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Embracing the future: Artificial intelligence in the provision of pre-employment transition services to autistic and neurodivergent youth

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Abstract

Background: Transition-aged youth with autism and other neurodiversities face high levels of unemployment and under-employment and can benefit from pre-employment and transition services to improve long-term outcomes. While the mainstream proliferation of artificial intelligence tools has garnered global attention over the last year, there is a growing body of research exploring how these technologies can be used to enhance communication and workplace readiness skills for these transition-aged youth.
Objective: This article examines the current state of artificial intelligence and technology integration into pre-employment and transition skills training for neurodivergent and autistic youth.
Method: We completed a scoping literature review across these topic areas, pre-employment services and artificial intelligence and technology for neurodivergent and autistic youth.
Results: We found the literature in this area of research to be in a state of rapid development and flux. A total of 27 articles were found. Specifically, there is literature describing the needs of neurodivergent and autistic youth in pre-employment services related to workplace readiness. Our review revealed promising advances in the use of technology and artificial intelligence to support the development of social communication and job-related skills for use in pre-ETS.
Conclusions: The proliferation of artificial intelligence and technology into mainstream society provides an opportunity to explore and hone the use of these tools to improve pre-employment and transition skills for neurodivergent youth. Stakeholders should engage in participatory and ethical practices to develop and implement strategies that improve workplace readiness and employment outcomes for this population.

Keywords

autism, artificial intelligence, neurodiversity, neurodivergence, pre-employment transition services, transition, employment

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Introduction

People with disabilities, among all age groups, are less likely to be employed than those without disabilities. Regardless of education credentials, individuals with disabilities endure significantly higher rates of unemployment than those without disabilities (Diener et al., 2020; Ezerins et al., 2023). Workers with disabilities are nearly twice as likely to work only part-time compared to other workers, with 29% of individuals with a disability working part-time in contrast to 16% of non-disabled workers (Bureau of Labor Statistics, 2023, p. 2).

When looking at transition-age youth, we can see similar patterns of disparity even prior to high school completion. Only 27% of youth aged 16–19 years with a disability are engaged in the labor force, whereas 37.5% of youth aged 16–19 without a disability are employed (US Department of Labor, Office of Disability Employment Policy, 2024). When focusing specifically on individuals with autism, research indicates that 70,000 transition-age youth with

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autism become eligible for employment each year in the United States. Unfortunately, they often face high rates of unemployment, underemployment, and an increased likelihood of working in sheltered settings (Ezerins et al., 2023; Schall et al., 2020).

Author and disability activist Alice Wong (2020) describes the holistic nature of disability as “both apparent and non-apparent. Disability is pain, struggle, brilliance, abundance, and joy. Disability is sociopolitical, cultural, and biological” (p.xxii). In this vein, neurodiversity, or differences in neurological functioning, can be viewed as a natural state of being, versus a problem to be cured (Krzeminska et al., 2019). Neurodivergence frames the concept of these differences as organic, with neurodivergent individuals often identified as having ADHD, autism, or Dyslexia, though the scope of identities under this umbrella term is broadening (Borsotti et al., 2024). Much of the research on technology use within this community focuses on autism, and as such, this will be the primary community addressed in this paper. While each individual experience is unique, autism can be “characterized by core features in two areas - social communication and restricted, repetitive sensory-motor behaviors - irrespective of culture, race, ethnicity, or socioeconomic group” (Lord et al., 2018, p. 508). An understanding of the biological basis of autism provides a diagnostic understanding for intervention, but it fails to address the need for employers to play an active role in seeking ways to reduce societal barriers to employment for autistic youth (Wen et al., 2024).

Autistic workers represent a wide spectrum of intellectual and ability levels. Many lack needed employment supports, while others are overqualified for their jobs, work in occupations that are not of genuine interest, and change jobs more often than their neurotypical colleagues (Diener et al., 2020; Ezerins et al., 2023; Schall et al., 2020; Wen et al., 2024). These factors contribute to both financial and personal hardships for many individuals with autism as well as to the communities around them who could potentially benefit from their talent and labor (Black et al., 2019; Ezerins et al., 2023; Schall et al., 2020; Wen et al., 2024).

Challenges for autistic individuals on their journey to employment are two-fold. First, maneuvering the job search and interview process itself and then applying workplace readiness and professional communication strategies during the employment period (Bruyere et al., 2020; Carter et al., 2021; Ezerins et al., 2023). The job interview process can prove especially challenging for autistic job-seekers, as they may not manifest the social expectations of interviewers. Family members of youth with autism report their autistic youth being hesitant to apply to job ads when they do not meet all the requirements listed, even when the perceived points of disqualification are not technical requirements of the job, and they may also become discouraged from continuing to engage in the job search process all-together (Diener et al., 2020).

For youth who are Black, Indigenous, or Persons of Color, these challenges can be exacerbated further by limited access to both vocational services and competitive employment opportunities, as well as from the harmful intersection of ableism and racism (Williams & Smith, 2023). Hispanic youth with disabilities have lower rates of employment as well, likely due in part to cultural barriers to accessing vocational services (Rios, 2023). While each individual with autism has their unique preferences, skills, and strengths, many traits associated as negative within the neurotypical community are potential sources of talent, such as the ability to hyperfocus, amplify visual information, and factual recall, as seen in a higher than average occupational rates of Autistic employees in technology firms (Diener et al., 2020). Still, many autistic employees have reported the stress of on-the-job expectations that lead to burnout, including “masking autistic traits, lack of social acceptance and understanding, decoding expectations, and relationships” (Ezerins et al., 2023, p. 16). These perspectives underscore the importance of social connections and accessible work environments for these prospective employees (Ezerins et al., 2023).

The purpose of this paper is to scope the extant literature to understand the current state of the science regarding the use of artificial intelligence as a conduit to help neurodivergent youth transition to employment. Further, we were interested in understanding the degree to which neurodivergent youth participate in the development of these technologies toward their own transition to employment.

Method

We used a scoping review methodology according to the PRISMA guidelines. The following databases were accessed for research within the areas of education, psychology, and health research: ERIC, PsycInfo, and CINAHL. Inclusion criteria included scholarly peer-reviewed articles. Research focused on curing autism was excluded. Figure 1 illustrates the total number of articles included and excluded at each stage of our review.

Results

We found significant literature in these topic areas: Pre-employment transition services, stakeholder collaboration, workplace readiness, artificial intelligence, and technology. To organize these findings, we present an overview of Pre-ETS, followed by our findings related to the use of AI. These findings are presented below.

Use of pre-ETS in preparing autistic youth for employment

Under the Individuals with Disabilities Education Act (IDEA) implemented in 1975, students with disabilities

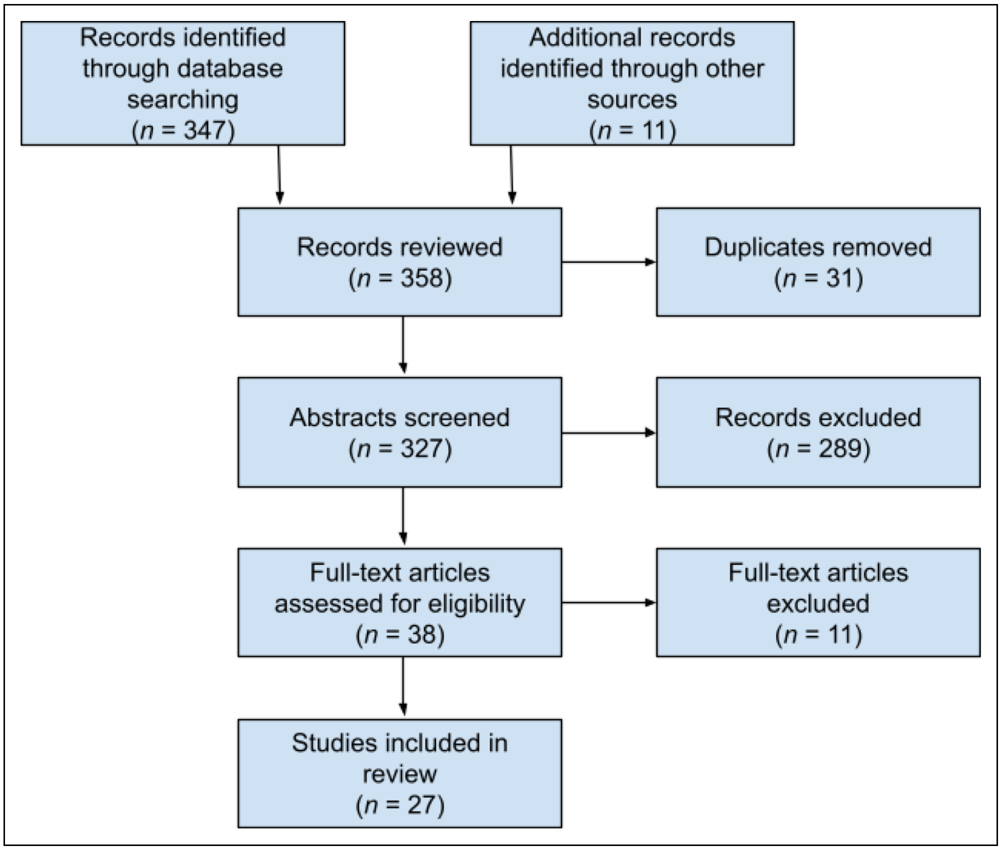

Figure 1. PRISMA chart.

that impact their academic performance have the right to a "free and appropriate public school education" (National Center on Education Statistics, 2023, carp.1). During the 2021–2022 school year, 7.3 million students with disabilities, ages 3–21, were provided with special education services under the IDEA, with 435,000 of those students who received special education services graduating during the 2020–2021 school year (National Center on Education Statistics, 2023). An average of 1 in 36 children were diagnosed with autism in 2020 (Maenner et al., 2023) with 12% of students with disabilities in the United States being identified as having autism in the 2020–2021 school year (National Center on Education Statistics, 2023). In their cost analysis of the financial impact of autism on the economy, Leigh and Du determined the combined medical fees, targeted education interventions, and child care costs borne by parents of children with autism would escalate to a cost of $461 billion by 2025 (Ezerins et al., 2023; Leigh & Du, 2015).

Pre-employment Transition Services (Pre-ETS) are an increasingly relevant way to create connections for disabled and Autistic youth as they transition from school to adult life, especially in preparing for the future and sustaining employment (Smith et al., 2021). Pre-ETS services are divided into five categories and include Job Exploration, Work-Based Learning, Counseling on Postsecondary Education and Training Options, Workplace Readiness Training, and Instruction in Self-Advocacy (Bishop et al., 2022; Carlson et al., 2020; Lau & McKelvey, 2023; WIOA, 2014). Calling on the need for vocational rehabilitation agencies to increase early employment and transition service activities for youth with disabilities, including- though not specifying- students with autism, the United States federal government broadened the scope of the Rehabilitation Act, amended in 1998, through the passage of the Workforce Innovation and Opportunity Act (Achola, 2019; Awsumb et al., 2020; Bishop et al., 2022; Brown Ruiz & Scott, 2021; Carlson et al., 2020; Frentzel et al., 2021; Honeycutt et al., 2019; Lau & McKelvey, 2023; McDonnall et al., 2018; WIOA, 2014). The WIOA mandates that "each state shall ensure that the designated State unit, in collaboration with the local educational agencies involved shall provide, or arrange for the provision of, pre-employment transition services for all students with disabilities in need of such services who are eligible or potentially eligible for services" (2014).

WIOA broadens the scope of state vocational rehabilitation services provided to students with disabilities to increase pre-ETS that prepare students for life after graduation, including post-secondary education and employment (Carlson et al., 2020). The law mandates not only that state vocational rehabilitation agencies earmark 15% of federal funding for the cost of pre-ETS for students with disabilities, but also that services begin earlier and span from ages 14–21 or ages 16–21 depending on state regulations. This change signals a focus on earlier services that can be delivered in a continuum throughout a student's high school career (Awsumb et al., 2020; Carlson et al., 2020; Lau & McKelvey, 2023; WIOA, 2014).

Pre-ETS and stakeholder collaboration

Beyond the legal and policy implications of vocational rehabilitation agencies providing required funding for pre-ETS, a shared understanding of the community's responsibility to reduce barriers to employment for youth with disabilities and autism is vital to seeing holistic progress. In their review of state implementation plans following the passage of WIOA, Roux et al. found that 44 state plans included references to autism, though only ten states had robust plans to address the vocational needs of students in this population (2019). Essential to moving Pre-ETS efforts for students with disabilities forward are substantial buy-in, training, and partnership among stakeholders, including vocational agencies, educators, employers, and vendor service providers (Benitez et al., 2009; Bishop et al., 2022; Carter et al., 2021; Frentzel et al., 2021; McKnight et al., 2022; Oertle et al., 2017; Taylor et al., 2022).

Autistic youth and workplace readiness

For students with autism, exposure to early pre-ETS services, particularly in the area of workplace readiness, can open the door to developing awareness and strategies to maneuver the crucial aspects of a job search and interview process. Facilitating early job interview preparation and workplace readiness for Autistic youth is essential to promoting positive long-term employment outcomes (Fong et al., 2021). Traditional pre-ETS instruction can take many forms, including coaching and instruction on the job search and application process in the classroom, interview preparation, modeling social interaction with colleagues, and workplace internships and apprenticeships (Fong et al., 2021; Smith et al., 2023; Wilson et al., 2017). However, in a world where the workplace is evolving into a digital space, and with a population of students who have expressed a desire and capacity for technology-based communication and learning, an exploration of how to merge pre-ETS with technology and artificial intelligence (AI) for autistic youth is warranted (Iannone & Giansanti, 2024; Smith et al., 2023).

Artificial intelligence and technology, as pre-ETS

Although interest in exploring the use of computer-based interventions for autistic youth can be found in published works dating back to the1960's (Colby, 1968; Miller & Bugnariu, 2016), AI has recently gained widespread acceptance and integration into daily life for a multitude of purposes. AI refers to machines that utilize models and algorithms to analyze data and recognize patterns, thereby mimicking human intelligence with the ability to learn, problem-solve, self-correct, recognize speech, and make decisions (Rehman et al., 2021; Senechal et al., 2023).

According to Iannone and Giansanti's (2024) review of studies on the intersection of AI and assistive technology for individuals with autism, research reveals "a promising landscape where AI-driven solutions are actively contributing to the enhancement of rehabilitation, independence, and overall well-being" (p. 6). Grynszpan et al. (2014) highlighted the numerous potential benefits that computerized learning offers individuals on the autism spectrum, including the consistency and specificity of the task, the use of visually cued directions, decreased distractibility related to extraneous sensory stimuli, elimination of social demands, and immediacy and predictability of responses. Their meta-analysis of studies with robust research design involving participants' direct interaction with computerized systems (e.g., virtual reality, interactive DVD, and other computerized devices) yielded overall support for these innovative interventions for the education of autistic youth. More recently, in a systematic review of AI tools used to teach neurodiverse students, Barua et al. (2022) reported evidence supporting AI for improving social interaction and supporting educational outcomes. However, the authors noted that the majority of this body of research focuses on autism, with limited research on other neuro-developmental disorders such as ADHD and Dyslexia.

Access to AI technology is also becoming more readily available via smartphones and mobile devices. And despite the widely-recognized challenges of the COVID-19 pandemic, it has required transition aged youth to utilize technology in unprecedented ways to access their education (Cardy et al., 2021). With a reported 95% of adolescents in America having access to a smartphone (Rimel et al., 2023), there exists a valuable opportunity to leverage technology for the purposes of teaching skills necessary for employment.

Rehman et al. (2021) performed a systematic review of 25 highly-rated mobile apps designed explicitly for autistic individuals. These apps, which utilize AI features and are available from the Google Play Store, were categorized according to general purpose and functionality (e.g., games, education, medical, communication, and others). The authors noted that a majority of the apps employing AI were those intended to bolster communication skills. When considering tools for employment preparation for autistic transition-aged youth, the use of AI in communication supports/apps is particularly notable due to its accessibility and affordability. These include augmentative and alternative communication (AAC) apps, allowing individuals to express themselves more efficiently and independently across settings. Many AAC apps utilize components of AI such as natural language processing, machine learning algorithms, and neural networks to perform functions such as predictive text, speech recognition, and speech synthesis to produce natural-sounding speech from text input, all of which contribute to the effectiveness of communication for individuals with speech and language difficulties (Barua et al., 2022; Rehman et al., 2021).

Additionally, as many Autistic individuals prefer technology-based activities, researchers are exploring the use of virtual reality (VR) and augmented reality (AR) to support skill development (Deschsling et al., 2022; Mosher & Carreon, 2021). By integrating computer-generated, interactive environments, VR simulations provide multi-sensory feedback, including visual, auditory, and sometimes tactile input (Mak & Zhao, 2023). Similarly, AR also engages the user's sensory system by superimposing virtual information into a real environment, so they are perceived to be part of one's surroundings (Lorenzo et al., 2019; Suh & Prophet, 2018). Both VR and AR have promising implications for neurodiverse individuals, as they offer immersive environments in which individuals can practice a variety of skills within a safe and supportive setting. Karami et al. (2021) highlight a multitude of advantages to the use of these technologies, including the provision of a realistic environment with reduced social pressure on the individual, the ability to control task complexity, opportunities for reinforcement of skills through repeated practice and real-time feedback, and potential reduction in the amount of training time required. Another type of reality that is often used to teach pre-employment skills for Autistic students is mixed reality (MR). Mixed Reality (MR) refers to a technology that merges elements of both VR and AR, allowing users to interact with both virtual and real-world environments in real time (Azuma et al., 2001). The utilization of AI in combination with VR, AR, and MR brings about extraordinary capabilities for preparing Autistic youth for real-world job interviews by reducing anxiety and building confidence and skills through simulated experiences.

Robotics tools for autistic students

Researchers are also exploring the use of robotics (mechanical devices capable of moving and performing tasks with varying degrees of autonomy) as a therapeutic tool for Autistic youth (DiPietro et al., 2019). Pennisi et al. (2016) indicated that robots can serve as a means by which researchers and therapists can engage and connect with Autistic children. Although no studies on using robotics specifically for employment preparation were included in Iannone & Giansanti's (2024) narrative review, they reported that the use of AI within robotics has enhanced communication, interaction, and social engagement in individuals with ASD. Though research indicates that robotics may be a useful tool in teaching social and communication skills to Autistic children, limitations of current studies often include relatively small sample sizes (e.g., fewer than 50 subjects) and the use of subjective measures (e.g., observation) as a data collection method. Future research should explore the use of robotics among neurodiverse adults across a wide range of functional and intellectual ability levels (DiPietro et al., 2019).

Bozgeyikli et al.'s (2018) systematic review of VR for individuals with autism found that both computer and robot interventions may benefit Autistic youth, particularly with virtual environments that can be generalized to real-world settings. Overall, the studies reviewed had small sample sizes with limited perspectives on the part of researchers, as most researchers were not in the virtual environment with students. Future studies should also expand population types to include a wider range of neurodivergent participants (these studies end with 2018). Best practices should include exploration of the most up-to-date immersive and non-immersive technologies to improve social skills and other vocational skills with participants across the autism spectrum.

Virtual reality and workplace readiness

In their study of a transition to employment program for Autistic transition-aged youth, Strickland et al. (2013) determined that the combination of Job Training, Internships, a Placement System (JobTIPS, a web-based interviewing skills program), and VR practice was effective in improving responses to interview questions; however, improvements in "content" (verbal responses) were greater than "delivery" (posture, facial expressions, affect; p. 9). In addition to the limitations of their sample size ($n = 22$, with 11 being randomly assigned to the treatment group), the authors reported the need for replication with female participants, a second follow-up interview to determine the maintenance of skills, as well as completing interviews under novel conditions to assess generalization of skills.

Burke et al. (2021) also sought to explore the efficacy of VR through the moderately immersive virtual interactive training agents (ViTA) for interview preparation and practice for individuals with autism and other developmental disabilities. Findings indicated that ViTA improved interview skills and self-efficacy among participants, and, in contrast to previous studies (Strickland et al., 2013), a six-month follow-up revealed that participants who completed the ViTA program were more likely to be employed than were those who did not.

In partnership with the autism community, the Virtual Interview Training for Transition-Age Youth (VIT-TAY) was developed and licensed by SIMmersion® as an adaptation of the efficacious Virtual Reality Job Interview Training (VR-JIT). VIT-TAY is one of the most widely researched technologies in autism and virtual reality and a teaching tool for job interview preparation (Smith et al., 2014, 2015). Sherwood et al. (2023) examined qualitative and quantitative data gathered following the implementation of VIT-TAY in five schools with a total sample size of 71 Autistic transition-age students. While teachers found VIT-TAY to be time-consuming and reported a desire for additional training, they also rated it as “highly acceptable, feasible, and sustainable in a school context” (p. 149) and appropriate for Pre-ETS. Autistic students also had positive perceptions of VIT-TAY regarding its acceptability and usability, indicating that they learned new interview skills and found VIT-TAY “fun and easy to use” (p. 149).

To address the disparities in participation in transition services; employment rates; and average incomes of Black, Indigenous, and Persons of Color (BIPOC) Autistic transition-aged youth compared to White Autistic youth, Williams and Smith (2023) sought to examine the effectiveness of an internet-delivered job interview simulator for Autistic BIPOC. Results indicated that compared to those who only had Pre-ETS, BIPOC participants receiving Pre-ETS and VIT-TAY demonstrated better job interview skills, reduced job interview anxiety, and increased likelihood of gaining competitive and integrated employment. Notably, participants in the Pre-ETS + VIT-TAY group reported VIT-TAY as having both strong acceptability and usability, which has positive implications for future use with BIPOC Autistic transition-aged youth.

While acknowledging that additional research is needed on training programs that educate employers and staff to be more accepting and affirming of Autistic individuals, Smith et al. (2023) set out to develop *WorkChat: A Virtual Workday*, a program that aims to enhance role-play training to support social abilities in Autistic transition-aged youth. Facilitated via a virtual learning environment, the authors hypothesize that this novel use of *WorkChat* for Pre-ETS provided in post-secondary educational settings has potential implications for individuals as well as corporations hiring individuals with ASD. Virtual environments (VEs), a subset of VR, provide the illusion of being in a different location (Miller & Bugnariu, 2016). Through the use of specialized equipment such as head-mounted displays or immersive projection systems, deeper immersion in the virtual world and greater interactivity can be achieved through immersive virtual environments (IVEs).

IVEs offer promising avenues for supporting individuals with autism in various domains, including job interview preparation. This technology provides simulated environments that closely resemble real-world settings, allowing individuals to practice social interactions, communication skills, and job-related tasks in a controlled and supportive environment (Parsons & Cobb, 2011). Recent research has highlighted the effectiveness of IVEs as a tool for job interview training in individuals with ASD, demonstrating improvements in interview performance, self-confidence, and job-related skills following virtual reality interventions (Smith et al., 2014, 2015). By immersing individuals in virtual environments that mimic job interview scenarios, IVEs enable repeated practice, feedback, and skill refinement, thereby enhancing the transfer of learned skills to real-world settings (Strickland et al., 2013). Overall, the use of IVEs holds considerable potential for improving employment prospects and outcomes for Autistic individuals.

The question remains: can students with autism generalize skills learned in the virtual world to real-life situations? Using a head-mounted display to access an IVE, participants in a pilot study showed moderate gains in social communication skills (Beach & Wendt, 2014). Their experiences in the IVE were realistic enough to allow for generalization across settings. As these technologies become more readily accessible and affordable, special educators and related professions can potentially use IVE to improve social skills across environments, including home, entertainment, and work settings.

Spherical, video-based virtual reality (SVVR) is another emerging technology that has the potential to serve as an alternative to the often cost-prohibitive, highly specialized hardware needed for immersive VR systems. SVVRs, or 360-degree videos, are simpler and less costly to develop, which creates opportunities for non-experts (e.g., teachers, therapists, and service providers) to develop and use VR to support Autistic youth in their own settings. While this technology appears to be promising, additional research is needed on the generalization and sustained effects of using SVVR for instruction and learning. Additional considerations include the exploration of potential adverse physical effects (e.g., eye strain, dizziness, cybersickness) and the ethical challenges that accompany the use of emerging technology with Autistic individuals (Glaser et al., 2023). Operational definitions with examples of technology applications that support workplace readiness skills are detailed in Table 1.

Discussion

Ethical considerations

As with the use of AI technology in the general population, there are ethical concerns that should be addressed when using these newly emerging technologies for pre-ETS with Autistic transition-age youth in both the classroom and the community (Deschsling et al., 2022). Stakeholders need to provide guidance on safety, policy, and privacy implications for both facilitators and users. Guidelines should be developed in tandem with Autistic participants. While acknowledging that AI is a newly emerging technology,

Table 1. Operational definitions of technology use to address workplace readiness skills in autistic individuals.

Technology	Definition	Examples	Use in supporting workplace readiness skills
Artificial Intelligence (AI)	Machines that are developed to mimic the intelligence of humans; relies on algorithms to analyze data and recognize patterns that allow it to learn, problem-solve, recognize speech, and make decisions (Senechal et al., 2023)	Open AI's ChatGPT	Provides communication practice through simulated conversations that may assist in job interview preparation; can assist in development of resumes, cover letters, and correspondence with employers
		Goblin.tools	Can assist in altering text to sound more or less formal, aid in understanding the tone of a written message, create task list from a broad task or brain dump
Machine Learning	Subset of AI; in the absence of explicit human programming, the model learns from and makes predictions based on data that is input (Barua et al., 2022; Yamamoto & Alverson, 2022)	Predictive Text	Promotes expressive communication skills, increases independence and efficiency, and decreases cognitive load by suggesting words or phrases as a message is typed
Robot	Mechanical device capable of moving and performing tasks with varying degrees of autonomy (DiPietro et al., 2019)	Misty Robotics	Use in special education to support learning, communication, and social development
Natural Language Processing (NLP)	Allows computers to recognize, interpret, and produce human language	Augmentative and Alternative Communication (AAC) devices	
		Speech/Voice Recognition (e.g., Google Assistant, Apple Siri, Amazon Alexa)	Given voice commands, these can assist with setting reminders, scheduling appointments, getting directions, making calls, etc.
		Speech-to-Text (e.g., Google Speech-to-Text, Amazon Transcribe)	Assists with documenting/ note-taking, generates real-time transcriptions and captions for live meetings
		Text-to-Speech	Increases accessibility by reading on-screen text aloud; Allows for hands-free use of smart devices for reading text messages, emails, and other content
Extended Reality (XR)	Umbrella term that encompasses immersive, computer-altered or computer-generated technologies with the most widely known being virtual reality (VR), augmented reality (AR), and mixed reality (MR) (Gu et al., 2023)	Pathful	XR can enhance learning experiences by providing immersive simulations, interactive tutorials, virtual field trips, and hands-on training in various fields, such as healthcare, manufacturing, aviation, and vocational skills training.
Augmented Reality (AR)	The addition of digital/virtual objects into a real environment so that they are perceived to be part of one's surroundings (Lorenzo et al., 2019)	AR App on Smartphone or Tablet	Various options provide practice with job interview skills and social interaction skills (greetings, answering questions, problem-solving); can be utilized for task management with visual schedules
		AR/Smartglasses	Provide individualized supports for managing stress and sensory needs; Can support job skill acquisition through visual cues/prompts

(continued)

Table 1. Continued.

Technology	Definition	Examples	Use in supporting workplace readiness skills
Virtual Reality (VR)	Computer-generated, interactive environment that provides multi-sensory feedback, including visual, auditory, and sometimes tactile input (Mak & Zhao, 2023)	Virtual Reality Driving Simulation Training (VRDST) (Cox et al., 2017)	Increase access to employment opportunities by Improving driving-specific executive functioning skills and tactical driving skills
		OpenSimulator (Ke & Moon, 2018)	Collaborative VR gaming offers social interactive skill practice and role-playing that align with participant interests
		Virtual Interactive Training Agents (ViTA) (Burke et al., 2021)	Teaches ways to respond to interview questions and general interview etiquette (e.g., greetings, acceptable small talk, closing remarks, thanking the interviewer)
		Virtual Interview Training for Transition Age Youth (VIT-TAY) by SIMmersion LLC (Sherwood et al., 2023)	Provides interactive and repeated practice of job interviews through the use of speech recognition
		Virtual Robot (GOT): group-based online job interview training program using a virtual robot (Kumazaki et al., 2022)	May improve interview performance skills, including self-confidence, verbal and non-verbal competence, and perspective-taking
Mixed Reality (MR)	Hybrid of AR and VR; offers a combined presentation of both real and virtual objects in a single display (Suh & Prophet, 2018)	Safety Training and Problem Solving Scenarios	Allows users to participate in simulations of hazardous situations to learn about safety procedures and protocols in a safe, controlled virtual space
Virtual Environment (VE)	Interactive, computer-generated environment that provides the illusion of being in a different location (Miller & Bugnariu, 2016)	Virtual Interactive Training Agents (ViTA) (Burke et al., 2021)	Teaches ways to respond to interview questions and general interview etiquette (e.g., greetings, acceptable small talk, closing remarks, thanking the interviewer)
Immersive Virtual Environment (IVE)	Achieved through the use of head mounted displays or projection systems in conjunction with motion tracking, users are fully surrounded by the virtual environment	Oculus Rift (Beach & Wendt, 2014)	Realistic simulations to target social interactions and sensory engagement in employment situations

Senechal et al. (2023) provided a brief that explores both the pros and cons of using these technologies in K-12 classrooms. The authors noted that school district concerns include risks associated with privacy, plagiarism, mature content, and discriminatory materials. To use these technologies to the maximum benefit of students and educators, school districts should stay current on the evolution of these emerging technologies, create policies that are congruent with school division frameworks, educate students and teachers on the ethical use of these technologies, and facilitate effective training and development for instructors using these technologies both for themselves and students.

The response of school districts and government officials in using AI technology in the classroom has been decidedly mixed and is evolving quickly. School districts in New York, Los Angeles, and Baltimore have restricted its use, with New York City School's releasing a statement that restricted the technology use based on "concerns about negative impacts on student learning, and concerns regarding its safety and accuracy of content" (Senechal et al., 2023, p. 7). Virginia's Governor Glen Youngkin lobbied for school districts' bans of the technology following Fairfax County, Virginia's prohibition on the technology, stating that "if a machine is thinking for (our students), then we're not accomplishing our goal" (Senechal et al., 2023, p. 7), but then changed course in 2024 by creating a roadmap of ethical guidelines for the use and exploration of this technology in the classroom (Commonwealth of Virginia, 2024). Other school divisions, like Prince George's County in Maryland and Orange County, Florida, have also viewed this technology with curiosity and mindful planning. Open conversations, education, and training on the benefits of these technologies for Autistic youth also need to become part of the narrative, particularly in the area of Pre-ETS. However, targeting educators and vocational counselors for professional development on the ethical use of these technologies in developing workplace readiness will have only a limited impact if policies on using these technologies leave out the Autistic community.

Limitations

This scoping review is limited by the number of articles included. As this is a quickly evolving area of research, studies were being developed and published as we worked. Research conducted by and with individuals with lived experience in these areas of research have the potential to expand this important body of research. Even so, readers are cautioned to take this information in light of the evolving nature of this field.

Technology recommendations

Iannone and Giansanti (2024) have forecasted that, in the future, AI may assist in determining the best tools and supports based on assessment data and provide tailored solutions to meet the specific needs of the Autistic individual. However, until such technological advances are refined, facilitators should use caution with any technology or tool that offers a one-size-fits-all approach.

VR is the primary focus of the current body of research on the use of technology in supporting workplace readiness with Autistic youth, but it has yet to be widely accessible for the purpose of pre-ETS. Grynszpan et al. (2014) acknowledged that these tools are primarily used in research settings, but need to be utilized more in practice. They further note that this "presents a special challenge to designers to develop games and interventions that will not only be effective but will also be accessible in terms of price and ease of operation" (p. 358).

In an effort to mitigate some of the barriers to effective use and integration of technology, Deschsling et al. (2022) recommended interdisciplinary collaboration between software and technology developers, autism researchers, and Autistic individuals. In addition to the inherent technical challenges of developing AI tools to support workplace readiness skills in Autistic transition-aged youth, there are financial aspects that make it difficult to implement or sustain. Installation, maintenance, and repair of AI tools is often cost-prohibitive for school districts. Barua et al. (2022) suggested that the use of a cloud-based approach would make AI tools more affordable and accessible. Cloud systems simply refer to applications or software programs hosted over the internet, including well-known systems such as Amazon Web Services, Google Cloud, Salesforce, and Dropbox. These systems have become increasingly integrated into daily life and capitalizing on the use of cloud-based systems and AI for pre-ETS would provide numerous benefits for stakeholders. Data collection and analysis via intelligent automation reduces the time and effort required by educators, while simultaneously providing real-time, personalized recommendations for students (Barua et al., 2022). By leveraging the capabilities of cloud-based systems, educators can more effectively integrate AI as a multi-faceted tool for preparing Autistic students for their transition into the workplace.

Conclusion

AI and virtual technologies have exploded into every facet of modern life. The emergence of these technologies provides a rich landscape to explore the use of these tools in preparing transition-aged youth with autism for better employment outcomes. With these opportunities comes a responsibility for stakeholders to establish ethical guidelines and participatory research or inclusion of Autistic youth in developing technologies such as Virtual Reality and head-mounted devices. Deliberate and creative exploration regarding the use and feasibility of this technology for Pre-ETS curriculum with students in the autism and neurodivergent communities is key to creating holistic teaching and employment practices.

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Ethics statement

This paper did not require IRB approval.

Informed consent

Not applicable.

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