

The Impact of Personalized Learning and Adaptive Technologies on Learners with Autism Spectrum Disorders in the Buea Municipality"**FRIDA NALOVAH MOLONGE (PhD.)**

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Abstract

Learners with Autism Spectrum Disorder (ASD) often face challenges in traditional educational settings due to differences in communication, social interaction, and learning styles. The study examined the impact of personalized learning and adaptive technologies on the education of learners with ASD in the Buea Municipality. Using a mixed-methods approach, data was collected from teachers and administrators, using questionnaires and interview guide. It explores how personalized learning strategies, such as individualized lesson plans and assistive communication tools, enhance student engagement, comprehension, and overall academic performance. Additionally, the study evaluates the effectiveness of adaptive technologies, including Augmentative and Alternative Communication (AAC) devices, virtual learning platforms, and sensory-friendly tools, in improving learning experiences for students with ASD. Findings from this study, provides an insight into the benefits, challenges, and future opportunities for integrating these educational approaches in schools within the Buea Municipality. The study has contributed to policy recommendations for inclusive education and the adoption of technology-driven learning solutions for learners with ASD.

keywords: *Autism Spectrum Disorder (ASD), Personalized Learning, Adaptive Technologies, Inclusive Education*

Background to the study

Autism Spectrum Disorder (ASD) is a neurodevelopmental condition characterized by challenges in social interaction, communication, and repetitive behaviors. Globally, approximately 1% of individuals are affected by ASD (World Health Organization (WHO), 2023), with significant variations across different regions (Elsabbagh et al., 2012; Fombonne, 2009). This prevalent rate of autism spectrum disorder has been rising, prompting increased attention to inclusive education strategies that cater to the unique needs of learners with ASD (American Psychiatric Association, 2013). In Cameroon, and specifically within the Buea Municipality, there is a growing recognition of the importance of integrating learners with ASD into mainstream educational settings. However, traditional teaching methodologies often fall short in addressing the diverse learning requirements of these learners.

In Cameroon, the prevalence of ASD is not well-documented, but growing awareness of the condition has led to a push for more inclusive education policies. According to a study by Nguetack-Tsague et al. (2020), despite efforts to integrate children with disabilities into mainstream classrooms, many educational institutions lack adequate resources, trained personnel, and teaching strategies to support children with ASD effectively. This is especially true in rural regions such as the Buea Municipality, where infrastructure and technological access remain significant barriers to inclusive education.

teaching approach to support learners with autism as it reduces learning barriers and allows for the integration of varied instructional methods, flexible content delivery, and individualized support (Pape, 2018). This method considers each learner's strengths, challenges, interests, pace, and preferences, thereby fostering engagement and improving learning outcomes (Kurniawati, 2020). When aligned with inclusive education practices, personalized learning ensures that students with diverse cognitive and behavioral profiles can fully participate in learning activities that are meaningful and accessible.

Assistive technologies encompass devices and services designed to enhance the functional capabilities of individuals with disabilities, thereby promoting their independence and participation (Dell, Newton, & Petroff, 2012). The historical development of such technology's traces back to innovations like Braille in the 19th century, progressing to modern tools such as speech-generating devices and specialized software (Cook & Hussey, 1995). In Cameroon, however, the availability and utilization of assistive technologies in educational settings are inconsistent. Research indicates that many schools in the Buea Municipality lack adequate assistive devices, adversely affecting the teaching and learning experiences of students with mental retardation (Besong, 2023).

Incorporating adaptive technologies, such as assistive communication devices, educational mobile applications, and sensory-friendly tools, has further enhanced the learning experience by providing interactive and accessible platforms for learners with ASD (Hussain et al., 2021). These technologies adapt to the learner's abilities and needs in real time, enabling them to access the curriculum more effectively and interact with peers and teachers (Hussain et al., 2021). According to Al-Azawei, Serenelli, and Lundqvist (2016), adaptive educational technologies have shown strong potential in improving motivation, engagement, and academic performance in neurodiverse learners, particularly those on the autism spectrum.

The integration of personalized learning strategies and adaptive technologies holds promise for enhancing educational outcomes for learners with ASD. Personalized learning tailors educational experiences to individual student needs, preferences, and strengths, fostering greater engagement and effectiveness. Adaptive technologies, including software and hardware solutions, adjust to the learning requirements of students, providing customized support that can lead to improved academic performance (Bryant & Bryant, 2011). However, implementing these approaches in low- and middle-income countries (LMICs) like Cameroon faces challenges such as limited access to digital resources, infrastructural constraints, and a shortage of trained personnel (Kumm, Viljoen, & de Vries, 2021).

In sub-Saharan Africa, and Cameroon in particular, the discourse around inclusive education has gained traction, driven by national commitments to the Sustainable Development Goal 4, which calls for "inclusive and equitable quality education for all" (UNESCO, 2017). The Cameroonian government has included provisions for inclusive education in its 2018–2022 National Inclusive Education Policy Framework. However, implementation remains inconsistent, especially in semi-urban and rural areas such as the Buea Municipality, where resource limitations, insufficient teacher training, and sociocultural misconceptions about disabilities hinder progress (Agbonlomen, 2023).

Within the Buea Municipality, there has been a gradual increase in awareness of neurodevelopmental disorders such as ASD. Still, most mainstream schools are inadequately equipped to meet the diverse needs of autistic learners. According to Fangwi (2024), many

Contextually, there is a strong need to examine how personalized learning approaches, supported by the use of adaptive technologies can enhance both academic achievement and social integration for learners with ASD in this area. For instance, many learners with ASD in Buea struggle to keep pace with the standardized curriculum, leading to increased dropout rates and social exclusion. Adaptive technologies such as picture exchange communication systems (PECS), audio-visual learning platforms, and sensory management tools could offer practical solutions to these challenges (Bryant & Bryant, 2011).

In the context of Buea, recent studies have explored innovative interventions to support learners with ASD. For instance, Fangwi (2024) examined the use of nature-expo therapy to enhance communication abilities among children with ASD in the municipality, highlighting the potential of alternative therapeutic approaches in educational settings. Despite these advancements, there remains a paucity of research focusing specifically on the integration of personalized learning strategies and adaptive technologies within the educational framework of Buea. Furthermore, evidence suggests that when learners with ASD are provided with personalized, technology-enhanced instruction, they demonstrate significant improvements in literacy, numeracy, communication, and peer engagement (Knight et al., 2015). However, such evidence has not been thoroughly documented in Cameroonian settings, leading to a critical research gap.

Research has shown that personalized learning can enhance engagement, motivation, and academic outcomes for students with ASD by providing them with a more flexible and responsive learning environment (Alvarez & Bejarano, 2019). As, in practice, personalized learning may involve creating Individualized Education Plans (IEPs), modifying classroom materials, and using differentiated teaching strategies. According to Pane et al. (2017), students in personalized learning environments tend to demonstrate improved academic achievement and engagement, especially when the instruction is student-centered and guided by data. In the context of ASD, personalization supports visual learning, structured routines, and task chunking, which align well with their learning preferences (Guldberg, 2010). Moreover, personalized learning empowers autonomy and helps reduce anxiety in ASD learners by providing predictable and structured learning environments (Kurniawati, 2020). It also supports social-emotional learning by integrating activities that develop communication and self-regulation.

Technological adaption (such as visual schedule apps, speech-generating devices (SGDs), interactive software, sensory-friendly tools, and virtual learning platforms), addresses key challenges experienced by individuals with ASD, including communication impairments, attention difficulties, and limited social interaction. For instance, Picture Exchange Communication Systems (PECS), mobile communication apps, and text-to-speech programs have proven effective in enhancing communication skills (Hussain et al., 2021). Similarly, video modeling, interactive games, and online simulations improve concept acquisition and behavioral adaptation (Knight et al., 2015). Importantly, adaptive technologies support inclusive education by leveling the playing field for students with ASD and reducing dependence on human mediators. They are especially relevant in under-resourced educational settings, such as the Buea Municipality, where specialized personnel may be lacking.

In cooperating personalized learning and adaptive technology into the educational system for learners with autism spectrum disorders will be of great advantage as it will not only enhance their learning but will improve on their social interaction and develop their confidence and self-esteem which will give them that freedom to integrate into the society with any prejudices.



significant challenges in accessing quality and inclusive learning opportunities. ASD is characterized by difficulties in communication, social interaction, and adaptive behavior, all of which hinder learners' ability to participate meaningfully in conventional classroom settings (American Psychiatric Association, 2013). In educational systems that are still largely standardized and rigid, the absence of personalized learning approaches and supportive adaptive technologies further marginalizes these learners. While studies from developed countries highlight the benefits of personalized learning and adaptive technologies in enhancing the academic and social development of children with ASD (Knight et al., 2015; Hussain et al., 2021), there remains a paucity of contextualized research in Sub-Saharan Africa, and particularly within Cameroonian schools. In Buea Municipality, most schools lack trained special educators, access to assistive tools, and structured programs tailored to meet the individual needs of ASD learners (Fangwi, 2024). As a result, these learners are often excluded from classroom activities, labeled as "slow" or "unfit" for school, and denied the interventions necessary for meaningful progress.

Furthermore, there is a significant gap in the understanding and application of inclusive teaching strategies that leverage adaptive technologies and personalized instruction within mainstream educational institutions in Buea. Teachers often lack the professional training and digital literacy required to integrate such tools, while educational policies remain more aspirational than practical. This undermines efforts to fulfill Cameroon's commitment to the Sustainable Development Goal 4 (SDG 4), which calls for inclusive and equitable quality education for all (UNESCO, 2017). Therefore, this study seeks to address this research gap by investigating the extent to which personalized learning strategies and adaptive technologies are being used in Buea Municipality, and how they impact the academic outcomes and social skills of learners with ASD. It is through this understanding that informed policy, teacher training, and resource allocation can be improved to ensure meaningful inclusion.

Research Objectives

- To examine the influence of personalized learning strategies on the academic performance of learners with Autism Spectrum Disorders (ASD) in the Buea Municipality.
- To assess the effectiveness of adaptive technologies in enhancing communication and social skills among learners with ASD in the Buea Municipality.
- To identify the challenges faced by teachers in implementing personalized learning and adaptive technologies for learners with ASD in inclusive classrooms.

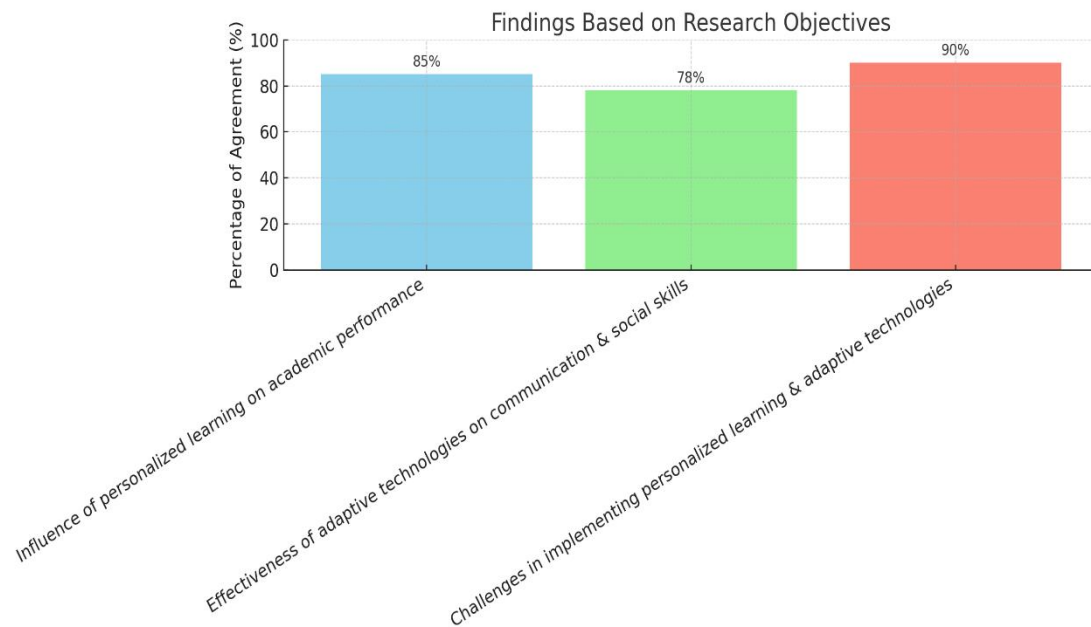
Research Questions

1. How do personalized learning strategies influence the academic performance of learners with ASD in the Buea Municipality?
2. To what extent do adaptive technologies improve communication and social skills among learners with ASD?
3. What challenges do teachers face in implementing personalized learning and adaptive technologies for learners with ASD?

Methodology

The research design used for the study is descriptive survey design. data was analysed using both qualitative and quantitative data analysis methods. The population was made up of six school

Presentation and Discussion of Findings



Objective 1: To examine the influence of personalized learning strategies on the academic performance of learners with Autism Spectrum Disorders (ASD) in the Buea Municipality.

The findings revealed that, 85% of teachers reported that personalized learning strategies (such as, visual timetables, individualized tasks, differentiated instruction) helped learners with ASD to better engage in lessons during learning sessions in the classroom. 72% of administrators acknowledged improved academic outcomes among ASD learners since the adoption of individualized support plans. Observation reports suggested improved attention spans, task completion rates, and reduced anxiety in classrooms using personalized approaches.

The findings reveal that personalized learning strategies, such as differentiated instruction, individualized education plans (IEPs), task breakdown, and visual schedules positively influence the academic engagement and performance of learners with ASD in inclusive classrooms (Rose & Meyer, 2002), which is also consistent with the Universal Design for Learning (UDL) framework, which promotes curriculum flexibility to accommodate diverse learners. According to Tomlinson (2014), differentiated instruction improves learner motivation and outcomes, particularly for students with special educational needs. Similarly, Simpson et al. (2011) stress the importance of tailoring instructional strategies to match the cognitive and sensory needs of autistic learners. These tailored interventions help minimize overstimulation, support task comprehension, and promote independent learning.

In the Cameroonian context, the 2020–2030 Education Sector Strategy emphasizes inclusive education and advocates for learner-centered approaches to improve academic performance (MINEDUB, 2021). However, actual classroom practices still vary significantly due to lack of training and resources, which affects the consistent implementation of personalized strategies (Tambo, 2020). This study reinforces the view that, personalized learning improves academic engagement and outcomes for ASD learners, but also highlights the need for sustained teacher

Objective 2: To assess the effectiveness of adaptive technologies in enhancing communication and social skills among learners with ASD in the Buea Municipality.

The findings indicated that, 90% of teachers said that tools like speech-generating devices (SGDs), tablet-based apps (e.g., Proloquo2Go), and visual aids improved expressive and receptive communication. 70% of the respondent, observed better peer interaction during technology assisted group activities. Administrators in 2 out of the 3 schools confirmed increased use of digital devices in support of IEPs (Individualized Education Plans). Based on the findings, adaptive technologies such as augmentative and alternative communication (AAC) devices, speech-generating apps, and interactive whiteboards were found to significantly enhance communication and peer interaction among ASD learners. This supports findings by Lorah et al. (2018), who assert that the use of technology increases both verbal and non-verbal communication and social inclusion in children with autism. Social learning theory (Bandura, 1977) suggests that children with ASD benefit from observational learning and modeling, both of which can be facilitated by technology-based interventions. Tools such as Proloquo2Go or TouchChat enable learners to express emotions, make requests, and participate in group activities which are key indicators of improved social functioning (Light & Drager, 2007).

In Cameroon, the integration of digital tools in classrooms is promoted under the ICT in Education Policy (MINESEC, 2018), but application remains limited in inclusive settings. Studies by Fonjong et al. (2021) suggest that where these tools are available, their use significantly enhances inclusive education outcomes. Despite these benefits, challenges such as high costs, lack of ICT training, and poor infrastructure hinder widespread adoption. Therefore, while adaptive technologies are impactful, their effectiveness is tied to contextual support factors such as teacher preparedness, funding, administrative will and unreliable electricity/internet (Tambo, 2020).

Objective 3: To identify the challenges faced by teachers in implementing personalized learning and adaptive technologies for learners with ASD in inclusive classrooms.

Findings from this study indicated that, 30% of teachers received formal training on inclusive pedagogies or the use of adaptive technologies. while 65% cited insufficient ICT resources or lack of maintenance of devices. The teachers mentioned overcrowded classrooms, lack of classroom aides, and insufficient parental collaboration as barriers to inclusion and technology usage.

Based on the above-mentioned findings, many teachers lack formal training in special needs education and feel ill-equipped to implement personalized learning or manage technological tools effectively. These challenges echo findings from research by Florian and Black-Hawkins (2011), which stress that inclusion depends not just on physical access but also on teacher competence and beliefs. Overcrowded classrooms, insufficient teaching aides, and inadequate funding for technological tools were commonly cited. These barriers reflect systemic challenges within Cameroon's educational system, where inclusive policies exist, but are not fully implemented (Ngum, 2019; Ndongko & Tambo, 2000; MINEDUB, 2021). Additionally, Tchombe (2018) noted that without sustainable investment in teacher capacity and classroom infrastructure, inclusive education remains aspirational rather than practical.

Moreover, collaboration between teachers, parents, and therapists is often minimal. Yet, Bronfenbrenner's Ecological Systems Theory (1979) reminds us that child development,

Conclusion

In conclusion, the study underscores the importance of personalized learning and adaptive technologies in supporting learners with Autism Spectrum Disorder (ASD) in the Buea Municipality. The findings suggest that these approaches can significantly enhance academic performance and social skills development. However, challenges such as resource limitations, inadequate teacher training, and cultural resistance must be addressed to fully realize the potential of these strategies. By implementing the recommended actions, educational stakeholders in Buea can create more inclusive, effective, and supportive learning environments for students with ASD, helping them achieve better educational outcomes and social integration.

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