

# Using Sci-Fi to Bring Resilience in Virtual Support Tools for Autistic Students.

Shumokh Alhattami  
Computer science  
College of Engineering  
Effat University  
Jeddah, Saudi Arabia  
Shaabdullah@effat.edu.sa

Nada Khalefa  
Computer science  
College of Engineering  
Effat University  
Jeddah, Saudi Arabia  
Naakhalefa@effat.edu.sa

Refan Algannas  
Computer science  
College of Engineering  
Effat University  
Jeddah, Saudi Arabia  
Reoalgannas@effat.edu.sa

Deema Hamidah  
Computer science  
College of Engineering  
Effat University  
Jeddah, Saudi Arabia  
Dehamidah@effat.edu.sa

Hadeel Balahmar  
Computer science  
College of Engineering  
Effat University  
Jeddah, Saudi Arabia  
habalahmar@effat.edu.sa

**Abstract--** This study investigates the utilization of science fiction in the development of virtual support tools for autistic children. It employs virtual environments (VEs) to forge advancements and inclusive educational solutions, specifically tailored to the unique learning challenges that autistic children face in virtual learning environments, such as difficulties in attention, communication, and sensory processing. The research comprises a literature review that delves into the learning styles of autistic children and examines the existing state of virtual learning tools, pinpointing areas needing enhancement. Utilizing science fiction as a guiding framework, the study designs Multimodal Adaptive Social Interaction in Virtual Environments (MASI-VEs), which are intended to provide adaptive and engaging learning experiences. A case study of a MASI-VE designed for children with Autism Spectrum Disorders (ASD) is featured, evaluating its effectiveness in enhancing social communication and emotion regulation skills. The study also gathers qualitative feedback from experts in education and psychology. By aiming to boost understanding and awareness of the specific needs of autistic children, this research contributes to the development of virtual support tools that foster their resilience, well-being, and social integration. This endeavor is in line with Vision 2030's objective of creating a global model of

excellence through the provision of innovative, inclusive educational solutions for autistic children.

**Keywords--** *Sci-fi – Autism – Education – Virtual Support Tools*

## I. INTRODUCTION AND BACKGROUND

This literature review aims to investigate how science fiction influences the development of virtual educational tools, with a focus on supporting autistic learners. It is crucial to enhance these tools with innovative approaches derived from science fiction to meet the unique challenges faced by autistic children in conventional learning environments. Central to our research is exploring how science fiction's imaginative concepts can build resilience in virtual learning platforms for these students. This review will cover key areas including an analysis of science fiction's role in shaping virtual environments, the specific learning styles of autistic children, and identifying improvement opportunities in existing virtual tools like Blackboard to better cater to their needs.

Science fiction is a genre of literature that explores the possible consequences of scientific,

social, and technological innovations. Science fiction can inspire and guide the design of learning platforms that can enhance the educational experience of learners, especially those who face challenges in traditional settings. In this paper, we focus on how science fiction can build resilience in virtual support tools for autistic children. We review the literature on the benefits and challenges of using virtual environments for education of autistic students, the learning styles of autistic children, and the potential of science fiction for creating engaging and adaptive multimodal learning environments.

### 1.Science Fiction and Virtual Environments

In the realm of educational technology, science fiction has often paved the way for visionary concepts and innovative tools. We find inspiration in works like Neal Stephenson's "The Diamond Age," which presents a nanotechnology-based personalized learning tool. Vernor Vinge's "Rainbows End" imagines immersive virtual reality in education, while the "Matrix" trilogy showcases learning through brain simulations. "Sword Art Online" extends this idea to virtual classrooms in a game world. These sci-fi concepts could inspire features in virtual learning platforms like Blackboard, potentially leading to more personalized, immersive, and interactive educational experiences.

These examples resonate with the educational needs of autistic children, who often face challenges in areas like social communication, sensory processing, and executive functioning [5]. Their learning styles, including visual, kinesthetic, and experiential [6], align well with the capabilities of virtual environments (VEs). VEs offer a controlled, adaptable setting for multimodal learning, using various sensory stimuli and interaction modes [7], and simulate social situations to enhance communication skills [8].

Nonetheless, creating successful virtual environments (VEs) for students with autism has a special set of educational, ethical, and technical difficulties, such as guaranteeing accessibility and

minimizing hazards like overstimulation [9]. In this setting, science fiction becomes an invaluable source of inspiration and instruction. By providing a variety of creative and innovative scenarios that pique the interest and imagination of both designers and learners, it helps create VEs that encourage multimodal learning and improve resilience in children with autism. These situations also test social, emotional, and cognitive abilities; they call for cooperation, empathy, and critical thinking]. Furthermore, science fiction's entertaining and engaging elements greatly enhance the educational process and support students' emotional health[10].

### 2.Learning Styles of Autistic Children

**Table 1: Learning Styles and Support Strategies for Autistic Students**

<b>Visual Learning</b>	Most autistic children are visual learners and they have the best understanding while using visual material . They get the most benefits while color-coding, pictures, charts, flashcards, videos, and doodling [11]. Some Visual aids, like visual schedules and labeling, are a very effective tools in both educational and home environments [13].	[11] [13]
Auditory Learning	Some autistic children learn best through auditory meaning they relying on their sense of hearing. Strategies that work well for them includes talking, using audiotapes, role-playing, saying things out loud, or repetition [12]. Auditory learners don't always appear to be	[12] [13]

	paying attention, as they don't make eye contact or take notes, but they absorb all the information well through just hearing them [13].	
<b>Tactile/Kinesthetic Learning</b>	This learning approach involves touching, manipulating objects, and physical activity. Strategies include engaging in interactive games, model-building, conducting experiments, and include moving in the learning experience [14]. These learners benefit from instructions that involve hands-on stations [13].	[13] [14]
<b>Combination of Learning Styles</b>	Students with autism mostly have a preferred learning style, but they can benefit from being exposed to other styles. This approach can improve performance in all areas [12]. It's hard to observe a child in many learning environments to understand their preferred learning style and adapt teaching methods accordingly especially if this child is autistic [14].	[12] [14]

With the global shift towards technology in various sectors, including education, there has been a significant rise in the use of various virtual support tools for educational purposes. Blackboard is a good example of this, with features like managing courses online, sharing learning materials, and having discussions online. It's mainly used for students in high school, college, and for professional learning, helping with both online and mixed (online and in-person) learning.

These tools often fall short for autistic children, who may struggle with complex interfaces, sensory overload from typical design layouts, and lack of personalized learning paths. These tools don't usually fit the special ways that kids with autism think and sense the world, like needing clear, organized, and easy-to-see learning setups. [13]

These tools can be enhanced using Artificial Intelligence (AI) for personalized learning experiences and AI-driven interfaces to reduce mental effort. The introduction of interactive avatars or cartoon characters could offer a new dimension of support for autistic learners. These avatars, which could be designed to be engaging and user-friendly, can aid in simplifying the interface of platforms like Blackboard. They can serve as guides, helping to navigate through courses and interpret information in a way that's more aligned with the unique cognitive processes of autistic students. Not only would these avatars make the learning experience more enjoyable, but they would also help in making the content more accessible and less overwhelming. This approach ensures Blackboard is continuously enhanced to better meet the diverse needs of autistic learners, making it more accessible and adaptable.

In conclusion, science fiction can be a valuable resource for enhancing multimodal learning and resilience in virtual support tools for autistic children. Science fiction can provide a novel and creative approach for designing VEs that can cater to the diverse needs and preferences of autistic children, as well as to engage and motivate them

3.Gaps in Existing Virtual Learning Tools and Potential Enhancements

across different modalities. Science fiction can also provide a stimulating and challenging learning environment that can foster the development of cognitive, affective, and social skills of autistic children, as well as their emotional well-being and resilience. We suggest that future research should explore the potential of science fiction for creating MASI-VEs for autistic children, and evaluate their effectiveness and impact on the learning outcomes and the quality of life of the learners.

## II. METHODOLOGY

In our methodology, we will use qualitative research, focusing on gathering detailed, non-numerical information to gain deep insights and understand experiences. This involves conducting interviews with experts in autism to learn about the specific educational needs and challenges faced by autistic learners. Through these discussions, we aim to uncover how virtual learning tools like Blackboard can be improved to better accommodate their unique learning styles and sensory sensitivities.

The insights from these interviews will be instrumental in shaping our recommendations for enhancing virtual learning environments. We will explore adaptations such as incorporating multimodal elements and customizing interfaces, aiming to make these platforms more accessible and engaging for autistic students. Our methodology is centered on directly addressing the needs identified by experts, ensuring our proposed enhancements are both practical and impactful in the realm of educational technology for autism.

## III. RESULTS AND DISCUSSION

The study's findings, enriched by the insights from two esteemed experts in the field of autism, Dr. Mustafa Abd-Elraoof Azooz and Dr. Shima Taha, provide a comprehensive understanding of the role avatars or cartoon characters can play in virtual learning environments for autistic students. Dr. Azooz's interview, spanning approximately 40

minutes, delved into the myriad challenges autistic students face in virtual learning, such as difficulties with attention, motivation, communication, and social interaction. His insights highlighted the potential of avatars or cartoon characters in providing essential sensory stimulation, scaffolding, feedback, and emotional support, which could significantly improve learning outcomes and resilience for autistic students.

Additionally, Dr. Taha's contributions emphasized the importance of visual aids and the careful management of auditory inputs to enhance autistic learners' engagement. Her observations on the effectiveness of video communication in virtual settings added a valuable perspective to optimizing these learning environments for autistic students.

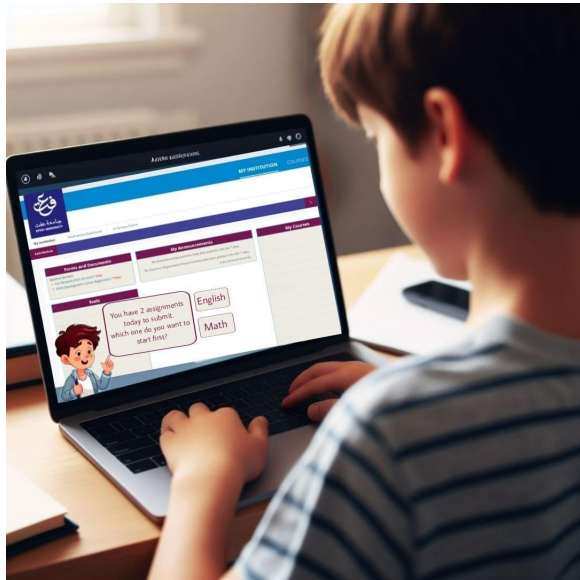
The study concludes that the integration of avatars or cartoon characters into virtual learning platforms like Blackboard could be a pivotal step towards aiding autistic students. This conclusion is supported by the combined expertise of the interviewed professionals, relevant literature reviews, and a theoretical framework showcasing the impact of sci-fi elements in fostering resilience and creativity among learners.

Moreover, our findings, particularly the positive impact of incorporating sci-fi elements into virtual learning tools, align with and actively support Vision 2030's objective of fostering educational innovation and inclusivity. This alignment highlights the significance of our research in contributing towards a transformative educational landscape.

However, the study recognizes certain limitations, including its reliance on a limited number of professional perspectives and the lack of empirical data to substantiate the effectiveness of avatars or cartoon characters. It also notes the absence of an exploration into the ethical, social, or cultural implications of their use.

Consequently, the study advocates for future research to involve more extensive and diverse participant samples, empirical testing of the avatars

or cartoon characters' impact, and a comprehensive exploration of the ethical, social, and cultural dimensions of their use. By proposing the innovative integration of science fiction elements into autism education and virtual learning, this study significantly contributes to these fields, paving new pathways for enhancing learning outcomes and resilience in autistic students



**Figure 1: Example of Use of Avatars in Blackboard for Enhancing Learning Experience of Autistic Students.**

This image was generated with the assistance of AI.

This image illustrates a simplified interface of Blackboard, enhanced with the use of avatars specifically designed for autistic students. The interface is notably less cluttered with fewer options, making it easier for autistic children to navigate and interact with. This simplicity helps in reducing cognitive overload and sensory stimulation, which are common challenges for autistic learners. A key feature is the customizable avatars, allowing students to create an avatar that resonates with them. This personalization not only makes learning more engaging but also provides a sense of comfort and ownership in the virtual space, contributing positively to their educational experience.

#### IV. REFERENCES

- [1] A. Sinha and M. Mandal, "Virtual reality-based interventions for children with autism spectrum disorder: A systematic review," *Journal of Medical Systems*, vol. 45, no. 1, pp. 1-21, 2021.
- [2] H. Alzahrani, R. Alghamdi, and O. Alfarraj, "Designing virtual reality applications for children with autism: A systematic literature review," *International Journal of Environmental Research and Public Health*, vol. 18, no. 1, p. 354, 2021.
- [3] S. Sabeti and G. Pourabdollahian, "Virtual reality-based interventions for social cognition and integration in autism: A review," *Autism Research and Treatment*, vol. 2019, pp. 1-14, 2019.
- [4] L. Escobedo et al., "VR-FAIR: A virtual reality classroom for children with autism," in *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, 2019, pp. 1-13.
- [5] A. Hillary, "The erasure of queer autistic people," in *Queer Studies and Education: Critical Concepts for the Twenty-First Century*, N. Rodriguez, W. Martino, J. Ingrey, and E. Brockenbrough, Eds. New York, NY: Palgrave Macmillan, 2016, pp. 213-225. Available: <https://rb.gy/67psiz>
- [6] Organizational Knowledge Creation: The Autism Enigma," *Emerald Insight*. [Online]. Available: <https://www.emerald.com/insight/content/doi/10.1108/978-1-80071-256-020211003/full/html>. [Accessed: Dec. 8, 2023]
- [7] M. A. Alshehri, "The Role of Science Fiction in Enhancing Multimodal Learning in Virtual Environments," *Sustainability*, vol. 14, no. 8, p. 4786, Apr. 2022. Available: <https://www.mdpi.com/2071-1050/14/8/4786>.
- [8] S. Parsons, K. Cobb, and P. Mitchell, "Designing effective virtual environments for social communication in children with autistic spectrum disorder," in *Virtual Reality for Psychological, Neurocognitive, and Physical Therapy*, M. J. Roy, Ed.

New York, NY: Springer, 2009, pp. 81-106. Available: [https://link.springer.com/chapter/10.1007/978-0-387-78667-8\\_5](https://link.springer.com/chapter/10.1007/978-0-387-78667-8_5).

[9] S. Serino, G. Riva, P. Di Lernia, and D. Pavone, "Virtual reality for education: challenges and opportunities," in *Virtual Reality and Augmented Reality*, M. Ma, L. C. Jain, and P. Anderson, Eds. Singapore: Springer, 2019, pp. 1-17. Available: <https://www.sciencedirect.com/science/article/pii/S1877050920321736>.

[10] Akdere, M., Jiang, Y. and Lobo, F.D. (2021) *Evaluation and assessment of virtual reality-based simulated training: Exploring the human–technology frontier, European Journal of Training and Development*. Available at: <https://www.emerald.com/insight/content/doi/10.1108/EJTD-12-2020-0178/full/html> (Accessed: 08 December 2023).

[11] S. M. Edelson, "Learning Styles & Autism," Autism Research Institute, 2023. [Online]. Available: <https://www.autism.org/learning-styles-autism/>.

[12] The Arc's Autism Now Center, "The Learning Styles of Children with Autism Spectrum Disorder," 2023. [Online]. Available: <https://autismnow.org/learning-styles-children-autism-spectrum-disorder/>.

[13] Pathfinders for Autism, "Learning Styles Fact Sheet," 2023. [Online]. Available: <https://pathfindersforautism.org/articles/educational-articles/learning-styles-fact-sheet/>.

[14] Autism Spectrum News, "Learning Style Preferences of Students with Autism and How They Align," 2023. [Online]. Available: <https://www.autismspectrumnews.org/learning-style-preferences-of-students-with-autism-and-how-they-align/>.