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Exploring the Psychological Impact of Virtual Learning on Students with Special Educational Needs

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A B S T R A C T

This study aims to explore the psychological impact of virtual learning on students with special educational needs (SEN). This qualitative study utilized semi-structured interviews with 24 students with SEN recruited through online platforms. Theoretical saturation was reached, and data were analyzed using NVivo software following a thematic analysis approach. The interviews explored students' experiences with virtual learning, including emotional responses, cognitive struggles, and social adaptation. Themes were identified through an iterative coding process, ensuring reliability and depth in capturing the psychological effects of digital education on this population. The results indicate that virtual learning has led to heightened emotional distress, including anxiety, stress, and reduced motivation, largely due to isolation and the absence of structured classroom environments. Participants reported significant cognitive challenges, such as attention difficulties, cognitive overload from digital tools, and struggles with learning retention. Socially, students experienced decreased peer interaction, communication barriers, and difficulty adapting to digital learning norms. However, some students developed coping mechanisms such as parental support and self-regulation strategies. The findings align with previous research highlighting the adverse effects of digital learning on students with disabilities, emphasizing the need for targeted interventions. The psychological impact of virtual learning on students with SEN is profound, affecting their emotional well-being, cognitive engagement, and social adaptation. While some students benefit from digital learning's flexibility, most require additional support to mitigate stress, cognitive overload, and social isolation. Educators and policymakers must prioritize inclusive digital education strategies, enhance accessibility, and provide structured support systems to improve learning experiences for students with SEN.

Keywords: *virtual learning, special educational needs, psychological impact, online education, emotional challenges, cognitive difficulties, social adaptation*

1. Introduction

The rapid shift to virtual learning, driven largely by technological advancements and global disruptions such as the COVID-19 pandemic, has significantly altered the educational landscape. While online education offers increased accessibility and flexibility, its impact on students with special educational needs (SEN) remains a critical area of inquiry (Colvin et al., 2024; Fitria et al., 2024). Students with disabilities often rely on structured learning environments, individualized attention, and physical classroom interactions to support their cognitive, social, and emotional development. The transition to remote education has introduced both opportunities and challenges for these students, raising concerns about their psychological well-being and academic engagement (Täljedal et al., 2023; Tanaka, 2023). As digital learning becomes a more permanent feature of modern education, understanding its impact on students with SEN is essential for developing inclusive policies and interventions.

One of the primary concerns regarding virtual learning is its influence on the emotional well-being of students with disabilities. Studies suggest that the shift to online education has been associated with increased stress, anxiety, and emotional distress among students who require additional learning support (Shikako-Thomas et al., 2023; Speidel et al., 2023). The lack of in-person interactions, disruptions in routine, and difficulties in accessing special education services have exacerbated feelings of isolation and frustration among these students (Shapovalova et al., 2023). Research indicates that children with disabilities may experience higher levels of anxiety in digital learning environments due to difficulties in navigating technology, maintaining attention, and understanding digital instructions (Piñeros-Ortíz et al., 2023). A study examining the mental health of children with special needs during the pandemic found that many exhibited signs of increased emotional distress, particularly in households where parental support was limited (Okazawa, 2023).

The cognitive impact of virtual learning on students with SEN is another significant consideration. Many children with disabilities, such as autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), and intellectual disabilities, struggle with the cognitive demands of online education (Hsieh, 2023; Javed & Imran, 2023). Virtual learning requires a high degree of self-regulation, executive functioning, and digital literacy, which may pose challenges for students who rely on structured instruction and hands-on learning experiences (Faizah & Sulfiana, 2023). A study examining the experiences of children with disabilities in online education reported that many students faced difficulties in maintaining focus, comprehending lessons, and retaining information, particularly when digital platforms lacked accessibility features (Amo-Adjei et al., 2023). Moreover, cognitive overload due to prolonged screen exposure, frequent transitions between tasks, and multitasking demands has been reported as a barrier to effective learning in virtual environments (Abdat et al., 2023).

The social implications of virtual learning for students with disabilities cannot be overlooked. In traditional classrooms, peer interactions play a critical role in fostering social-emotional skills, communication, and a sense of belonging. However, in online settings, students with SEN often experience reduced peer engagement, limited socialization opportunities, and difficulties in interpreting social cues (Wu et al., 2022; Шубочкина & Ibragimova, 2022). Many students with disabilities struggle to adapt to the virtual learning environment due to challenges in communication, decreased participation in group activities, and a lack of immediate teacher support (Toseeb & Asbury, 2022). Research has shown that children with ASD, in particular, may face difficulties in processing non-verbal communication cues in virtual settings, leading to increased social withdrawal (Taylor & Abernathy, 2022). The absence of structured social interactions in online learning has also been linked to feelings of loneliness and emotional disengagement among students with SEN (Tandon et al., 2022).

Accessibility barriers in digital learning environments further compound the challenges faced by students with disabilities. Many online learning platforms lack essential accessibility features, such as screen readers, captioning services, and customizable learning tools, making it difficult for students with visual, auditory, and cognitive impairments to engage effectively in lessons (González et al., 2022). Research highlights that students who require assistive technologies often encounter technical issues, leading to frustration and disengagement (Dameria, 2022). Additionally, disparities in digital access remain a pressing concern, as students from low-income families may lack reliable internet connections, appropriate learning devices, or parental support necessary for effective online education (Riemersma et al., 2021). These accessibility limitations have been shown to widen educational inequalities, disproportionately affecting students who already face

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systemic barriers to quality education (Rasoulian-Kasrineh & Tabatabaei, 2021).

Despite these challenges, virtual learning has also introduced potential benefits for students with SEN, particularly in terms of flexibility, self-paced learning, and reduced sensory overload. Some students with disabilities prefer online education as it allows them to learn at their own pace, access recorded lessons, and avoid the sensory challenges of physical classrooms (Harris et al., 2021; Painter & Scannapieco, 2021). For example, children with sensory processing disorders may find virtual learning environments less overwhelming compared to traditional classrooms, where auditory and visual stimuli can be distracting (Adamiv et al., 2021). Additionally, online education enables students to receive personalized support through digital tools, such as speech-to-text applications, interactive learning modules, and virtual tutoring services (Bennadi et al., 2020). A study examining the role of technology in special education found that adaptive learning platforms can enhance engagement and comprehension for students with disabilities, particularly when integrated with individualized support mechanisms (Balgimbekov et al., 2020).

Parental involvement has emerged as a crucial factor in mitigating the challenges of virtual learning for students with SEN. Research suggests that children with disabilities benefit significantly from active parental support, structured home routines, and consistent communication with educators (Vorontsova & Shipkova, 2019). Parents play a key role in facilitating their child's engagement with digital learning platforms, reinforcing lesson materials, and providing emotional encouragement (Täljedal et al., 2023). However, the increased responsibility placed on parents to assist with virtual learning has also introduced additional stressors, particularly for families with limited resources or time constraints (Shikako-Thomas et al., 2023). A study exploring parental experiences during remote learning found that many caregivers struggled to balance work obligations with the demands of supporting their child's education, leading to heightened stress and burnout (Speidel et al., 2023).

In light of these findings, it is essential for policymakers, educators, and researchers to develop inclusive strategies that address the unique challenges of virtual learning for students with disabilities. Implementing universal design principles in online education, enhancing teacher training in digital accessibility, and fostering collaboration between schools and families are critical steps toward creating a more equitable learning environment (Colvin et al., 2024; Tanaka, 2023). Additionally, expanding access to assistive technologies, improving digital literacy among students and parents, and incorporating social-emotional learning frameworks into virtual curricula can help mitigate the psychological impact of remote education (Fitria et al., 2024).

As the education system continues to evolve, it is imperative to prioritize the needs of students with SEN in the design and implementation of digital learning programs. While virtual learning presents both opportunities and obstacles, ensuring that students with disabilities receive adequate support, resources, and accommodations will be key to fostering their academic success and emotional well-being in an increasingly digital world (Piñeros-Ortíz et al., 2023). This study aims to explore the psychological impact of virtual learning on students with special educational needs (SEN).

2. Methods and Materials

2.1. Study Design and Participants

This study employs a qualitative research design to explore the psychological impact of virtual learning on students with special educational needs. The research follows an interpretative approach, allowing for an in-depth understanding of participants' lived experiences. The study sample consists of 24 participants who were selected through purposive sampling to ensure diversity in educational backgrounds, learning difficulties, and experiences with virtual learning environments. The recruitment process was conducted through online platforms, targeting individuals who had firsthand experience with virtual education. The study adhered to the principle of theoretical saturation, meaning that data collection continued until no new themes emerged from the interviews.

2.2. Measure

2.2.1. Semi-Structured Interview

Data collection was carried out using semi-structured interviews, allowing for flexibility while ensuring consistency in exploring key psychological aspects of virtual learning. The interview questions were designed to investigate the emotional, cognitive, and social challenges experienced by students with special educational needs in virtual learning settings. Each interview lasted approximately 45 to 60 minutes and was conducted via video

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conferencing platforms to facilitate accessibility for participants. All interviews were audio-recorded with the participants' consent and later transcribed verbatim for analysis.

2.3. Data Analysis

For data analysis, NVivo software was used to systematically organize and code the transcribed interviews. Thematic analysis was employed to identify, analyze, and interpret patterns within the data. The coding process involved an initial open coding phase, followed by axial coding to establish relationships between emerging themes. Throughout the analysis, researcher reflexivity was maintained to ensure the reliability and validity of the findings. The final themes were derived through iterative engagement with the data, aligning with the principles of qualitative rigor.

3. Findings and Results

The demographic characteristics of the 24 participants in this study indicate a diverse range of backgrounds in terms of age, gender, and type of special educational needs. The participants' ages ranged from 10 to 18 years, with a mean age of 14.3 years (SD = 2.4). In terms of gender distribution, 14 participants (58.3%) identified as male, while 10 participants (41.7%) identified as female. Regarding their diagnosed special educational needs, 9 participants (37.5%) had attention deficit hyperactivity disorder (ADHD), 7 participants (29.2%) had autism spectrum disorder (ASD), 5 participants (20.8%) had dyslexia, and 3 participants (12.5%) had other learning disabilities such as auditory processing disorder (APD) or dyscalculia. Participants were enrolled in different educational settings, with 15 students (62.5%) attending mainstream schools with support services and 9 students (37.5%) enrolled in specialized educational programs. Additionally, 18 participants (75%) had prior experience with virtual learning before the COVID-19 pandemic, while 6 participants (25%) were introduced to online education for the first time during the pandemic. These demographic details provide a comprehensive overview of the participant group and offer insights into the diverse challenges faced by students with special educational needs in virtual learning environments.

Table 1

The Results of Qualitative Analysis

Category	Subcategory	Concepts (Open Codes)
Emotional Challenges	Anxiety and Stress	Feelings of isolation, performance pressure, screen fatigue, uncertainty about assessments, fear of failure
	Lack of Motivation	Difficulty staying engaged, absence of peer interaction, monotony of online lessons, procrastination
	Emotional Exhaustion	Overwhelming workload, difficulty in self-regulation, frustration with technology, loss of enthusiasm
	Reduced Sense of Belonging	Feeling disconnected from peers, lack of classroom bonding, limited social support, difficulty expressing emotions online
	Coping Strategies	Seeking parental support, self-imposed study schedules, mindfulness techniques, reliance on teacher encouragement
Cognitive Difficulties	Attention and Concentration Issues	Frequent distractions, difficulty following instructions, shorter attention span, multi-tasking challenges, cognitive overload
	Learning Retention Problems	Forgetting key concepts, difficulty in recalling information, lack of reinforcement, struggles with independent learning
	Cognitive Load from Digital Tools	Over-reliance on screen-based learning, difficulty navigating multiple platforms, confusion with digital interfaces, lack of digital literacy
	Processing Speed Variability	Struggles with real-time comprehension, need for additional time on tasks, frustration with fast-paced instruction
Social and Behavioral Adjustments	Decreased Peer Interaction	Limited social engagement, fewer group activities, difficulty in making friends, reliance on text-based communication
	Communication Barriers	Difficulty in interpreting non-verbal cues, hesitancy to ask for help, challenges in expressing thoughts clearly, technical interruptions
	Adaptation to Virtual Learning Norms	Struggles with independent learning, adjusting to online etiquette, need for structured routines
	Parental and Teacher Support	Need for continuous guidance, increased parental involvement, reliance on structured teacher feedback, limited real-time assistance, emotional reassurance from caregivers
	Self-Regulation Strategies	Developing personal study habits, setting reminders, using self-reward systems, structuring daily schedules

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The findings of this study reveal three primary themes related to the psychological impact of virtual learning on students with special educational needs: emotional challenges, cognitive difficulties, and social and behavioral adjustments. Each theme consists of several subcategories that highlight the specific struggles and coping mechanisms of students in virtual learning environments.

One of the main emotional challenges experienced by students was anxiety and stress, which stemmed from feelings of isolation, performance pressure, screen fatigue, uncertainty about assessments, and fear of failure. Many participants expressed that the absence of direct teacher support increased their stress levels, making it difficult to manage coursework. One participant described this experience: "I constantly worry if I am doing the assignments correctly because I don't get instant feedback like I would in a physical classroom." Another student shared that prolonged screen time contributed to exhaustion, stating, "Staring at the screen for hours makes me feel drained, and sometimes I can't focus at all."

Another emotional challenge was lack of motivation, which was commonly linked to the absence of peer interaction, the monotonous nature of online lessons, and a tendency to procrastinate. Several participants indicated that they struggled to stay engaged during virtual classes because they missed the social aspects of learning. One student noted, "In a regular classroom, I would listen because my friends were around, but online, I just turn off my camera and get distracted." Another participant highlighted that the absence of a structured environment led to procrastination: "At home, there's no one watching over me, so I keep delaying my assignments."

Emotional exhaustion was another major concern, as students reported being overwhelmed by the workload, struggling with self-regulation, and feeling frustrated with technical difficulties. Some students mentioned that managing multiple assignments without clear guidance led to a loss of enthusiasm for learning. One participant stated, "I feel like I am constantly catching up with deadlines, and it makes me want to give up." Others mentioned that the unpredictable nature of technical issues added to their stress, as one student explained: "Sometimes, the internet cuts off during an important class, and I feel so frustrated because I miss out on key points."

A significant aspect of emotional adjustment was reduced sense of belonging, as students felt disconnected from their peers and struggled to find social support. Many described their online learning experience as lonely, with one participant stating, "It feels like I am studying in isolation; I don't really talk to my classmates anymore." Another student emphasized the difficulty in expressing emotions online, stating, "In a physical class, my teacher could see when I was struggling, but online, I just keep quiet and try to figure things out myself."

In response to these emotional difficulties, students developed coping strategies such as seeking parental support, establishing self-imposed study schedules, practicing mindfulness techniques, and relying on teacher encouragement. One student explained, "My parents help me set a study routine so I don't fall behind." Another participant mentioned using mindfulness exercises to manage stress: "I take deep breaths and try to focus on one thing at a time when I start feeling overwhelmed."

In addition to emotional difficulties, students faced attention and concentration issues due to frequent distractions, difficulty following instructions, and cognitive overload. Many participants reported struggling to stay attentive during online classes because of their home environment. One student stated, "It's hard to concentrate when there's noise at home, and I can't always find a quiet space." Others mentioned that multitasking challenges made virtual learning more difficult, as one participant noted, "I try to listen, take notes, and look at the screen, but sometimes, I get lost in between."

Another cognitive struggle was learning retention problems, which included difficulty recalling information, lack of reinforcement, and struggles with independent learning. Some participants reported that they forgot key concepts quickly due to the lack of in-person interaction with teachers. One student shared, "In a normal class, the teacher repeats things, and I remember them better, but online, I forget as soon as the class ends." Others emphasized the difficulty of retaining information when they had to learn independently without structured reinforcement.

Students also encountered cognitive load from digital tools, as they had to navigate multiple platforms, deal with interface confusion, and develop digital literacy skills. Many participants expressed frustration with the constant switching between applications, with one stating, "Sometimes, I spend more time figuring out where to submit an assignment than actually doing it." Another student mentioned the stress caused by platform-related issues: "Every teacher uses a different website, and it's really confusing to keep track of everything."

Another common difficulty was processing speed variability, as students needed additional time to

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comprehend materials but struggled to keep up with real-time instructions. Some students mentioned that they needed more breaks during lessons, with one stating, "In a regular class, I could ask the teacher to slow down, but online, everything moves too fast for me to process." Others emphasized that their learning pace was different from their peers, making it hard to stay engaged in a synchronous learning environment.

Beyond cognitive struggles, students faced decreased peer interaction, which affected their social and emotional well-being. Many participants stated that they missed group activities and informal conversations with classmates. One student expressed, "Before, I could talk to my friends before and after class, but now, I just log in and log out without speaking to anyone." Others highlighted that the lack of casual social interaction made learning less enjoyable.

Students also struggled with communication barriers, particularly in interpreting non-verbal cues and expressing themselves clearly. Some reported that they felt hesitant to ask for help because they were unsure of how teachers would respond online. One student explained, "In a classroom, I can just raise my hand, but online, I have to type my question, and sometimes it takes too long to get an answer." Others found it difficult to interpret tone and body language, which made online discussions less engaging.

Adapting to virtual learning norms was another key challenge, as students struggled with independent learning, online etiquette, and the need for structured routines. Some participants noted that they had to develop self-discipline to stay on track, with one stating, "At first, I treated online classes like a holiday, but then I realized I had to create a schedule to keep up." Others mentioned that understanding virtual classroom rules took time, especially in terms of muting microphones and using chat functions.

Despite these challenges, many students relied on parental and teacher support to navigate virtual learning. Some reported that their parents played a more active role in their education, with one stating, "My mom helps me plan my day so I don't miss anything." Others emphasized the importance of structured feedback from teachers, with one participant explaining, "I feel more confident when my teacher gives me direct feedback, even if it's online."

Lastly, students developed self-regulation strategies to cope with the demands of virtual learning. These included setting reminders, using self-reward systems, and structuring daily study schedules. One participant shared, "I set small goals for myself and reward myself with breaks when I finish tasks." Another student mentioned, "I write down everything I need to do for the day, so I don't feel overwhelmed."

4. Discussion and Conclusion

The findings of this study reveal significant psychological impacts of virtual learning on students with special educational needs (SEN), highlighting emotional challenges, cognitive difficulties, and social and behavioral adjustments. Participants reported heightened levels of anxiety, stress, and emotional exhaustion due to the shift to remote learning, with many experiencing a reduced sense of belonging. The absence of face-to-face interactions, difficulties in maintaining motivation, and the overwhelming cognitive load of digital tools contributed to emotional distress. In addition, attention and concentration issues were prevalent, as students struggled with distractions, cognitive overload, and difficulties in processing online instructions. Socially, participants encountered decreased peer interaction, communication barriers, and challenges in adapting to virtual learning norms, all of which affected their overall engagement and learning outcomes. These findings align with previous research indicating that students with disabilities face unique obstacles in digital learning environments due to their reliance on structured classroom support and individualized teaching strategies (Colvin et al., 2024; Fitria et al., 2024).

The increased levels of anxiety and stress reported in this study are consistent with previous research highlighting the psychological toll of virtual learning on students with SEN (Tanaka, 2023). A study examining the effects of online education on children with disabilities found that disruptions in routine, lack of immediate teacher support, and technological barriers significantly contributed to increased stress and emotional distress (Täljedal et al., 2023). Similarly, research on the mental health of students with disabilities during the COVID-19 pandemic found that many experienced heightened anxiety due to uncertainty surrounding their academic progress and difficulties adapting to digital learning tools (Speidel et al., 2023). The findings of this study further suggest that students with SEN struggled to maintain motivation, largely due to the lack of structured classroom settings and peer interaction. This aligns with studies demonstrating that the absence of direct social engagement negatively impacts students' intrinsic motivation and sense of purpose in learning (Shikako-Thomas et al., 2023).

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The theme of emotional exhaustion was also evident, as students reported experiencing overwhelming workloads and frustration with technological barriers. This is in line with research indicating that students with disabilities often require additional time and support to process information, and the fast-paced nature of online learning exacerbates their cognitive burden (Shapovalova et al., 2023). The cognitive overload resulting from prolonged screen time, excessive digital multitasking, and difficulties in understanding online instructions has been previously documented as a major challenge for students with SEN (Piñeros-Ortíz et al., 2023). Research on digital learning accessibility suggests that when online lessons are not adapted to the cognitive needs of students with disabilities, they lead to increased frustration and disengagement (Okazawa, 2023).

The findings also underscore the attention and concentration difficulties faced by students with SEN in virtual learning settings. Participants frequently mentioned struggling to stay focused, experiencing frequent distractions at home, and having difficulty following instructions during online lessons. These findings are supported by research indicating that students with attention-deficit hyperactivity disorder (ADHD) and other learning disabilities face heightened challenges in sustaining attention in digital classrooms due to the lack of interactive and structured learning environments (Hsieh, 2023; Javed & Imran, 2023). Studies have shown that online education often places increased demands on students' executive functioning skills, which can be particularly problematic for those with cognitive impairments (Faizah & Sulfiana, 2023). The issue of learning retention problems also emerged, with participants reporting difficulties in recalling information, comprehending lessons, and retaining new material. This aligns with previous findings that suggest students with disabilities require frequent reinforcement of concepts, and the lack of structured, hands-on learning activities in virtual education negatively affects their information retention (Amo-Adjei et al., 2023).

Another key challenge reported by participants was social and behavioral adjustments, particularly decreased peer interaction and communication barriers. Many students described feeling isolated due to the lack of opportunities for spontaneous peer interactions, group work, and informal discussions. This is supported by studies showing that students with disabilities often struggle with socialization in virtual classrooms due to the absence of face-to-face interactions and difficulties in interpreting non-verbal cues (Abdat et al., 2023). Research has shown that students with autism spectrum disorder (ASD), in particular, face significant barriers in online learning environments as they struggle with digital communication and the absence of structured social routines (Шубочкина & Ibragimova, 2022). The findings also highlight the challenges in adapting to virtual learning norms, with students experiencing difficulties in self-regulation, online etiquette, and independent learning. Similar challenges have been documented in studies on digital learning among children with disabilities, emphasizing the need for tailored interventions to support self-regulation and engagement in online education (Wu et al., 2022).

Despite these challenges, some participants reported utilizing self-regulation strategies and parental support to navigate the difficulties of online education. Studies suggest that when students with disabilities are provided with structured routines, parental guidance, and personalized digital tools, they can develop greater self-regulation skills and improve their engagement in virtual learning (Toseeb & Asbury, 2022). Research has also emphasized the critical role of parents and educators in providing consistent feedback and emotional support to students with SEN in online learning settings (Taylor & Abernathy, 2022). However, many parents themselves faced challenges in balancing work responsibilities with their child's educational needs, underscoring the necessity for additional institutional support (Tandon et al., 2022).

This study has several limitations that should be considered when interpreting the findings. First, the sample size was limited to 24 participants, which, while sufficient for qualitative research, may not fully capture the diversity of experiences among students with SEN. A larger sample could provide more generalizable insights across different disability types, socio-economic backgrounds, and educational settings. Second, the study relied solely on self-reported experiences from students, which may be influenced by subjective perceptions and memory recall biases. Future studies could incorporate perspectives from parents, teachers, and special education professionals to provide a more comprehensive understanding of the challenges faced in virtual learning. Additionally, the study was conducted using online interviews, which may have limited participation from students with severe communication difficulties or those who struggle with digital accessibility.

Future research should further explore the long-term psychological impacts of virtual learning on students with SEN, particularly in terms of academic outcomes, mental

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health, and social development. Longitudinal studies examining how students adapt to digital learning over time and whether certain interventions improve engagement and well-being would be valuable. Additionally, research should investigate the effectiveness of various online learning accommodations, such as adaptive learning technologies, digital accessibility tools, and virtual social skills training programs. Comparative studies analyzing differences between fully online learning, hybrid education, and traditional classroom models could also provide insights into which educational approaches are most effective for students with disabilities.

To improve the virtual learning experiences of students with SEN, educators and policymakers should prioritize the development of inclusive digital learning environments. This includes incorporating universal design for learning (UDL) principles, providing accessible learning materials, and integrating assistive technologies to support students with diverse needs. Schools should offer training for teachers on how to adapt instructional methods for online settings and effectively engage students with disabilities. Additionally, structured routines, social-emotional learning programs, and virtual peer support networks should be implemented to foster a sense of belonging and reduce social isolation. Strengthening collaboration between educators, parents, and special education professionals can further enhance student support and ensure that children with SEN receive the individualized attention they need in virtual learning environments.

Authors' Contributions

Authors contributed equally to this article.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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