The Importance of Design Elements in Special Education of Individuals with Autism and Learning Disabilities

Efecan Serin¹, Dimas Rifqi Novica², and Ima Kusumawati Hidayat²

¹Universidade de Lisboa, Lisbon, Portugal
²Universitas Negeri Malang, Malang, Indonesia

ORCID:
Efecan Serin: http://orcid.org/0000-0002-3741-8115

Abstract
This study examines the fundamental relationship between design and special education. The paper presents a literature review on autism learning difficulties and special education, including the scope of sensors, training, accessibilities, learning methods and requirements, and their connection with design needs. According to the study, the benefits of using specially designed elements in special education can contribute to the student’s learning and perception processes. A further recommendation is to develop more research in educational materials specially designed according to an individual’s design needs in reading, acquiring essential life skills, and communication.

Keywords: Autism, design, special education

1. Introduction
Autism Spectrum Disorder (ASD) has been defined as a developmental disability characterized by social communication and interaction deficiencies that affect basic human behaviors and can persist throughout life [1]. ASD is often associated with sensory processing difficulties, including excessive or under-sensitivity, to sensory stimuli in the environment [2]. There is no medical test that can diagnose people with ASD. However, when the necessary educational interventions are applied, it has been observed that they could overcome social and communicative problems. The findings obtained from many research [3]–[8] revealed that the education strategies for people with ASD should be developed according to their individual needs. Also, it states that early intervention is essential to develop education strategies as a treatment for autism.

Autism and learning disability are co-associated. Autism is prevalent among individuals with learning disabilities and increases accordingly with lower levels of IQ. Previous
research has estimated that 30-50% of people with ASD were found with severe learning disabilities [9]–[11]. These numbers have indicated that the two conditions are so strongly connected that there has been some concern regarding whether they should be considered as different syndromes.

Effective educational strategies help these individuals with autism and learning difficulties to gain social and academic skills [12]. An interdisciplinary approach to education is critical in teaching people with ASD. This article explores the design relevance of these effective teaching strategies.

2. Method

The literature was gathered to create a resource of knowledge in several scopes, such as sensors, computer-based programs, visual strategies, accessibilities, and reading education. The literature was then reviewed to obtain essential information for developing a design approach in special education for individuals with autism and learning difficulties. The aim of the study is to draw attention to the necessity of specially designed products in special education and to reveal the need for specially designed products.

3. Sensor

Individuals with autism may have difficulty processing sensory information and may overreact to environmental stimuli such as noise, colors, and sunlight, while other individuals with autism may not notice or respond to such inputs [13], [14].

Since such emotional problems affect learning activity, different learning environment designs have been developed for such individuals to benefit [15]. A study on color perception of individuals with autism mentioned that they generally react to yellow color. Grandgeorge and Masataka [16] believed that this might be due to the fact that yellow is the brightest color. However, many designers are unaware of the sensory issues related to the built environment in the daily life of autism before the design phase. Any unwanted distraction could negatively affect children's learning ability [17].

The communication, cognitive, and focus problems of children diagnosed with ASD are frequently mentioned in the literature [18]. These problems can negatively affect the teaching processes of individuals. For this reason, many approaches have been developed to gain efficiency in children with autism education. One of these approaches is technology-based approaches [19].
4. Computer-Based Programs

Common attention skills in students with ASD could be controlled by giving them social and non-social cues such as social stimuli speaking, making eye contact, and distractor toys [20]. However, making eye contact negatively affects children’s teaching processes [21]. Interactive teaching designs, game designs, computer-aided activities, and applications come to the fore within the framework of an individual’s mental processes with autism [22], [23]. The research summary between 2010-2014 made by Omar and Bidin [24] showed that visual strategies and computer-based programs are essential for autism. It can improve the understanding of information when texts and images are presented with computer-based programs.

As a result, computer technologies specially designed for autistic children have content that focuses on eliminating problems such as deficiency in communication and inability to speak, which concurrently with autism. The computer is seen as an exciting object by autistic children, which has made the computer an easily used and useful tool in educational activities [25]. Moreover, using computer-based programs is proven helpful in improving literacy ability and understanding written texts on individuals with autism [26]–[29].

5. Visual Strategies

Visual communication strategies have been applied as the primary communication and education method in individuals with communication and language problems [30]. suggested that using visual strategies in the education of individuals with autism significantly affects the learning process. Similarly, other studies [31]–[33] have demonstrated that visual strategies enhance the daily routine and independent behaviors of people with autism [34]. Moreover, it is indicated that visuals increase reliability, predictability, and a sense of stability [35]. The most well-known visual communication technique used on individuals with autism is The picture exchange communication system (PECS) [12].

The study on autism and education with visual support emphasizes that children with ASD learn more visually compared to auditory or other alternative ways [36]. In addition, used colors in education can be beneficial for the education activities of individuals with autism [37]. Information technologies present visual, text, touch, and sound components with multimedia tools according to the user’s preference. Therefore, individuals with autism enable to use these technologies easily [38]. For instance, One
computer application enables a child with ASD to make a few sentences to ask for food or toys, which express their daily needs [39].

6. Accessible Design

Accessible design is the concept of creating products, devices, services, or environments that can be used by all individuals (with and without disabilities) [40]. There are many studies of non-governmental organizations in countries around the world for accessible design [41]. However, the most striking of them is The World Wide Web Consortium (W3C) [42]. The Web is necessarily designed to work for all people, regardless of their hardware, software, language, location, or ability. Thus, in order to accommodate disabilities, the Web continually changes. Certain websites are designed for individuals with autism and learning disabilities, where design is prioritized and designed according to the perception and sensory characteristics of individuals. The most striking of these is the 'easy to read' web plugin, which includes easy reading and perception study designed by Autism Europe. The web plugin consists of a special web page made for an individual's design requirements. There are several options to change the website's visual, such as changing the text or the color of the website on the page. The examples of design changes in the website can be seen in Figure 1 [43].

![Figure 1: From Left To Right The Layout Of Autism Europe Design: Normal Version, Black And Yellow Version, And Easy To Read Version](image)

7. Reading Skill

Reading is an essential skill to be acquired in primary school [44]. It is expected from students that they will first learn to read and then read to learn [45]. The reading phase in the learning process is necessary and recommended for everyone, including people with ASD. A study investigating learning to read performance in people with autism reported that they might have difficulties learning letterform based on letter design. They may confuse letters that look similar to each other based on letterform design. The research resulted in a new font design adapting learning to read strategies for individuals with autism and learning difficulties [46]. Furthermore, easy to read
instructions were also provided for people with ASD. These instructions are adapted from the UK Department of Health [47], ILSMH European Association [48], and Ofqual [49].

8. Conclusion

Although the literature generally states that individuals with autism benefit from visual strategies [36] and special education strategies [12], the use of specially designed elements in special education and the evidence-based results of these design elements are limited in the literature.

Even though it is emphasized that visual strategies are essential for autism and learning disabilities, the quality of the visual or the effects of the specially designed visual strategies is not fully explained [30]. According to the results of evidence-based sensory sensitivity studies, it is stated what kind of color should be used for individuals with autism [16]. However, in the literature, it is not mentioned what kind of design elements should be used on the designed special education object for individuals with autism or learning difficulties except the color. It was seen in the emerging literature there were limited instructions to be able to design for visual requirements of individuals with autism and learning disabilities.

However, it was developed some customizable design tools according to individual characteristics in order to enable individuals with autism to comprehend better and contribute to their communication activities by using empirical knowledge, although it is not based on evidence, e.g., Europe Autism- Easy to read [43] and Open Book - First Project [50].

As a result, it is thought that specially designed educational materials should be designed according to the sensory needs and developmental disorders of an individual, and attention-increasing elements should be added to the design to contribute to the individual’s educational activities. However, this judgment should be tested, and the contribution of design elements to individuals with autism and learning difficulties should be determined.

According to the review, There is still an inadequate design research approach to provide special education studies and products. Considering these factors, it is recommended to conduct more research on specially designed educational materials according to an individual’s design needs in terms of reading skills, basic life skills, or communication skills.
References

[1] American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (DSM-5) (5th ed.). https://doi.org/10.1176/appi.books.9780890425596

[2] Christensen, D. L. et al. (2018) Prevalence and characteristics of Autism Spectrum Disorder among children aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2012. Morbidity and Mortality Weekly Report Surveillance Summary, 65(13), 1–23. http://dx.doi.org/10.15585/mmwr.ss6503a1

[3] Corsello, C. M. (2005). Early intervention in Autism. Infants Young Children, 18(2).

[4] Elkeseth, S., Smith, T., Jahr, E., & Eldevik, S. (2002). Intensive behavioral treatment at school for 4- to 7-year-old children with Autism: A 1-year comparison controlled study. Behavior Modification, 26(1), 49–68.

[5] Iovannone, R., Dunlap, G., Huber, H., & Kincaid, D. (2003). Effective educational practices for students with Autism spectrum disorders. Focus on Autism and Other Developmental Disabilities, 18(3), 150–165.

[6] Lovaas, O. I. (2002). Teaching individuals with developmental delays: Basic intervention techniques.

[7] Stephens, C. E. (2005). Overcoming challenges and identifying a consensus about Autism intervention programming. International Journal of Special Education, 20(1), 35–49.

[8] MacDuff, G. S., Krantz, P. J., & McClannahan, L. E. (1993). Teaching children with autism to use photographic activity schedules: Maintenance and generalization of complex response chains. Journal of Applied Behavior Analysis, 26(1), 89–97.

[9] Fombonne, E. (1999). The epidemiology of autism: A review. Psychological Medicine, 29(4), 769–786.

[10] O’Brien, G., & Pearson, J. (2004). Autism and learning disability. Autism, 8(2), 125–140.

[11] Emerson, E., & Baines, S. (2010). The estimated prevalence of Autism among adults with learning disabilities in England. Improv. Heal. Lives Learn.

[12] National Research Council. (2001). Educating children with Autism. The National Academies Press.

[13] Ben-Sasson, A., Hen, L., Fluss, R., Cermak, S. A., Engel-Yeger, B, & Gal, E. (2009). A meta-analysis of sensory modulation symptoms in individuals with Autism spectrum disorders. Journal of Autism and Developmental Disorders, 39(1), 1–11.
[14] Tomchek, S. D., & Dunn, W. (2007). Sensory processing in children with and without autism: A comparative study using the short sensory profile. *American Journal of Occupational Therapy, 61*(2), 190–200.

[15] Mostafa, M. (2008). An architecture for Autism: Concepts of design intervention for the Autistic user. *Archnet-IJAR: International Journal of Architectural Research, 2*.

[16] Grandgeorge, M., & Masataka, N. (2016). Atypical color preference in children with Autism Spectrum Disorder. *Frontiers in Psychology, 7*.

[17] Ghazali, R., Sakip, S., & Samsuddin, I. (2018). The effects of sensory design on Autistic children. *Asian Journal of Behavioural Studies, 3*, 68.

[18] Newell, L. C., Best, C. A., Gastgeb, H., Rump, K. M., & Strauss, M. S. (2011). *Infant perception and cognition: Recent advances, emerging theories, and future directions*. Oxford University Press.

[19] Baron-Cohen, S., Ashwin, E., Ashwin, C., Tavassoli, T., & Chakrabarti, B. (2009). Talent in Autism: Hyper-systemizing, hyper-attention to detail and sensory hypersensitivity. *Philosophical Transactions of the Royal Society B, Biological Sciences, 364*(1522), 1377–1383.

[20] Chawarska, K., Macari, S., & Shic, F. (2012). Context modulates attention to social scenes in toddlers with Autism. *Journal of Child Psychology and Psychiatry, 53*(8), 903–913.

[21] Carbone, V., Obrien, L., Sweeney-Kerwin, E., & Albert, K. (2013). Teaching eye contact to children with Autism: A conceptual analysis and single case study. *Education & Treatment of Children, 36*, 139–159.

[22] Eristii S. B., Firat, M., Izmirli S., & Ceylan, B. (2017). Otizm Spektrum Bozukluğu olan Çocuklar için tasarım tabanlı araştırma yaklaşımına dayalı eğitsel oyun tasarım. *Uludağ Üniversitesi Eğitim Fakültesi Derg., 30*(1), 73–99.

[23] Tsai, T-W., & Lin, M-Y. (2011). An application of interactive game for facial expression of the Autisms BT - Edutainment Technologies. Educational games and virtual reality/augmented reality applications. 204–211.

[24] Omar, S., & Bidin, A. (2015). The impact of multimedia graphic and text with Autistic learners in reading. *Universal Journal of Education Research, 3*, 989–996.

[25] Ersöz, A., & Ceylan, M. (2013). Bilişim teknolojilerinin Otizm Spektrum Bozukluğunun tedavisinde kullanımı.

[26] Chiang, H-M., & Lin, Y-H. (2007). Reading comprehension instruction for students with Autism spectrum disorders: A review of the literature. *Focus on Autism and Other Developmental Disabilities, 22*(4), 259–267.
[27] Whalon, K. J., Al Otaiba, S., & Delano, M. E. (2009). Evidence-based reading instruction for individuals with Autism spectrum disorders. *Focus on Autism and Other Developmental Disabilities, 24*(1), 3–16.

[28] Ramdoss, S. et al., (2011). Use of computer-based interventions to improve literacy skills in students with Autism spectrum disorders: A systematic review. *Research in Autism Spectrum Disorders, 5*(4), 1306–1318.

[29] Basil, C., & Reyes, S. (2003). Acquisition of literacy skills by children with severe disability. *Child Language Teaching and Therapy, 19*(1), 27–48.

[30] Meadan, H., Ostrosky, M. M., Triplett, B., Michna, A., & Fettig, A. (2011). Using visual supports with young children with Autism Spectrum Disorder. *Teaching Exceptional Children, 43*(6), 28–35.

[31] Arthur-Kelly, M., Sigafouss, J., Green, V., Mathisen, B., & Arthur-Kelly, R. (2009). Issues in the use of visual supports to promote communication in individuals with Autism Spectrum Disorder. *Disability and Rehabilitation, 31*(18), 1474–1486.

[32] Cohen, M. J., Sloan, D. L. (2007). *Visual supports for people with Autism: A guide for parents and professionals.* Woodbine House.

[33] Dettmer, S., Simpson, R., Myles, B., & Ganz, J. (2000). The use of visual supports to facilitate transitions of students with Autism. *Focus on Autism and Other Developmental Disabilities, 15*, 163–169.

[34] Ganz, J. (2007). Classroom structuring methods and strategies for children and youth with Autism spectrum disorders. *Exceptionality, 15*, 249–260.

[35] Hodgdon, L. A. (1995). *Visual strategies for improving communication: Practical supports for school and home.* Quirkroberts Pub.

[36] Rao, S. M., & Gagie, B. (2006). Learning through seeing and doing: Visual supports for children with Autism. *Teaching Exceptional Children, 38*(6), 26–33.

[37] Ludlow, A. K., Wilkins, A. J., & Heaton, P. (2008). Colored overlays enhance visual perceptual performance in children with Autism spectrum disorders. *Research in Autism Spectrum Disorders, 2*(3), 498–515.

[38] Goldsmith, T. R., & LeBlanc, L. A. (2004). Use of technology in interventions for children with Autism. *J. Early Intensive Behav. Interv., 1*(2), 166–178.

[39] Wolpaw, J. R., McFarland, D. J., & Vaughan, T. M. (2000). Brain-computer interface research at the Wadsworth Center. *IEEE Transactions on Rehabilitation Engineering, 8*(2), 222–226.

[40] Centre for Universal Design. (2006). Definitions: Accessible, adaptable, and universal design. 1–3.
[41] Erlandson, R. F. (2007). *Universal and accessible design for products, services, and processes*. CRC Press.

[42] World Wide Web Consortium: Web Accessibility Initiative (WAI). (2019). *Introduction to web accessibility*. https://www.w3.org/WAI/fundamentals/accessibility-intro/

[43] Autism Europe. (2020). *Autism Europe*. Retrieved November 17, 2020, from https://www.autismeurope.org/

[44] The National Institute for Literacy. (2009). *Developing early literacy: Report of the National Early Literacy Panel*.

[45] Herbers, J. E., et al., (2012). Early reading skills and academic achievement trajectories of students facing poverty, homelessness, and high residential mobility. *Educational Research, 41*(9), 366–374.

[46] Serin, E., Morgado, A. L. M., & Santos, R. (2020). A Latin-script typeface, based on special education teachers’ opinions, to use in literacy education of individuals with Autism. *Visible Language, 54*(1/2), 67–97.

[47] Department of Health. (2009). *Basic guidelines for people who commission Easy Read information*. DH Publications Orderline.

[48] Freyhoff, G., Hess, G., Kerr, L., Tronbacke, B., Van, K., & Veken, D. (1998). *Make it simple*.

[49] Janan, D., & Wray, D. (2012). *Guidance on the principles of language accessibility in national curriculum assessments research background*.

[50] Mitkov, R. (2014). *Project*. First project. http://www.first-asd.eu/?q=about