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Structural and functional analysis of the models of professional training of teachers to work with technologies for the development of educational abilities of children with ASD in the BRICS countries

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Abstract

The increasing global prevalence of Autism Spectrum Disorders (ASD) necessitates equipping educators with specialized skills, a challenge acutely faced by the socio-economically diverse BRICS nations in their pursuit of inclusive education. The purpose of this study is to conduct a structural and functional analysis of the models of professional training for teachers working with children with ASD in the BRICS countries. The main objectives are to identify the core approaches, shared strategies, and country-specific adaptations of the above-mentioned models and to compare them within the inclusive education frameworks. Employing a qualitative comparative case study design underpinned by Bronfenbrenner's ecological systems theory, the study analyzes policy documents and scholarly literature (2015–2023) to examine interactions across macro-, exo-, meso-, and micro-systemic levels. Findings reveal significant disparities in policy implementation, resource allocation, and cultural adaptation mechanisms. A pervasive policy-practice gap, a pronounced urban-rural training divide, and divergent efficacy in localizing imported models were identified as cross-national patterns. Common systemic constraints include a deficit in integrating evidence-based practices, a critical shortage of diagnostic services, and fragmented collaborative linkages between universities and schools. The study's novelty lies in its holistic, multi-level comparative analysis, which moves beyond isolated national case studies to reveal interconnected systemic barriers and leverage points across the BRICS bloc, offering a synthesized perspective on teacher preparation for inclusive education. Future research should pilot integrated digital platforms to mitigate resource disparities and develop scalable, culturally adaptive training modules tailored to specific national contexts within the alliance.

Keywords: professional training, educators, autism spectrum disorders, inclusive education, BRICS countries.

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Introduction

In today's world, inclusive education has become increasingly critical, necessitating quality professional training for teachers working with children with special educational needs, including autism spectrum disorders (ASD). The relevance of this issue is particularly acute in BRICS nations – rapidly developing economies with diverse populations that face unique challenges in creating inclusive learning environments (Abilova, 2025; Nigmatullina et al., 2024).

The Dakar Framework for Education for All, adopted at the World Education Forum in 2000, established fundamental principles for meeting children's basic learning needs through international cooperation (UNESCO, 2000). BRICS countries have since prioritized educational quality in their reform agendas, focusing on access equality, quality improvement, and student exchange programs (BRICS Summit, 2024). However, as recent studies indicate, professional training for ASD educators in these nations remains under-researched, with existing literature often overlooking this specific aspect of inclusive education (Nigmatullina et al., 2024; Pillay et al., 2022).

Despite the growing interest in inclusive education in the countries, the issues of professional training of teachers to work with children with ASD remain insufficiently studied. Currently, the accumulation of existing experience in this area, adaptation of models to the specifics of socio-cultural and educational contexts requires in-depth analysis and development of approaches (Nigmatullina et al., 2024).

The complexity of ASD teacher training systems within nations necessitates a theoretical framework capable of accounting for multiple interacting levels of influence. This study employs Bronfenbrenner's ecological systems theory as a guiding lens to examine how microsystem (classroom, teacher competencies), mesosystem (school-university partnerships), exosystem (national policy), and macrosystem (cultural attitudes) factors collectively shape the efficacy of professional development models across diverse national contexts (Guy-Evans, 2020).

Purpose and objectives of the study

The purpose of this study is to conduct a structural and functional analysis of the models of professional training for teachers working with children with ASD in the BRICS countries. The main objectives are to identify the core approaches, shared strategies, and country-specific adaptations of the above-mentioned models and to compare them within the inclusive education frameworks.

Literature review

The effectiveness of educators working with children with Autism Spectrum Disorders (ASD) hinges on a sophisticated blend of theoretical knowledge and practical skills, a concept central to the competence-based approach (Alexander et al., 2015). Stobbe (2009) defines professional competence not merely as a set of knowledge and skills, but as a systemic manifestation that allows a specialist to successfully solve functional tasks, integrating personal attitude and practical experience. This foundational understanding is operationalized through various training models. The personality-oriented and interdisciplinary approaches, as highlighted by Leonova (2021) and Bekirova (2023), emphasize individualized learning and collaboration between specialists from different fields, which is crucial for addressing the complex needs of children with ASD. Furthermore, the integrated approach (Tachibana et al., 2017) and modular competency framework (Nigmatullina et al., 2024) provide the flexibility and comprehensive understanding necessary for developing tailored educational strategies. These theoretical underpinnings are not merely academic; they form the essential bedrock for designing effective teacher training programs, yet their implementation varies dramatically across different national contexts.

The professional preparation of educators to work with children with Autism Spectrum Disorders (ASD) is a critical area of educational research, with several models proposed to structure this training effectively. These models vary in their structural components, theoretical foundations, and practical applications, yet share a common goal: to equip teachers with the competencies necessary to support the diverse needs of learners with ASD.

One prominent approach is the structural-functional model, which emphasizes a systematic organization of training components to achieve specific educational outcomes. For instance, Sharifzyanova et al. (2015) developed a structural-functional model for designing individual educational paths for teachers' professional development within an informational educational environment. This model comprises three core units: conceptual, technological, and assessment-effective. The conceptual block includes principles such as advanced training, professional and personal self-development, and individualization. The technological unit involves a stepwise algorithm for designing individual learning paths, incorporating both

invariant and variable modules (e.g., profiling, internships, post-cycle development). The assessment-effective unit evaluates the formation of teacher competencies and the effectiveness of training organized within the informational educational environment. This model highlights the importance of integrating information and communication technologies (ICT) to support personalized and competency-based teacher development.

Another significant contribution is the comprehensive support model proposed by Nigmatullina et al. (2021), which focuses on interdisciplinary collaboration among medical, psychological, and pedagogical specialists. This model is structured across three levels of interaction: federal, regional, and institutional. At the federal level, collaboration involves research institutes and federal resource centers; at the regional level, district services and support centers; and at the institutional level, kindergartens, resource centers, and medical organizations. The model emphasizes early diagnosis, individualized educational routes, and the use of evidence-based practices, such as applied behavior analysis (ABA), to address the complex needs of children with ASD. It also incorporates parent training and continuous professional development for educators, ensuring a holistic approach to support.

Additionally, Nigmatullina and Tvardovskaya (2020) presented a structural-functional model for supporting preschoolers with ASD within a consortium of scientific and educational organizations. This model integrates multiple structural units, including a resource center for children with disabilities, university departments, a scientific and clinical center, and a kindergarten. The model outlines four key functions: diagnostic, correctional-developmental, consultative, and educational. Each function is operationalized through specific activities, such as developing adaptive educational programs, conducting applied research, providing supervision, and organizing training for specialists and parents. The model underscores the importance of interagency collaboration and the use of innovative technologies to enhance the quality of education and socialization for children with ASD.

Folostina et al. (2022) highlighted the training needs model based on a cross-sectional study in Romania and Greece. Their research identified significant gaps in teachers' knowledge regarding ASD symptoms, behavior management, communication strategies, and innovative teaching technologies. The study advocates for a tailored training model that includes e-learning platforms, continuous professional development, and practical, hands-on experiences. This model stresses the importance of addressing both declarative and procedural knowledge through structured, accessible, and contextually relevant training programs.

In summary, existing models of teacher preparation for working with children with ASD share a focus on structured, multi-level approaches that integrate theoretical knowledge with practical skills. They emphasize individualization, interdisciplinary collaboration, and the use of technology to enhance training effectiveness. However, these models often operate in isolation, and there remains a need for a unified framework that can be adapted across diverse educational contexts to ensure consistent and comprehensive teacher preparation.

Methodology

This study is grounded in Bronfenbrenner's ecological systems theory, which posits that human development (and, by extension, the effectiveness of professional training systems) is shaped by a complex interplay of multiple environmental levels. This framework provides an ideal lens for a cross-national analysis, as it allows for the systematic examination of how factors at different levels – from broad national policy to immediate classroom practice – interact to shape ASD teacher training models. Guided by this theory, we adopted a qualitative comparative case study design to examine the structural and functional characteristics of these training systems across the five BRICS nations. Our investigation specifically focused on analyzing the interaction between factors at different ecological levels: macrosystem (national policies, cultural norms), exosystem (regional resource allocation, institutional structures), mesosystem (university-school partnerships, inter-agency collaboration), and microsystem (curricular content, teaching practices, educator competencies) (Guy-Evans, 2020).

Data Collection and Sources

Data were drawn from two complementary sources to capture these multi-level interactions (2015–2023):

Scholarly Literature: peer-reviewed articles, book chapters, and conference proceedings from major databases (Scopus, Web of Science, PubMed, ERIC, eLIBRARY.ru, CNKI), identified using targeted keywords related to ASD teacher preparation and inclusive education in BRICS contexts.

Policy Documents: National and sub-national legislation, ministerial directives, national action plans, and official reports from government education agencies and recognized NGOs. Documents were sourced from official government portals, UN/UNESCO repositories, and reputable institutional websites.

Results

The BRICS Context: A Nexus of Promise and Disparity in Inclusive Education

The BRICS alliance, with its commitment to sovereign equality and openness (Abilova, 2025), presents a unique platform for educational cooperation. The Kazan Declaration (2024) explicitly prioritizes the development of continuous professional education and digital training, outlining a shared vision for the future. However, a stark contrast exists between this collaborative vision and the fragmented on-the-ground reality of ASD teacher training across member states. Existing research reveals a collection of deep, yet isolated, national challenges rather than a synthesized body of knowledge. In Brazil, studies by Pasian et al. (2017), Nunes and Schmidt (2019), and Rocha et al. (2021) consistently document a critical gap between policy (e.g., Technical Note 24/2013) and practice, where teachers lack adequate preparation and struggle to apply evidence-based practices (EBP) in inclusive classrooms. Russia has developed a more centralized, interagency model centered around Regional Resource Centers (RRCs), yet as Nigmatullina et al. (2022) point out, its efficacy is hampered by jurisdictional conflicts between federal and regional authorities, hindering coordination with universities.

Moving to Asia, India's community-driven Autism Intervention Training Programme (AITP) demonstrates the remarkable efficacy of transdisciplinary, NGO-partnered models, achieving high satisfaction rates (Duggal et al., 2020). However, its potential is severely limited by its inability to scale beyond urban centers due to infrastructural deficits and a crippling shortage of trainers in remote areas, a gap highlighted by Sambasivan (2023). China's situation is characterized by internal disparity. While Hong Kong employs a sophisticated tiered-support model and professional certification pathway (PDP (CDLN)) that shows high efficacy (Ho, 2022; Tat et al., 2015), mainland China's "Learning in Regular Classrooms" (LRC) model suffers from inconsistent institutional capacity and a vast urban-rural expertise divide, leaving many educators without essential ASD-specific skills (Han, 2022). In South Africa, the research of Pillay et al. (2022) and Zeleke et al. (2021) identifies a different set of obstacles: a profound lack of public awareness, severe shortages in diagnostic services, and the consequent reality of teachers managing undiagnosed children without support. While innovative, culturally adaptive pedagogies show promise, they are stifled by weak policy implementation and a lack of mandatory ASD competencies in national certification.

Identifying the Critical Gap: From Isolated Analysis to Integrated, Actionable Solutions

The prevailing trend in the current literature is its siloed nature. Studies provide deep, valuable analyses of individual BRICS countries but fail to engage in a systematic *comparative* analysis that can identify transnational patterns, shared challenges, and transferable solutions. This creates a significant knowledge

gap. We know the individual problems well, but we lack a framework to synthesize this knowledge for the benefit of the entire bloc. Furthermore, while the Kazan Declaration (2024) and scholars like Viter (2021) champion digital cooperation and innovation hubs, no research has yet explored how technology could be leveraged to bridge the identified resource and accessibility gaps, particularly for rural educators in India, China, and South Africa. Similarly, the successful cultural adaptation efforts in South Africa (Zeleke et al., 2021) remain an isolated case study rather than a model for a broader BRICS-wide cultural adaptation framework.

Positioning Our Contribution: Closing the Gap with a Structural-Functional Analysis

The prevailing siloed nature of the literature can be theorized as a focus on isolated levels of what Bronfenbrenner's ecological model would term a larger ecosystem. Studies tend to examine either exosystemic policy directives (Guy-Evans, 2020; Nigmatullina et al., 2022; Pasian et al., 2017) or microsystemic classroom practices and competencies (Alexander et al., 2015; Stobbe, 2009), without accounting for their interconnectedness. The critical gap, therefore, is not merely a lack of comparison, but a lack of a unifying theoretical framework that can analyze how these levels – micro (teacher), meso (institutional), exo (policy), and macro (cultural) – interact to enable or constrain effective ASD teacher training across the BRICS nations. This theoretical deficit impedes the development of holistic and transferable solutions.

Thus, the existing body of literature provides a deep, yet fragmented analysis of national contexts. A critical gap remains in the lack of a systematic comparative analysis that could identify transnational patterns, shared challenges, and transferable solutions across the BRICS bloc. Furthermore, while the potential for digital cooperation and cultural adaptation frameworks is acknowledged (Kazan Declaration, 2024; Viter, 2021; Zeleke et al., 2021), these possibilities remain largely unexplored in a synthesized, cross-national context.

Our comparative analysis, structured through Bronfenbrenner's ecological framework, reveals not just national disparities but three overarching, cross-cutting patterns that define the landscape of ASD teacher training across BRICS nations. These patterns emerged from a synthesis of data across all five countries, highlighting systemic challenges and opportunities.

1) The Policy-Practice Chasm: A Universal Disconnect

The analysis revealed a universal adaptation strategy aimed at implementing policies, which, however, results in a significant gap between design and classroom practice. This disjuncture manifests through

different approaches: a fragmented adoption of evidence-based practices (EBP) in Brazil despite existing guidelines; jurisdictional conflicts undermining the centralized strategy of Russia's Regional Resource Centres (RRCs); and provincial inertias hindering the implementation of South Africa's progressive policy approach.

2) The Urban-Rural Dichotomy: Infrastructure as a Determinant

The analysis of national strategies unequivocally identifies a common approach to resource allocation that prioritizes urban centers, making geographic equity a primary determinant of training accessibility. The data contrast highly effective but geographically confined models (exemplified by India's urban-centric AITP strategy and Hong Kong's tiered certification approach) against the severe deficits in rural reach. This strategic choice creates a two-tiered system within nations, where the approaches used in India and mainland China systematically exclude rural educators from quality training due to infrastructural constraints, a disparity less pronounced in more urbanized or centrally-planned contexts like Russia.

3) Cultural Adaptation vs. Standardized Import: A Spectrum of Efficacy

Our findings place national adaptation strategies on a spectrum of efficacy based on cultural contextualization. On the other, localized adaptation strategies – such as South Africa's recontextualization of DSM-V criteria using culturally relevant referents – prove significantly more effective in practitioner uptake and implementation. India's AITP, though successful, represents a middle ground; its community-based design is an inherent localization strategy yet lacks a formalized mechanism for cultural adaptation that could be scaled nationally or across BRICS.

Convergent Systemic Constraints

Furthermore, the comparative analysis revealed that despite their differing approaches, all national systems struggle to develop effective strategies to overcome three universal constraints:

EBP Integration Deficit: A universal struggle to seamlessly embed evidence-based interventions into core curricula and teaching practices.

Diagnostic-Capacity Mismatch: A critical shortage of diagnostic services forces educators to manage undiagnosed learners, demanding skills far beyond standard pedagogical training.

Collaborative Fragmentation: A consistent weakness in mesosystem linkages, particularly between universities (training providers) and schools (training implementers), impeding the flow of knowledge and support.

Discussion

The comparative analysis reveals three critical patterns shaping ASD teacher training efficacy across BRICS:

1) Divergent Policy Approaches and Implementation Strategies. The study identifies a spectrum of policy approaches, from Russia's standardized framework to more fragmented regulatory landscapes in Brazil and South Africa. The strategy of centralized control in Russia enhances consistency, whereas the decentralized adaptations in other contexts lead to a significant implementation disjuncture (Pasian et al., 2017).

2) Cultural Mediation Imperative. South Africa's DSM-V contextualization model demonstrates higher intervention efficacy than direct Western imports (Zeleke et al., 2021), highlighting the necessity of sociocultural adaptation. India's community-based AITP similarly succeeds through localized NGO partnerships but struggles with rural scalability.

3) Resource Stratification. China's tiered support model achieves satisfaction in Hong Kong yet reaches rural educators (Ho, 2022). This mirrors India's urban-rural training gap and reflects broader BRICS inequities in infrastructure investment.

Conclusion

In conclusion, our comparative structural-functional analysis has successfully identified and contrasted the core approaches, shared strategies, and country-specific adaptations in ASD teacher training across the BRICS nations. The key findings can be summarized as three pillars essential for future development:

Harmonizing regulatory approaches to ensure coherence and bridge the policy-practice gap, as seen in the challenges of Brazil and South Africa versus the more standardized Russian framework;

Promoting culturally adaptive strategies to increase intervention relevance and practitioner uptake, moving beyond direct importation of Western models towards localized solutions exemplified by South Africa's DSM-V contextualization;

Developing shared digital strategies to mitigate resource disparities and urban-rural divides, leveraging technology to scale successful but geographically confined models like India's AITP.

Bronfenbrenner's ecological systems theory provides a powerful framework for interpreting these findings, highlighting how the identified challenges – fragmented policies (exosystem), insufficient school-university collaboration (mesosystem), and inadequate teacher preparation (microsystem) – are fundamentally interconnected (Guy-Evans, 2020). Consequently, addressing these issues requires integrated strategies that simultaneously target all systemic levels to establish a coherent support ecosystem for both educators and children with ASD. This comprehensive approach ultimately aims to enhance pedagogical competencies and promote educational equity for children with ASD within demographically significant and rapidly developing regions.

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