise social learning since communication deficits hinder building and maintaining dialogue during social interactions. Furthermore, communication deficits harm symbolic learning, with damage to the acquisition of new meanings and the understanding of abstract concepts, reflecting on the process of reading, writing, and logical-mathematical reasoning (CHANG *et al.*, 2018; CUNHA, 2017; OSWALD *et al.*, 2016).

As for deficits in social interaction, they can negatively interfere with communication learning, especially in the social function of language, impairing the ability to initiate and maintain dialogues, share ideas and feelings, manage emotions, demonstrate empathy, and make decisions (LOPATA *et al.* 2018; PARSONS *et al.*, 2018; REIS; PEREIRA; ALMEIDA, 2016).

Regarding restricted and repetitive behaviors, some authors (WELSH; RODGERS; HONEY, 2019; AZAD; MANDELL, 2016) suggest that stereotypes, inflexibility to change, and rigidity of routines reduce favorable moments for learning basic and educational skills since entering these patterns prevents the learning of more adaptive behaviors. Therefore, the SEA teacher must master pedagogical strategies that reduce inappropriate behaviors and promote learning.

Finally, deficits in sensory processing can compromise the school of students with ASD, since, in the school environment, there is an overload of visual and auditory stimuli that make it difficult to maintain attentional focus and understand verbal instructions (DUNN, 2017). The hyperstimulation of the environment leads students with ASD to direct their attention to distracting stimuli during the teacher's explanation in the classroom (MONTEIRO *et al.*, 2020; HANLEY *et al.*, 2017).

From this perspective, the level of specific knowledge of the SES teacher about ASD was investigated. Table 2 shows the baseline level of specific knowledge about ASD, with the distribution of frequencies of responses to the questionnaire. We observed that most teachers (n= 42; 64.6%) do not know the formal concept of ASD according to DSM-5; and around 57% (n=37) are unable to describe the clinical characteristics of ASD following scientific evidence. However, most of them believe in understanding the deficits in communication (n=47; 72.3%) and social interaction (n=49; 75.4%); restricted and repetitive behaviors (n= 47;72.3%); deficits in sensory processing (n=35; 53.8%) and their influence on learning.

Thus, an inconsistency was identified in the statements between “not being able to describe the clinical characteristics of ASD following scientific evidence” and “being able to understand the deficits in communication and social interaction, the restricted and repetitive behaviors, and the deficit in sensory processing”. Therefore, teachers may have a superficial understanding of the characteristics of ASD, probably reflecting knowledge based on their daily experiences.

Barbosa and Fumes (2016) reinforce that, although the SEA teacher has the training to perform the role, their conception of ASD may be based on common sense, not scientific. The authors state that continued training in the area may not be sufficient to completely change teachers' beliefs and perceptions about ASD. Among the studies (OLIVEIRA; ANGELO; STREIECHEN, 2020; NASCIMENTO; CRUZ; BRAUN, 2016; SCHIMIDT *et al.*, 2016) it is unanimous that there are gaps in teacher training, regarding the lack of curricular content that deals with ASD and the school. Thus, the inability to “what” to teach and the way “how” to teach leads the teacher to adopt common sense practices (NUNES; SCHIMIDT, 2019).

Due to the difficulties reported previously, regarding the pedagogical actions inherent to SEA, most teachers (n=37; 57%) state that they can carry out the pedagogical assessment; 52.3% (n=34) can draw up an individual development plan; 69.2% (n=45) organize the SEA room to promote the learning of students with ASD; and 63.1% (n= 41) guide other teachers and family members regarding pedagogical strategies. Despite this, 60% (n=39) confirm that they are not capable of planning pedagogical interventions aimed at deficits based on DSM-5.

It is important to highlight that the specificities of each student, the assessment, and the individual development plan are the basis for developing the pedagogical intervention, to eliminate barriers that hinder learning (BRASIL, 2013). Thus, these findings show that the teacher's knowledge regarding pedagogical assessment and the individual plan may be based on general models and not specific to ASD. Furthermore, they reinforce the existence of gaps in knowledge about the disorder reflected in teaching practice, especially in a pedagogical intervention without targeting ASD deficits. In this sense, Araújo and Lotufo Neto (2014) emphasize the importance of the teacher's robust knowledge about the clinical manifestations of ASD to direct pedagogical intervention programs, especially for the difficulties and enhancement of skills peculiar to each student.

**Table 2** – Baseline frequency distribution of responses to the questionnaire on specific knowledge about ASD (n=65).

<b>Questions</b>	<b>n (%)</b>
<b>P1 Do you know the formal concept of ASD according to DSM–5?</b>	
Yes	23 (35.4)
No	42 (64.6)
<b>P2 Is ASD a neurodevelopmental disorder?</b>	
Yes	56 (86.2)
No	9 (13.8)
<b>P3 Does ASD predominate in one gender (boys or girls)?</b>	
Yes	45 (69.2)
No	20 (30.8)
<b>P4 Can you describe the clinical characteristics of ASD following scientific evidence?</b>	
Yes	28 (43.1)
No	37 (56.9)
<b>P5 Do you understand what the communication deficit in ASD is and its implications for learning?</b>	
Yes	47 (72.3)
No	18 (27.7)
<b>P6 Do you understand what the social interaction deficit in ASD is and its implications for learning?</b>	
Yes	49 (75.4)
No	16 (24.6)
<b>P7 Do you understand what restricted and repetitive behaviors are in ASD and their implications for learning?</b>	
Yes	47 (72.3)
No	18 (27.7)
<b>P8 Do you understand what sensory processing dysfunctions are in ASD and their implications for learning?</b>	
Yes	35 (53.8)
No	30 (46.2)
<b>P9 Does ASD have levels of severity?</b>	
Yes	63 (96.9)
No	2 (3.1)

P10 Do you believe that the greater the level of severity of ASD, the greater the difficulty in learning?	
Yes	57 (87.7)
No	8 (12.3)
P11 Do you believe that the characteristics of ASD can influence learning?	
Yes	55 (84.6)
No	10 (15.4)
P12 Can you assess student learning with ASD?	
Yes	37 (56.9)
No	28 (43.1)
P13 Can you develop an individual development plan with specific teaching objectives for the student with ASD?	
Yes	34 (52.3)
No	31 (47.7)
P14 Can you plan the pedagogical intervention based on the clinical characteristics (according to DSM-5) of the student with ASD?	
Yes	26 (40.0)
No	39 (60.0)
P15 Can you develop pedagogical strategies that facilitate learning for students with ASD?	
Yes	44 (67.7)
No	21 (32.3)
P16 Can you organize the AEE room to promote learning for students with ASD?	
Yes	45 (69.2)
No	20 (30.8)
P17 Can you guide other teachers and family members on the pedagogical strategies to be used with students with ASD?	
Yes	41 (63.1)
No	24 (36.9)

Source: Prepared by the authors (2021).

### Results of the refresher course on the clinical characteristics of ASD and their influence on learning

According to Conforto *et al.* (2011), training and refresher courses can modify communication between SES teachers and students with disabilities, as well as transform the way of teaching through pedagogical resources adapted according to the specificities of the students. Continuing training aimed at SES proposes to pedagogically and methodologically train teachers to carry out appropriate interventions that go beyond the multifunctional resource room and enter the regular classroom as collaborative teaching (regular classroom teacher and SEA teacher) with the sole objective, of school inclusion (HERMES, 2019).

In this study, the pedagogical intervention consisted of a refresher course on the clinical characteristics of ASD and its influence on learning, offered to research participants. Table 3 shows the comparative analysis of the proportions of responses between the pre-intervention (T0) and post-intervention (T1) pedagogical evaluation moments. McNemar's exact test showed that there was a difference in the proportions of responses between the two moments evaluated (T0 and T1) for questions P1, P3 to P8, P12 to P17, with a significant increase in "yes" answers for the post-intervention pedagogical moment (T1).

The increase in the percentage of teachers who came to know important information about ASD, regarding clinical characteristics based on scientific evidence (P1, P3 to P8) is directly proportional to the increase in the percentage of teachers who started to feel capable of carrying out specific actions (P12 to P17) for the ASD public after the intervention (Table 3). The more the teacher acquires

knowledge about ASD, the greater their ability to evaluate, develop an individual development plan, and promote teaching strategies.

Assessment is a fundamental step in the construction of the student's planning in SES, where information collected will support the choice of strategies, resources, and methodologies. The individual development plan is a guiding instrument that helps in the development of pedagogical interventions for compromised skills and the improvement of the student's skills (POKER *et al.*, 2013). Therefore, it suggests that teacher knowledge of ASD is an important predictor for the execution of actions that facilitate learning.

From this perspective, the study infers that specific pedagogical training aimed at knowledge gaps can modify teachers' conceptions of ASD. However, they do not ensure a significant change in conceptions about pedagogical practices over time. Therefore, training must be continuous, covering content focused on the teacher's needs, especially on clinical characteristics and pedagogical aspects, to then establish favorable conditions for the learning and development of students with ASD at school (CAMARGO *et al.*, 2020).

The discursive analysis of several studies (PINTO; AMARAL, 2019; BARBOSA; FUMES, 2017; SCHMIDT *et al.*, 2016; VÉLEZ-CLAVO *et al.*, 2016) highlights that professional qualification must transcend general theoretical conceptions regarding inclusive education. Furthermore, it emphasizes that there are important training deficits for teachers in several areas, especially in ASD, ranging from knowledge about the disorder and its implications for learning to the development of an individual teaching plan.

In this sense, teaching training focused on the theme of this study should be reformulated from the perspective of integrating theory with practice, based on educational neuroscience, a source of new knowledge about human neurodevelopment. Therefore, the participation of universities in reviewing their curricular matrices with the inclusion of subjects related to people with disabilities is essential. In addition to being included in the curriculum, practical experiences in which teachers in training participate in regular classes and specialized assistance attended by students with ASD are essential (GÓMEZ-MARÍ; SANZ-CERVERA; TÁRRAGA-MÍNGUEZ, 2021). Furthermore, public policies related to teacher training must be ensured by the responsible bodies, especially in expanding the offer of training courses systematically and continuously aimed at SEA.

**Table 3** – Comparative analysis of the proportions of responses between the pre-intervention (T0) and post-intervention (T1) pedagogical assessment moments (n=65).

Questions	T0 n (%)	T1 n (%)	$X^2_{(1)}$	p-value*
P1				
Yes	23 (35.4)	58 (89.2)	31.243	0.000
No	42 (64.6)	7 (10.8)		
P2				
Yes	56 (86.2)	61 (93.8)	1.778	0.180
No	9 (13.8)	4 (6.2)		
P3				
Yes	45 (69.2)	57 (87.7)	8.643	0.002
No	20 (30.8)	8 (12.3)		
P4				
Yes	28 (43.1)	58 (89.2)	26.281	0.000
No	37 (56.9)	7 (10.8)		
P5				
Yes	47 (72.3)	61 (93.8)	9.389	0.001
No	18 (27.7)	4 (6.2)		
P6				
Yes	49 (75.4)	61 (93.8)	7.562	0.004
No	16 (24.6)	4 (6.2)		
P7				

Yes	47 (72.3)	63 (96.9)	12.500	0.000
No	18 (27.7)	2 (3.1)		
P8				
Yes	35 (53.8)	63 (96.9)	24.300	0.000
No	30 (46.2)	2 (3.1)		
P9				
Yes	63 (96.9)	64 (98.5)	0.000	1.000
No	2 (3.1)	1 (1.5)		
P10				
Yes	57 (87.7)	60 (92.3)	0.444	0.508
No	8 (12.3)	5 (7.7)		
P11				
Yes	55 (84.6)	57 (87.7)	0.071	0.791
No	10 (15.4)	8 (12.3)		
P12				
Yes	37 (56.9)	55 (84.6)	11.115	0.001
No	28 (43.1)	10 (15.4)		
P13				
Yes	34 (52.3)	56 (86.2)	18.375	0.000
No	31 (47.7)	9 (13.8)		
P14				
Yes	26 (40.0)	57 (87.7)	27.273	0.000
No	39 (60.0)	8 (12.3)		
P15				
Yes	44 (67.7)	60 (92.3)	12.500	0.000
No	21 (32.3)	5 (7.7)		
P16				
Yes	45 (69.2)	63 (96.9)	16.056	0.000
No	20 (30.8)	2 (3.1)		
P17				
Yes	41 (63.1)	61 (93.8)	16.409	0.000
No	24 (36.9)	4 (6.2)		

Source: Prepared by the authors (2021). \*McNemar's exact test.

Due to the methodological heterogeneity, it is a fact that most studies suggest a possible association between the SEA teacher's lack of knowledge about ASD and the lack of continued training aimed at this audience, demonstrating that the difficulties in using practices based on evidence can negatively impact the learning of students with Autism Spectrum Disorder.

Also, the importance of discussing the limitations of this study is highlighted, given that as it is unprecedented research, whose collection instrument was authored by the researchers, and the incipience of studies on this topic and validated questionnaires, the comparison of results with the current literature available was hampered. Furthermore, the research has a quantitative approach and, according to Novaes, Passos, and Gonçalves (2022); and Gathi (2004), there is little tradition of using this approach in the field of educational research. Therefore, the development of new studies on this topic is suggested, as well as the validation of collection instruments aimed at the population analyzed.

## FINAL CONSIDERATIONS

By outlining the professional profile of the SEA teacher who works in schools in the state network of Pernambuco do *Vale do São Francisco* and identifying knowledge gaps, as well as beliefs and

knowledge regarding the clinical characteristics of ASD, this study points to a probable compromise in the quality of education offered to students with this disorder in the region. Because they are unaware of the clinical manifestations of ASD that interfere with the neural mechanisms of learning, the teachers have difficulties in carrying out assessments aimed at each neurodiverse student and in developing an individual development plan with specific objectives and appropriate methodologies, culminating in the proposal of strategies and ineffective pedagogical interventions.

Also, the results demonstrate a better percentage of use of SEA teachers' knowledge after the pedagogical intervention, offered as an update course on the topic. Therefore, the relevance and need for continuous training aimed at addressing gaps in knowledge on this topic stands out.

Although specific training can modify conceptions about ASD, they do not ensure a significant, long-term change in pedagogical intervention practices. We suggest the training be continued and permanent, with practical supervision that can assertively impact the learning results of this audience, transcending the school walls and favoring full inclusion in all spaces of society.

Therefore, it is important to reflect on teacher training within the undergraduate and postgraduate courses, regarding curricular reformulation. It is important to consider the addition of theoretical and practical content, supported by scientific evidence, that deals with ASD and the school, to provide the teacher with sufficient theoretical and practical skills to eliminate and/or reduce learning barriers for students with ASD.

SEA is a pedagogical activity regulated by official documents of inclusive public educational policy. Therefore, it is suggested that research, with a similar methodology to this study, be replicated in different regions of the country to obtain data, not only on training SEA teachers but about the knowledge and pedagogical practices of these teachers regarding ASD.

These data can assist in the implementation of public educational policies with a more equitable distribution of financial, material, and human resources and, especially, training aimed at Autism Spectrum Disorder. We also recommend future research aiming at a more in-depth analysis of the curricular matrix of university undergraduate courses, about inclusive education, so that gaps are identified, favoring curricular reformulation and, consequently, teacher training.

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**DECLARATION OF CONFLICT OF INTEREST**

The authors declare that there is no conflict of interest with this article.