

Development of a teacher training program for autism spectrum disorders: digital information possibilities

Desenvolvimento de um programa mediado por tecnologias digitais para a formação de professores sobre o transtorno do espectro do autismo: possibilidades da informação digital

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ABSTRACT

Objective: Continuing education focused on the inclusion of children with autism spectrum disorder (ASD) can contribute to better implementation of educational practices, and the use of online technologies is an alternative to increasing the number of specialized professionals. **Methods:** This study develops a distance teacher training program (DTTP) based on the previous research's identification of the essential requirements for training education professionals caring for children with ASD within a collaborative digital learning environment are used to facilitate learning techniques, strategies, and resources with the goal of fostering innovation; and tests and discusses the program's feasibility. **Results:** A total of 187 education professionals from a municipality in Brazil participated in this study and answered a structured questionnaire to collect information on practices, attitudes, and knowledge. Data were analyzed quantitatively to characterize the sample, and the answers were analyzed qualitatively using Nvivo coding assistance software and manual coding; key concepts were isolated, themes developed, and quotes were identified within the interview transcripts to illustrate data analysis. Data saturation was achieved through interviews to identify themes for the syllabus of the course. **Conclusion:** From the results and based on active learning methodologies to address real-world problems and promote practical and collaborative solutions to daily challenges with theoretical support, the DTTP was designed, and its application was conducted and evaluated.

Keywords: autism spectrum disorder; education, distance; technology; teacher training; social inclusion.

RESUMO

Objetivo: a educação continuada focada na inclusão de crianças com transtorno do espectro do autismo (TEA) pode contribuir para uma melhor implementação de práticas educacionais, e o uso de tecnologias on-line é uma alternativa para aumentar o número de profissionais especializados. **Método:** este estudo desenvolve um programa de formação à distância para professores (PFDP) baseado na identificação prévia dos requisitos essenciais para a capacitação de profissionais da educação que cuidam de crianças com TEA por meio de ambientes de aprendizagem digital colaborativos, que são utilizados para facilitar técnicas de aprendizagem, estratégias e recursos, com o objetivo de fomentar a inovação; testa e discute a viabilidade do programa. **Resultados:** um total de 187 profissionais da educação de um município no Brasil participaram deste estudo e responderam a um questionário estruturado para coletar informações sobre práticas, atitudes e conhecimentos. Os dados foram analisados quantitativamente para caracterizar a amostra, e as respostas foram analisadas qualitativamente usando o software de assistência à codificação Nvivo e codificação manual; conceitos-chave foram isolados, temas desenvolvidos e citações foram identificadas dentro das transcrições de entrevistas que facilitam a ilustração da análise de dados. A saturação de dados foi alcançada por meio de entrevistas para identificar temas para o currículo do curso. **Conclusão:** a partir dos resultados e com base em metodologias de aprendizagem ativa para abordar problemas do mundo real e promover soluções práticas e colaborativas para desafios diários com suporte teórico, o DTTP foi projetado, e sua aplicação conduzida e avaliada.

Palavras-chave: transtorno do espectro do autismo; educação a distância; tecnologia; formação de professores; inclusão social.

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INTRODUCTION

Autism spectrum disorder (ASD) is a neurological condition that affects social skills, communication, interaction, and behavior. Individuals with ASD exhibit restricted and repetitive patterns of behavior, interests, or activities.¹ According to the Centers for Disease Control and Prevention (CDC), the prevalence of autism in the United States is estimated to be 1 in 44 children.¹

In Brazil, the 1988 Constitution brought significant changes for individuals with disabilities. Special education became a responsibility of different levels of government, including the national government, states, federal districts, and municipalities.² Article 208, item III of the 1988 Constitution guarantees specialized educational assistance to individuals with disabilities, preferably within the regular school system.² People with ASD are legally recognized as having disabilities under Law No. 12.764/12.³

Recognizing the need for more effective educational practices for students with ASD, the Department of Specialized Modalities of Education within the Ministry of Education launched the “National Special Education Policy: Equitable, Inclusive, and Lifelong Learning – PNEE” in September 2020.⁴ This policy aims to guide students and their families in making informed decisions regarding the most appropriate choice for special education.

Regarding children with ASD, research in the literature has focused on inclusion, schooling, and social interactions within the school environment. It has identified the main challenges faced by education professionals with this population. These challenges include communication difficulties, a lack of knowledge about the characteristics of children with ASD, and a shortage of pedagogical strategies that support their learning process.^{5,6}

According to the 2018 Brazilian school census, only 5.4% of primary education teachers have received continuing education in special education.⁶ Additionally, studies have shown that teachers encounter significant challenges when it comes to including children with ASD, which directly impacts the education of these children.⁷⁻⁹

Therefore, considering the requirements of the PNEE and teachers' perceptions of the inclusion of students with special educational needs, such as children with ASD, specialized continuing education focused on effective inclusion could contribute to improved educational practices. Technology, particularly videoconferencing, offers a convenient alternative for delivering education and training to teachers, especially those in remote areas.

Thus, this study aims to identify the essential requirements for training education professionals to support children with ASD using videoconferencing technology. Additionally, the study discusses the feasibility and potential barriers associated with providing such training.

METHODS

Ethical approval was obtained from the authors' institution. Informed consent was obtained before participation

in the study. Participants were informed that refusal to participate would not affect their work status within their school. The local municipal Department of Education supported the entire project.

This study was approved by the relevant ethics committee and research committee (CAAE 30747620.9.0000.5373).

Study Design and Population

This cross-sectional study was carried out with 187 education professionals, including 107 mainstream classroom teachers (MCTs), 27 specialized educational service teachers (SESTs), 45 municipal school principals (MSPs), and eight professionals from the Special Education Division of the local municipality (PSEDs), with an average age of 40.6 years (92% female).

The criteria for inclusion were that participants had to be professional educators working in the local municipality and had to have provided valid informed consent before any study procedure. The data were collected between September and December 2020.

Procedures

Participants completed a questionnaire assessing their age, sex, educational experience, and prior experience working with children with special needs, taken from a study: School for all: experiences of municipal public schools with inclusion of students with disabilities, ASD, GDD, and high ability/giftedness.¹⁰ The study authors allowed the use of these questionnaires.

The items were multiple-choice and open-ended questions. The questionnaire was converted using Microsoft Forms, and a restricted-access link was generated, respecting data protection laws and the provisions of the National Health Council resolution CNS 466/12. The Microsoft Forms link was sent to participants by email and could be accessed using an electronic device (tablet, computer, cell phone, etc.).

Data Analysis

The data analysis process involved a combination of quantitative and qualitative methods to characterize the sample, identify themes, and develop a training course for teachers working with children with Autism Spectrum Disorder. The following are the steps:

Data Collection: Participants completed a questionnaire assessing their age, sex, educational experience, and prior experience working with children with special needs. The questionnaire was converted into Microsoft Forms and sent to participants via email.

Quantitative Analysis: To characterize the sample, descriptive analysis was conducted using frequency, percentage, and mean data.

Qualitative Analysis: The interview transcripts were analyzed using Nvivo coding assistance software and manual coding. Key concepts were isolated, themes were developed, and quotes were identified within the interview transcripts.

Data Saturation: Data saturation was achieved through interviews to identify themes for the syllabus of the course.

Thematic Analysis: Thematic categories were developed based on each question, and all participants' responses were



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considered thematic elements. Themes were determined according to the frequency of responses referencing a given thematic element.

Construction of the Training Course: Based on the results obtained from the perceptions of the various local actors involved in this process, a training course was created to meet the needs of this group of teachers.

RESULTS

Quantitative Analysis Results

Table 1 shows the sample's demographic characteristics:

MCTs comprise 57.3% of the total, SESTs 14.4%, MSPs 24%, and PSEDs 4.3%.

Most teachers (73%) were involved in regular education, with initial training in pedagogy. Those involved in regular education reported encountering inclusive and special education content in their initial training. Most MSPs (63%) reported having encountered content related to inclusive and special education during their initial training, albeit superficially.

Most education professionals generally had more than ten years of experience: 52% for MCTs and 80% for SESTs.

Table 1. Participants' demographic data

Characteristics	Professional				
	Mainstream classroom teachers (MCT) N 107 (57,3%)	Specialized educational service teachers (SEST) N 27 (14,4%)	Municipal school principals (MSP) N 45 (24%)	Professionals from the Special Education Division (PSED) N 8 (4,3%)	
Highest educational level achieved	Graduate	17 (19%)	0	5 (12%)	100% (8)
	Post-graduate	66 (73%)	22 (88%)	30 (70%)	0
	Master's degree	5 (5%)	2 (8%)	3 (7%)	0
	No answer	3%	4%	2%	
	Doctoral Degree	0	0	4 (9%)	0
Area of initial formation	Pedagogy	77 (85%)	21 (84%)	26 (60%)	0
	Degree (higher education)	11 (12%)	3 (12%)	5 (12%)	0
	Other	3 (3%)	1 (4%)	11 (26%)	100% (8)
	No answer			2%	
Received formal training in special education during the initial formation	Yes, but superficially	68 (75%)	22 (88%)	27 (63%)	2 (25%)
	Yes, and I consider it appropriate	12 (13%)	3 (12%)	2 (5%)	6 (75%)
	No	9 (10%)	0	12 (29%)	0
	No answer	2%			
Training in special-needs education ***	Lecture/ seminar/congress	24 (26%)	0	17 (40%)	
	Extension course/technical orientation	9 (10%)	0	5 (12%)	
	Post-graduate/latu sensu	43 (48%)	22 (88%)	16 (38%)	
	No	8 (9%)	0	2 (5%)	
	Other	0	3 (12%)	2 (5%)	
Working experience***	Up to 2 years	4 (4%)	1 (4%)	0	
	From 2 to 10 years	39 (43%)	4 (16%)	2 (5%)	
	More than 10 years	47 (52%)	20 (80%)	39 (91%)	
	No answer			5%	
Have or had students with autism spectrum disorder	Yes, currently and in the past	35 (38%)	22 (88%)	33 (79%)	
	Do not know	1 (1%)	0	1 (2%)	
	Yes, currently	16 (18%)	3 (12%)	3 (7%)	
	Yes, in the past	33 (36%)	0	3 (7%)	
	No	6 (7%)	0	2 (5%)	

Continua



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Participation and completion of any training course in inclusive education/special education offered by the Ministry of Education	No	76 (84%)	13 (52%)
	Yes	14 (15%)	6 (24%)
	Do not know or have no answer	1 (1%)	6 (24%)
Does the presence of students with ASD influence your class planning?	No answer	1%	
	Yes	74 (81%)	21 (95%)
	No	14 (16%)	1 (5%)
	Do not know	2 (2%)	0

Source: Authors data.

Qualitative Analysis Results

Before categorizing the corpus, the frequencies of individually coded data excerpts, indicated by themes, were determined (function words omitted). The distribution of themes by category presented 382 coded excerpts, and the distribution of sources/interviewees was as follows: 25 MSTs, 8 SESTs, 84 MSPs, and 20 PSDEs. Before categorizing the corpus, the frequencies of individually coded data excerpts indicated by themes were determined (function words omitted). The distribution of themes by category presented 382 coded excerpts: 25 MSTs, 8 SESTs, 84 MSPs, and 20 PSDEs.

Based on participants' responses, the program identifies the major contributors to themes related to teaching and learning about ASD. MSP 28 accounted for 43% of excerpts on this topic, increasing education professionals' knowledge about ASD, with MSP 19 contributing 37%. MCT6 accounted for 34% of textual references, and MCT 28 for 33%. The discussion section presents excerpts illustrating possible themes related to increasing ASD knowledge in teaching and learning processes.

Appendices A, B, and C show excerpts from interviewees related to knowledge, attitudes, and practices for in-school care for children with ASD. Interviewees focused on the social context and the panorama of schooling children with ASD in the local municipality. The site of care exists in a social context, influencing interviewees' knowledge about ASD and the specific demands of thematic courses and training. Family participation is a relevant channel supporting child development (Appendix A).

Appendix C contains excerpts about practices for monitoring, controlling, evaluating, and developing children with ASD. The adoption of materials, methods, and technological resources contributes to multidisciplinary work. Family participation supports diagnosis and development, with the social context influencing choices and views.

From participants' full speech data, relevant and most-cited words (count, percentage, similar terms) seen in the tag cloud (Appendix D) were adopted as themes. Appendix E shows the similarity index of words mentioned by participant pairs using the Pearson correlation coefficient. Results show strong relationships among MCT 53, SEST 11, MSP 19, MCT 18, MCT 92, MCT 77, and MCT 63. This aids in analyzing data saturation in each category and subcategory.

The analysis produces a tree with excerpts from representative interviews, providing elements for possible themes and subthemes related to training care for children with ASD. Appendices F, G, and H show the most representative sections of SESTs, MCTs, and MSPs, respectively. These analyses support the construction of the teacher training program by highlighting essential content for the special education of children with ASD.

Training Program Construction Theoretical Approach

The Distance Teacher Training Program (DTTP) focuses on active learning methodologies to address real-world issues. The program takes an interdisciplinary approach to working with students with ASD and promotes practical and collaborative problem-solving through data analysis.

Reflective practice is a key component of adult learning in the active learning method. It involves reflecting on problem-solving experiences, evaluating technical performance, and considering emotions and reactions. Group discussions are conducted through discussion forums, allowing participants to leverage their existing knowledge and anchor new information.

The DTTP is based on three theoretical principles: social theories of learning, reflection-change models, and concepts from Paulo Freire's theories on education.

1. Social theories of learning emphasize the importance of context and community.^{11,12} Etienne Wenger highlights the role of communities of practice in guiding and supporting learners.¹³

2. Reflection-change models posit that reflection leads to action, which brings about changes. Deliberate practice, incorporating reflection and feedback, helps educators foster autonomous learning in students.^{14,15}

3. Education from Freire's theories promotes an active, dialogical approach that encourages social and political responsibility. The aim is to raise awareness, facilitate liberation, and empower individuals to become agents of societal transformation.¹⁶

The DTTP is designed as an online platform for participants to reflect on their teaching practices. It enables self-evaluation of implicit theories,¹⁷ working methods, and attitudes. Educational strategies facilitate interactions and the exchange of experiences and knowledge among teams of teachers.



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Acquiring scientific, didactic, and psycho-pedagogical knowledge is central to the training process. Critical reflection on contextualized practices forms the foundation for developing a deep understanding of effective teaching practices.

Physical Structure

On the basis of the results of the NVivo 11 analysis and the theoretical approach, the DTTP was elaborated in five modules with a total workload of 80 hours. The structure of the DTTP modules focuses on the themes and subthemes highlighted in the qualitative analysis: 1) philosophical aspects of inclusive education, rights of children with autism, and general concepts related to ASD (definition, early signs, etiology, diagnosis, comorbidity, and treatments); 2) aspects of school mediation and pedagogical activities that can impact the development of autistic children; 3) occupational therapy and ASD; 4) aspects of behavioral analysis at school and management of complex behaviors; and 5) how to address epileptic seizures, multidisciplinary assessment of children with ASD, and pedagogical resources used in the education of children with ASD.

Each module has specific activities within each theme. Each theme contains texts or study guides and a discussion forum with guiding questions/situations accompanied by problematizations informed by our discussions with the interviewees. Learners can perform the activities asynchronously. Tutors can be deployed for mediation to raise and maintain discussions between participants. Finally, five fortnightly discussion forums are created to consider problems related to the respective themes.

To provide additional support for the teacher during the DTTP, other methods used include (a) instructional videos, (b) forums for exchanging experiences between people involved in the care of students with ASD at school, (c) creation of a library with materials and current studies on ASD (and) discussion forums with targeted themes, and (d) educational material construction activity on themes of educational praxis for ASD. The model proposed by Taylor and Hamdy⁹, the expanded adult learning model, was considered.

During the refinement and consolidation phase, which is the final one, the learner seeks several possible explanations or solutions to a problem (elaboration) and refines the new information into a series of concepts through completing tasks, research, reflection, and discussion. The final activity of the course is as follows: five groups of participants are created, each developing materials to be distributed in the municipal education network with one of the following themes: (1) how teachers can identify symptoms of ASD; (2) how to manage complex behaviors of autistic patients in school; (3) how to approach patients with epilepsy and epileptic seizures at school; (4) building a folder with resources that teachers can use for students with ASD; and (5) building didactic material on school inclusion of children with ASD in the local municipality, legal aspects, access, and how to help parents.

DISCUSSION

This study aimed to identify essential requirements for training education professionals caring for children with ASD using videoconferencing technology. The qualitative analysis made it possible to create a DTTP based on professionals' perspectives.

Thematic content should relate to learning conditions and explicitly address ASD characteristics. Based on active learning methodologies, this training focuses on teachers' critical reflection on contextualized practices, aiming to represent real-world issues and promote practical and collaborative solutions to daily challenges.

Reflective practice encourages teachers to explore their methods, uncovering new ways to understand theory and concepts that guide their work, allowing reconstruction. A transdisciplinary teacher training program can improve participants' contact with evidence-based therapeutic practices, enhancing learning and behavior, especially in developing countries with limited access to these professionals.

Brazilian special education policy guarantees students access to regular education; however, effective school inclusion is still lacking despite subsidies to strengthen teachers' work¹⁸. Fuller and Clarke noted that standardizing school inclusion policies often fails, disregarding local contexts and students' stories. The shift from specialized education to inclusive education values heterogeneity and individual coexistence, significantly impacting pedagogical practices.¹⁹

New demands challenge teachers' initial and continuing education, highlighting the need for frameworks and practices supporting inclusive education for children with ASD. Beyond understanding ASD characteristics, training should foster social attitudes toward inclusion. Local municipalities have structured various training strategies, including partnerships with universities and specialized service teachers.²⁰⁻²²

Survey responses indicated that regular classroom teachers, principals, and coordinators had participated in specific inclusive education training but cited low availability and frequency of such activities.²³ Many emphasized the need to innovate and adapt to individual student needs, with experience in special education fostering more capable professionals.

Inclusion in schools implies democratizing social spaces, providing better opportunities and conditions for students with disabilities. Promoting special education requires creating conditions for teachers to transform their spaces into investigative and self-training environments. Leveraging technology for teacher training through face-to-face and online initiatives can enhance interactions and knowledge exchange among teachers.

Reflexivity in teaching practices allows for reconstruction and better responses to daily challenges. Initial and continuing education is crucial for effective pedagogical practice, enabling children with ASD to reach their potential. These actions should involve support from various actors and public policies characterized by theoretical and practical training, fostering an environment that values diversity and respects differences.²⁴



CONCLUSIONS

Our findings suggest that the DTTP, developed from the perspective of teachers engaged in the difficulties of providing education for children with ASD in Brazil, is an educational possibility for strengthening inclusive education policies.

These strategies would allow for a greater scope of action and the organization of a learning network between teams of technicians and teachers. There would be interactions and exchanges of experiences and knowledge between schools and improvements in skills to increase quality. In this way, the process of including schoolchildren with ASD in regular education would be enabled and optimized.

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