Educational Technology Trends for Children with Autism Spectrum Disorder

Okan ARSLAN
Texas Tech University, United States
okan.arslan@ttu.edu
ORCID: 0000-0003-0245-6063

Fethi A. INAN
Texas Tech University, United States
fethi.inan@ttu.edu
ORCID: 0000-0002-1340-7980

Hyunchang MOON
Texas Tech University, United States
hyunchang.moon@gmail.com
ORCID: 0000-0003-0973-2593

Yusuf Murat OZDEMIR
Texas Tech University, United States
y.m.ozdemir@ttu.edu
ORCID: 0000-0002-3861-1013

Selin Deniz UZUNOSMANOGLU
Koc University, Turkey
suzunosmanoglu@ku.edu.tr

ABSTRACT
The purpose of this study is to explore a variety of technologies used in Autism Spectrum Disorder (ASD) education by examining published studies. A systematic literature review was conducted by using the Web of Science database to collect related studies. In total, 100 studies were reviewed comprehensively to investigate the trend regarding type and purpose of technology use, the kinds of technology commonly used for targeted skill development and instructional delivery tool. The results revealed that 1) the trend of scholarly publications have increased until 2016, 2) there are more studies targeted social skill rather than academic skills, 3) video, computer software, and mobile applications are commonly used software/multimedia, and 4) computers, mobile devices, and nondigital object are the most frequent used hardware for targeted skills.
Keywords: Autism Spectrum Disorder, Assistive Technology, Educational Technology, Special Education

INTRODUCTION

We have a very large sample of diversity in our daily lives, and autism spectrum disorder (ASD) is just one of them. ASD is not a disease, but a spectrum, a neurodevelopment disorder that affects general and social communication features such as verbal and nonverbal. (IDEA, 2007). The prevalence of ASD has been dramatically growing recently. According to the Centers for Disease Control and Prevention (CDC), the odds for an ASD diagnosis in the USA was increased from 1 in 68 (2013) to 1 in 54 rapidly in 8 years (CDC, 2020). Similarly, Baio et al. (2018) also discussed a significant increase, stating that the prevalence of ASD has risen 162.5% since 2002. Although the rates of diagnosis vary among continents, the CDC (2018) and Xu et al. (2018) reported that various studies in different continents expressed a determined average prevalence rate of 2.47%.

People with ASD have some common characteristics such as repetitive behaviors, stereotyped movements, constrained interests, resistance to routine changes, as well as unexpected responses to stimulus. Regardless of the severity of the common signs, their daily activities are influenced by their unique characteristics (Schall & McDonough, 2010). What is more, compared to their same-age peers, students with developmental disabilities, including ASD, have more challenges with academic skills, which usually results in lower achievement (Lynch et al., 2007). Thus, people with ASD may need extra supports in both social and academic skills. In a recent study, Arslan and Inan (2019) analyzed the topics of ASD-related posts on social media and reported that the need for special education strategies, challenges in a child's daily life, and communication and interactions skills were the three frequent topics among most discussed 10 topics.

Aligning with the increase in diagnosed cases of ASD, various non-digital and digital technologies have been developed and used in the ASD field today. The numbers of software and hardware dedicated to individuals with

ASD have accordingly increased (Bartemole & Zapirain, 2014). To assist people with ASD in developing social and academic skills, various research has been conducted on the effectiveness of new technologies such as computers, laptops, tablets, and various mobile devices, videos, toys, and a variety of software applications, in various intervention settings (Cai et al., 2017; Cheng et al., 2018; Fage et al., 2019; Gallardo-Montes, Caurcel Cara, & Rodríguez Fuentes, 2021; Ingersoll & Wainer, 2013; Murry, 2018; Panerai et al., 2018; Takeo, Toshitaka & Daisuke, 2007). Technology also has a great potential to capture the attention of children with ASD more easily than non-digital objects because it creates controllable and predictable environments as well as creates and offers visual multisensory stimulation that helps with motivation and reinforcement (Takeo, Toshitaka & Daisuke, 2007). Additionally, technology supports the education of students with ASD by maintaining children's attention and minimizing their frustration (Ingersoll & Wainer, 2013).

In these days, it is common to observe individuals with ASD engaging with computing devices more than in other spare-time activities (Shane & Albert, 2008). These technologies could provide opportunities to meet the needs of students with ASD, allowing family members and professionals to start interventions early. Early interventions improve social, communication, and life skills with various benefits through the lifespan of individuals with ASD (CDC, 2018; Lai et al., 2014). Recently published studies on technology-based intervention indicate that technology has generally positive impacts on ASD education (Alzrayer & Banda, 2017; Carter & Hyde, 2015; Carter, Williams, Hodgins, & Lehman, 2014; Hong, Gilbert, Abowd, & Arriaga, 2015; Kranak, Alber-Morgan, & Sawyer, 2017; Love, 2018; Morgan, 2018; O'Malley, Lewis, Donehower, & Stone, 2014).

Despite the importance of technology used in ASD research for effective interventions and practices, there is a lack of a systematic review of the literature to inform researchers, administrators, and practitioners about the current state of technology use and the trend of educational technology in the education of people with ASD. In this sense, the present systematic review is designed to explore a variety of technologies used in ASD education by examining published studies. To do so, we categorized and limited our research to examine the trends with regard to type (hardware vs. software) and purpose (social vs. academic) of technology use in publication. Lastly, in order to provide effective research-based solutions for a specific target skill, we investigated the kinds of technology commonly used for instructional delivery and specific target skills that were taught with technology. Specifically, the research questions of the study are:

1. In scholarly publications, what is the trend in technology use in ASD education?
2. What are the common technologies used in ASD education?
3. What are the target skills taught in ASD education?
4. What kinds of technologies are used for developing social or academic learning skills in ASD education?

METHOD

For a systematic literature review, Petticrew and Roberts's (2006) guideline and PRISMA framework (2009) were followed in conducting the following steps to gain information about related literature with specific selection criteria: (a) *planning:* review protocol to establish eligibility criteria; (b) *conducting:* database search and article selection, followed by screening and data extraction; (c) *reporting/dissemination* of the results.

Review Protocol

Before conducting the review, a protocol was prepared to set eligibility criteria by identifying inclusion and exclusion conditions to be able to search, locate, and evaluate articles for the review. Details about inclusion and exclusion criteria are indicated in Table 1.

Table 1: Inclusion and Exclusion Criteria for Review

Criteria	Inclusion	Exclusion
Population/Participants	Individuals with ASD under the age of 18	Individuals who are not diagnosed with ASD
Intervention/Exposure/Treatment	Any technology (including digital and non-digital) that is used for teaching and learning	NA
Context/Settings	Educational empirical studies targeting academic and/or social skills, Peer-reviewed journal articles	Review articles, Meta-analysis articles, Conceptual studies, Non-empirical studies, Proceedings,

		Books/Book chapters
Other Characteristics	Studies published in English, Studies published in the last 20 years (1999-2019)	Non-English studies, Studies published before 1999

Article Search and Selection

In order to execute article search and selection, the Web of Science Core Collection was used. We selected it as it is one of the biggest collections that is comprehensive, contains numerous research areas including multidisciplinary ones, and has over 74 million records. The relevant search keywords were set to be used in the Boolean operation to collect studies. As presented in Table 2, different keyword sets were identified to address pedagogical aspects; participants' characteristics; used technology format and features; and context of education. After the search, inclusion and exclusion criteria were applied to select relevant articles.

Table 2: Used Keywords for Database Search

Keyword Sets	Boolean Operations
Keyword Set 1	*([Teach* OR Learn* OR Instruction*] AND [Behavior* OR Communication* OR Social* OR Academic*])*
Keyword Set 2	*(ASD OR Autism)*
Keyword Set 3	*(Technology OR Tool OR Software OR Multimedia OR Interaction OR Application OR Virtual Reality OR Augmented Reality OR Game OR Robotics OR Mobile)*
Keyword Set 4	*(Special Education)*
Search Combination	*([Set1 AND Set2 AND Set3] AND Set4).*

Based on these keyword search combinations, 255 articles were located. Additionally, 12 studies identified through other resources were added, and as a result, there were 277 articles yielded, in total. The flow diagram (Figure 1) depicts the article search and selection process.

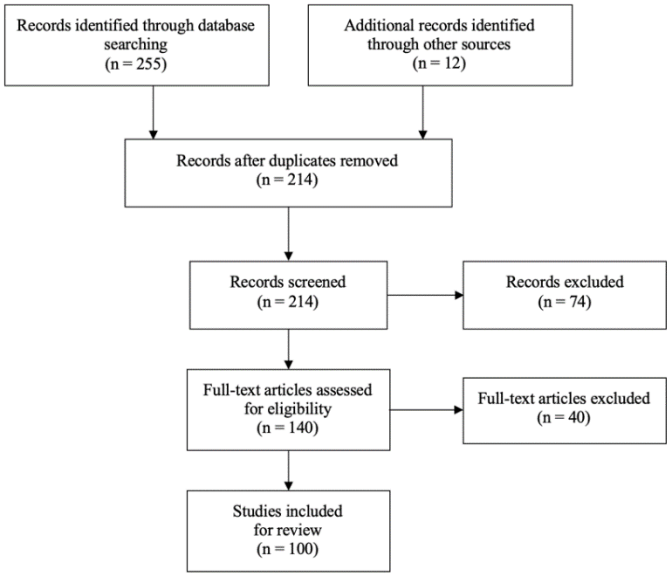

Figure 1: PRISMA framework (2009) flow diagram for article search and selection.

Three main steps were taken to refine the articles. In the first step, duplicate resources were eliminated from 277 to 214 articles. In the second step, 214 articles were screened by using eligibility criteria and 74 of them were excluded. Lastly, a comprehensive summary was conducted by creating summary tables for all 140 full-text articles. During this process, 40 articles were excluded due to insufficient or irrelevant scope and content. After all, procedures were carried out, 100 articles were retained for further analysis.

Data Extraction

To address the research questions, summary tables were assessed carefully. The first data were revealed the trend of scholarly publication. To create meaningful distinct data, as reviewed from the literature, and to understand and explain technology use better, we categorized the data into two subgroups: (Subgroup I) software/multimedia and (Subgroup II) hardware. As there are tremendous varieties of software/multimedia and hardware, specific ones were categorized and grouped in general terms. In addition to used technology, targeted skills were also extracted from the literature. These skills were linked with software/multimedia and hardware in the findings. In summary, data were extracted and categorized into four fields: (a) year trends, (b) used software/multimedia, (c) used hardware, and (d) target skills taught.

RESULTS

Trends of Technology Use in ASD Education in Scholarly Publication

The number of technology-related ASD publications per year increased rapidly between the years 2002 and 2016 and started to decrease dramatically till 2019 (see Figure 2). The number of articles was three in 2002, and the highest number of published journal studies was 16 in 2016. There were only 4 and 5 publications in 2017 and 2018 respectively, while there is only one for 2019. Although there have been slight increases and decreases over the years, the graph indicates an upward trend up to the year 2016. In the following years, there were tremendous studies related to ASD, however, the studies did not target technology for ASD children specifically. Rather, studies focus more on teaching methods, teacher training, and parents of ASD children.

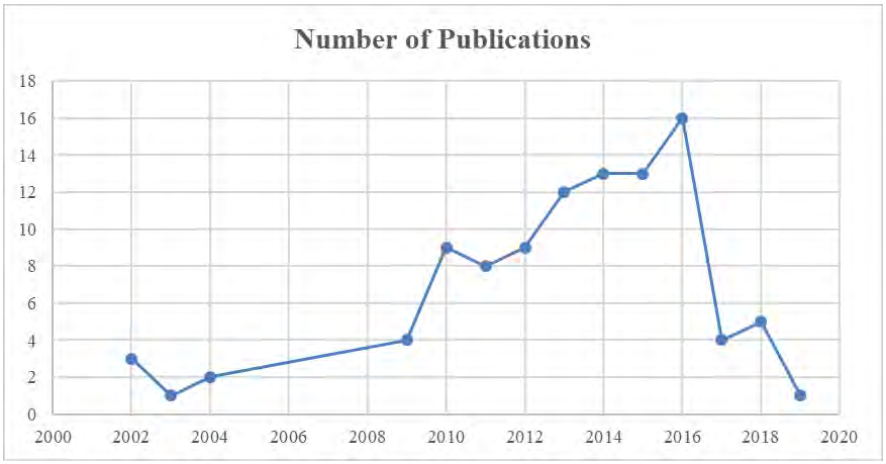

Figure 2: Trend of annual publications for technology use in ASD education between 2002 and 2019.

Types of Technology Used in ASD Education

In terms of the type of technology usage in ASD education, first, specific software and multimedia applications were grouped into relevant categories. The bar graph in Figure 3 gives a breakdown of the software/multimedia used for ASD education. The results revealed that, although numerous software multimedia was being used in studies, video and a variety of computer software were the most commonly observed applications with 25 studies each. Mobile applications, virtual reality, and digital graphics were the other commonly used software/multimedia, respectively. Comparing the left bar (highest) and right bar (lowest), there was a considerable difference in technology use.

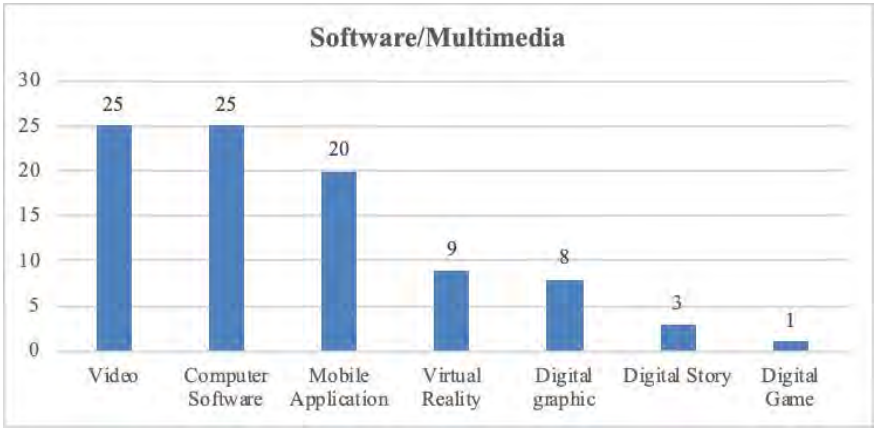

Figure 3: Technology used in ASD education.

To understand the actual and potential relationships among hardware, software, and learning, similar hardware was also grouped as in the software/multimedia case. As can be seen in Figure 4, the computer was the most frequently used hardware within 35 studies while a mobile device ranked second, in 30 studies. An interesting point is that these studies also reported the frequent use of non-digital objects. Wearable technologies and the video camera were the other prominently adopted hardware that delivered educational content for learning.

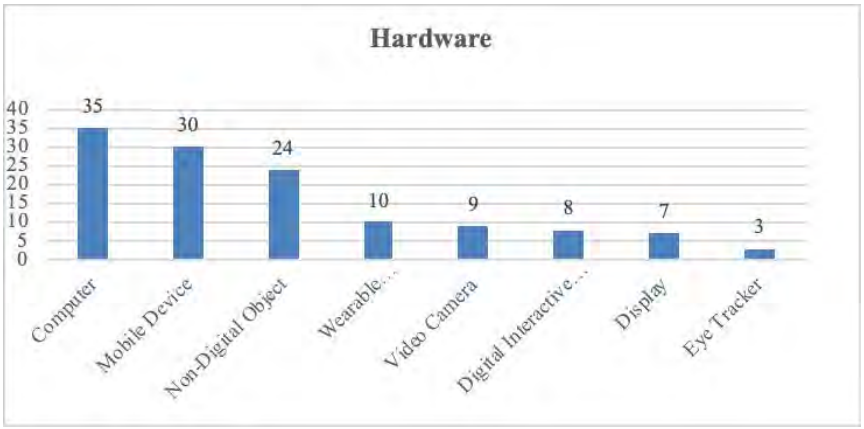

Figure 4: Hardware used for ASD education.

Targeted Skills Taught in ASD Education

After extracting the data for the software/multimedia and hardware used, target skills were also analyzed. Figure 5 illustrates the distribution of skills targeted with the software/multimedia used in ASD education. As can be seen from Figure 4, the highest frequency of target skills was 61 social skills while only 30 academic skills were the focus of studies. Within the social skills, general social skills were the most frequent set, within 44 studies. Communication and vocation skills are the following target skills with eleven and six studies, respectively. On the other hand, among the academic skills, language and arts were targeted the most—in 20 studies. The set of general academic skills ranked second, within seven studies. Unexpectedly, there were only two and one studies in both math and science during that period.

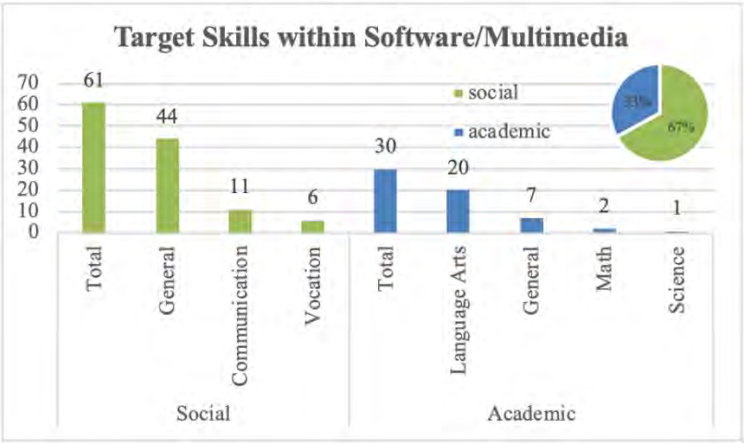

Figure 5: Target skills areas within software/multimedia in ASD publications.

Figure 6 represents the distribution of skills targeted with hardware used in ASD education. Similar to the results displayed in Figure 4, the skills most frequently targeted with hardware were social skills—in 91 studies. On the other hand, the number of research studies that targeted academic skills with the use of hardware was 35. Likewise, among all the skills, the most commonly targeted skills were general social and language arts, the focus of 71 and 20 studies, respectively. In terms of social skills, there were eleven studies on communication skills and nine studies on vocation skills. Concerning the hardware used, there were eleven general academic skills targeted, while there were only three studies for math skills and one study for science skills.

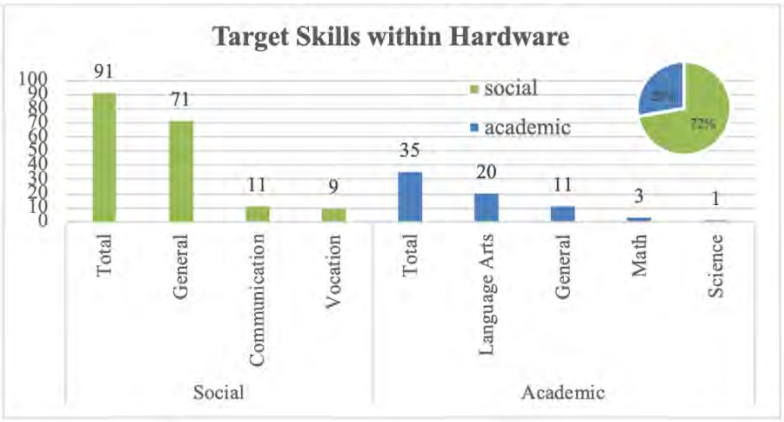

Figure 6: Target skills areas within hardware in ASD publications.

Targeted Skill Specific Technologies in ASD Education

Technologies for Social Skills

To understand the skills targeted with the use of technology, we investigated in detail the software/multimedia and hardware used in ASD publications. To begin with, software/multimedia and hardware used for social skills were examined. Figure 7 depicts the patterns of social skills developed with software/multimedia used in ASD education. The video was the most frequently used technology, as illustrated below, with 20 studies. The second and the third most used software/multimedia were computer software, with 13 studies, and mobile application, with 12 studies.

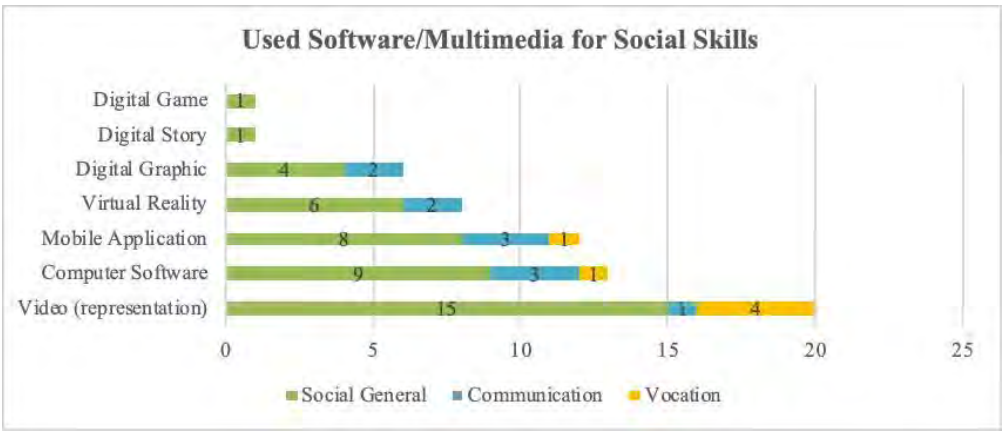

Figure 7: Software/multimedia used for social skills.

In terms of hardware, the most frequently used device for social skills was the computer. As can be seen in Figure 8, the number of publications focused on computer usage was 24. In addition to this, the mobile device was noted in 19 studies as the second most frequently used hardware, while non-digital objects came in third place with 18 publications.

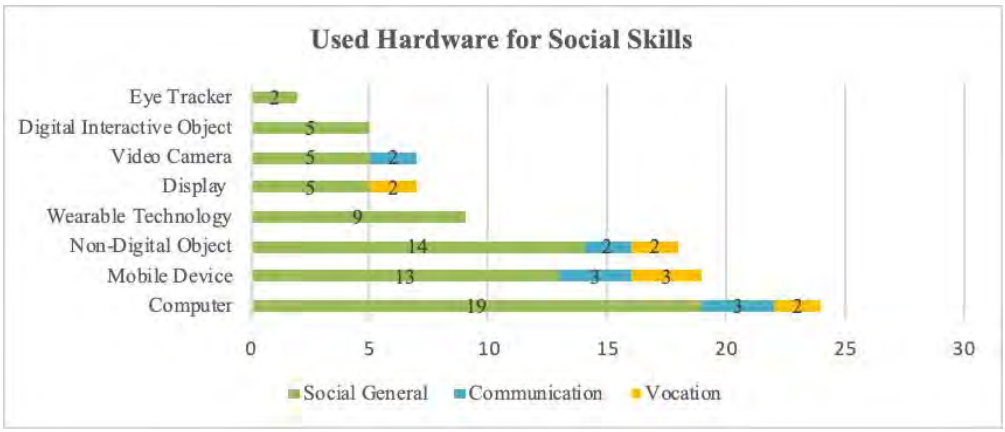

Figure 8: Hardware used for social skills.

Technologies for Academic Skills

Dissimilar to the results on social skills, the total number of software/multimedia used for academic skills was lower and slightly different from those used for social skills. As presented in Figure 9, the variety of software/multimedia depends on the subject to be taught. Among these, computer software and mobile applications were the most often used software/multimedia, reported by 12 and eight publications, respectively. In other words, software and application technology are more often used for enhancing the academic skills and achievements of those with ASD. Unlike social skills, the video was not used as commonly for academic purposes, as the number of studies on the use of video for academic skills was only five.

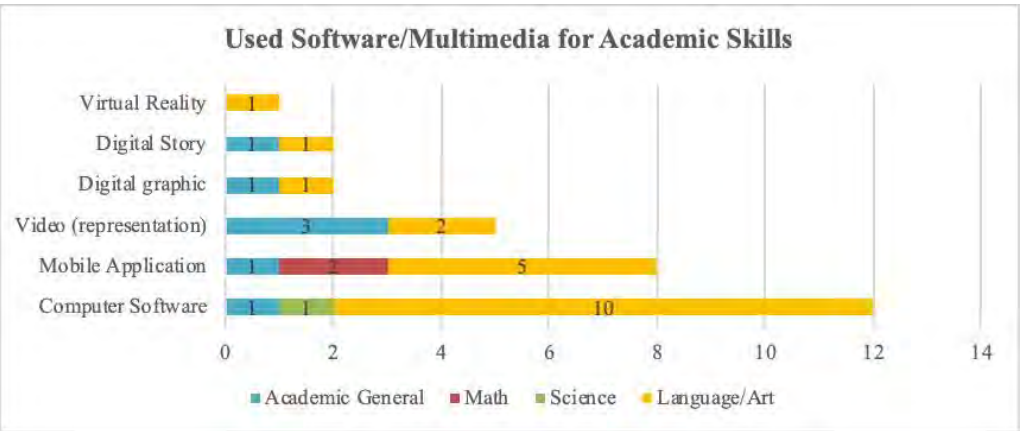

Figure 9: Software/multimedia used for academic skills.

Lastly, the hardware used for academic skills was investigated. Similar to the results of software/multimedia used, hardware use also differs, depending on the academic subject (see Figure 10). As expected, the most frequently used hardware was the mobile device and computer with 11 studies. non-digital objects and digital interactive objects, such as clickers, tactile devices, followed the mobile device, similar to social skills, with six and three publications, respectively. An interesting point is that mobile devices were used more like hardware than as software/multimedia. Mobile devices enable ASD individuals to receive support anytime and anywhere across topics.

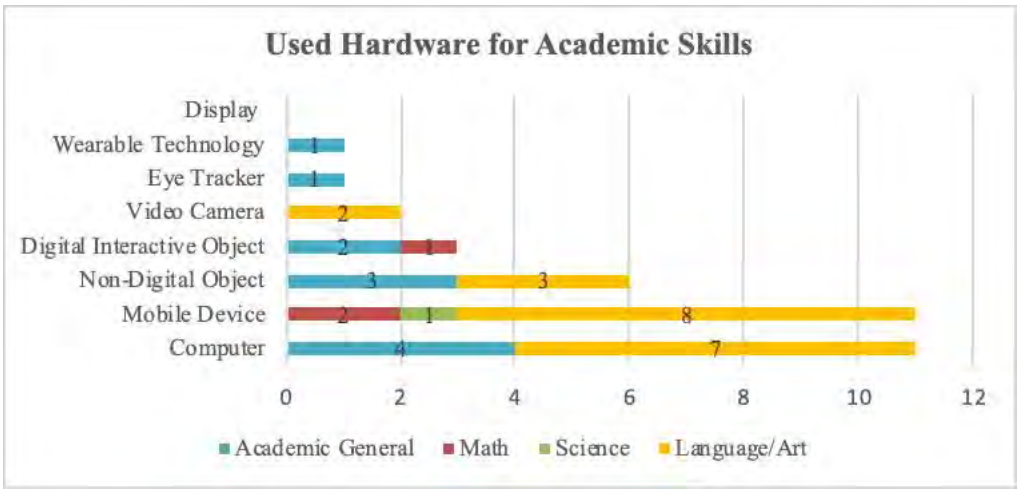

Figure 10: Hardware used for academic skills.

DISCUSSION

This systematic literature review was conducted to explore a variety of the currently available technologies and associated skills. The goal was to build a knowledge base to inform technology-related solutions for nurturing certain specific skills in ASD individuals. To do so, scholarly publications were examined, and findings were articulated, according to publication trends, types of technology used, and skills targeted.

Examined in this study were 100 studies, published between 2002 and 2019, on the use of various types of technology used in teaching learners with ASD. The number of similar publications has increased till 2016 and decreased dramatically in the following years. Although there are tremendous studies related to ASD, the studies did not target technology for ASD children specifically. Rather, studies focus more on teaching methods, teacher

training, and parents of ASD children. Those findings can be interpreted as available tools and software have been increasing, providing tremendous solutions to those with ASD. As articulated in other studies (Bernard-Opitz et al., 2001; Goldsmith & LeBlanc, 2004; Shabani et al., 2002), it can be concluded that taking advantage of emerging technologies, researchers focus on technological solutions for ASD education, especially to target specific skills.

There is a variety of software/multimedia used in ASD education. Video and computer software are the most preferred tools and are followed by mobile applications. Transition is crucial and challenging for ASD individuals, both in daily life and educational settings. Children with ASD usually struggle in situations involving a change in the environment, and such difficulties related to environmental change may cause severe behavioral problems in the process of transition (American Psychiatric Association, 2000; Cihak, Ayres, & Smith, 2010). In this regard, video can be used to ease the transition process for individuals with ASD by using various techniques, such as video modeling (Dowrick, 1999) which can be used to allow individuals with ASD to watch another person or themselves perform and improve desired behaviors and skills. Combining a specific software/multimedia, if utilized correctly, could influence the skill development of ASD individuals.

According to reviewed interventional studies, researchers have mostly used digitalized hardware, as expected, such as computers, mobile devices, wearable technologies. This finding supports Shane and Albert (2008)'s argument that people with ASD engage with technological devices more than in other spare-time activities. However, there is a great number of research studies that include non-digital objects as well. Studies have shown that non-digital objects also have had a positive impact on individuals with ASD for promoting desired behavior and skills. We conclude that not only highly complex hardware but also non-digital objects, such as toys and papers, can be used in ASD education with a proper educational method.

Another focus of this study was on the targeted skills. As illustrated in the findings, there were twice as many social-skill-related studies as academic-skill-related ones. It could be inferred that improving the social skills of children with ASD, to regulate their daily life routines, is of greater concern to educators than developing their intellectual skills. In this regard, the priority, especially in early childhood, is to improve the basic social skills of children with ASD. The targeted skills of selected publications are in line with Arslan and Inan (2019)'s study and emphasize that the need for social skill development is more crucial. However, students with developmental disabilities, including those with ASD, have more challenges in acquiring academic skills than do their same-age peers, which results in lower achievement (Lynch et al., 2007). Therefore, it is also reasonable to focus on developing their intellectual skills such as academic skills at an early age to promote easier school transition.

Although types of software/multimedia and hardware seem similar for both social and academic skill development, slight discrepancies were found in terms of the way they were used. This may have resulted from the accessibility or affordability of the related software/multimedia and hardware. For social skill development, for instance, the predominant used software/multimedia types were video, computer software, mobile applications, and virtual reality. The researchers used computers and mobile devices, as hardware, to deliver specific software/multimedia during the intervention. As mentioned above, there were also non-digital objects used without any software/multimedia. It is likely that those objects are used as a treatment strategy to address the target skill without needing any computerized technology. Used technologies for academic skills have similar patterns with the social skills but they had different frequencies. While computer software, applications, and video were used most frequently, the researchers utilized mobile devices and computers as hardware. Since the size of electronic devices has been decreasing rapidly, it is getting easier to demonstrate a variety of content and software via mobile devices, which could create new opportunities to integrate these devices in ASD education.

CONCLUSION

The purpose of this study was to summarize technology tools that have been used to promote the skill development of ASD individuals. These findings from our systematic literature review describe the recent use of software/multimedia and hardware in terms of promoting social and academic skills for ASD education. Many studies have been carried out to assess how different forms of technologies are used for ASD learners. . Those findings provide social and academic guidelines for the use of technology as different means to support ASD individuals' education. As the effective implementation of technology has generally positive impacts and outcomes in ASD education, this study can be used as a guideline by special education practitioners, school administrators, and policymakers. To be effective, the use of technology should be matched with an individual's needs. Adopting any technology without a well-guided recipe could fail. Therefore, technology should be matched with the characteristics of the student with ASD, and its use should be well-planned, customized, and individualized for parents, teachers, and administrators. The scope of this study is limited to one database, namely Web of Science Core Collection, to search keywords, and to publication dates 2002 – 2019.

REFERENCES

Alzrayer, N. M., & Banda, D. R. (2017). Implementing Tablet-Based Devices to Improve Communication Skills of Students With Autism. *Intervention in School and Clinic*, *53*(1), 50-57.

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: Author.

Arslan, O., & Inan, F. (2019, March). Twitter as a topic analysis tool for autism spectrum disorder: A text mining approach. In Society for Information Technology & Teacher Education International Conference (pp. 2669-2673). Association for the Advancement of Computing in Education (AACE).

Baio, J. (2012). Prevalence of autism spectrum disorders: Autism and developmental disabilities monitoring network. *Morbidity and Mortality Weekly Report*, *61*(3), 1–19.

Baio, J., Wiggins, L., Christensen, D. L., Maenner, M. J., Daniels, J., Warren, Z., ... & Dowling, N. F. (2018). Prevalence of autism spectrum disorder among children aged 8 years—autism and developmental disabilities monitoring network, 11 sites, United States, 2014. *MMWR Surveillance Summaries, 67*(6), 1.

Bernard-Opitz, V., Sriram, N., & Nakhoda-Sapuan, S. (2001). Enhancing social problem solving in children with autism and normal children through computer-assisted instruction. *Journal of Autism and Developmental Disorders, 31*, 377-384.

Bartamole, N. A., & Zapirain, B. G. (2014). Technologies as Support Tools for Persons with Autistic Spectrum Disorder: A Systematic Review. *International Journal of Environmental and Public Health, 11*, 7767–7802.

Cai, Y., Chiew, R., Nay, Z. T., Indhumathi, C., & Huang, L. (2017). Design and development of VR learning environments for children with ASD. *Interactive Learning Environments*, *25*(8), 1098-1109.

Carter, E. J., & Hyde, J. (2015). Designing autism research for maximum impact. *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, Seoul, Republic of Korea*, 2801-2804. doi:10.1145/2702123.2702471

Carter, E. J., Williams, D. L., Hodgins, J. K., & Lehman, J. F. (2014). Are children with autism more responsive to animated characters? *Journal of Autism and Developmental Disorders, 4*(10), 2475-2485.

Centers for Disease Control and Prevention. (2018). *CDC 2018 annual report*. Retrieved from https://www.cdc.gov/DataStatistics/

Cihak, D., Ayres, K. M., & Smith, C. (2010). The Use of Video Modeling via a Video iPod and a System of Least Prompts to Improve Transitional Behaviors for Students with Autism Spectrum Disorders in the General Education Classroom. *Journal of Positive Behavior Interventions,* 12(2), 103-115.

Cheng, Y., Luo, S. Y., Lin, H. C., & Yang, C. S. (2018). Investigating mobile emotional learning for children with autistic spectrum disorders. *International Journal of Developmental Disabilities, 64*(1), 25-34.

Fage, C., Consel, C., Etchegoyhen, K., Amestoy, A., Bouvard, M., Mazon, C., & Sauzeon, H. (2019). An emotion regulation app for school inclusion of children with ASD: Design principles and evaluation. *Computers & Education*, *131*, 1-21.

Dowrick, P. W. (1999). A review of self modeling and related interventions. *Applied and Preventative Psychology, 8*(1), 23-39. doi:10.1016/S0962-1849(99)80009-2

Gallardo-Montes, C. D. P., Caurcel Cara, M. J., & Rodríguez Fuentes, A. (2021). Technologies in the education of children and teenagers with autism: evaluation and classification of apps by work areas. *Education and Information Technologies,* 1-29.

Goldsmith, T. R., LeBlanc, L. A. (2004). Use of technology in interventions for children with autism. *Journal of Early and Intensive Behavior Intervention, 1*(2), 166-178.

Hong, H., Gilbert, E., Abowd, G.D. and Arriaga, R.I. (2015). In-group Questions and Out-group Answers: Crowdsourcing Daily Living Advice for Individuals with Autism. In CHI'2015, 627-636.

IDEA: Individuals with Disabilities Education Improvement Act (2007). IDEA of 2007, 20 U. S. C. Retrieved May 12, 2020 from https://sites.ed.gov/idea/regs/b/a/300.8/c

Ingersoll, B., & Wainer, A. (2013). Initial efficacy of Project ImPACT: A parent-mediated social communication intervention for young children with ASD. *Journal of Autism and Developmental Disorders, 43*(12), 2943-2952.

Kranak, M. P., Alber-Morgan, S. R., & Sawyer, M. R. (2017). A Parametric Analysis of Specific Praise Rates on the On-Task Behavior of Elementary Students with Autism. *Education and Training in Autism and Developmental Disabilities*, *52*(4), 453-464.

Kuehn, B.M. (2012). Data on autism prevalence, trajectories illuminate socioeconomic disparities. *JAMA, 307*, 2137–2138.

Lai, M.-C., Lombardo, M. V., & Baron-Cohen, S. (2014). Autism. *The Lancet, 383*(9920), 896–910.

Love, J. S. (2018). Sensory Spaces: Sensory learning-an experimental approach to educating our future designers to design autism schools. *Archnet-IJAR: International Journal of Architectural Research, 12*(3).

Lynch, S., Taymans, J., Watson, W. A., Ochsendorf, R. J., Pyke, C., & Szesze, M. J. (2007). Effectiveness of a highly random science curricula for students with disabilities in general education classrooms. *Exceptional Children, 73*, 202–223.

Morgan, L., Hooker, J. L., Sparapani, N., Reinhardt, V. P., Schatschneider, C., & Wetherby, A. M. (2018). Cluster randomized trial of the classroom SCERTS intervention for elementary students with autism spectrum disorder. *Journal of consulting and clinical psychology*, *86*(7), 631.

Murry, F. (2018). Using Assistive Technology to Generate Social Skills Use for Students With Emotional Behavior Disorders. *Rural Special Education Quarterly*, *37*(4), 235-244.

O'Malley, P., Lewis, M., Donehower, C., and Stone, D. (2014). Effectiveness of using iPads to increase academic task completion by students with autism. *Universal Journal of Educational Research, 2*(1), 90-97.

Panerai, S., Catania, V., Rundo, F., & Ferri, R. (2018). Remote Home-Based Virtual Training of Functional Living Skills for Adolescents and Young Adults With Intellectual Disability: Feasibility and Preliminary Results. *Frontiers in Psychology*, *9*, 1730.

Petticrew, M., & Roberts, H. (2006). *Systematic reviews in the social sciences: a practical guide*. Malden, MA; Oxford: Blackwell Pub.

PRISMA framework (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. PLoS Med 6(6): e1000097. doi:10.1371/journal.pmed1000097

Shabani, D. B., Katz, R. C., Wilder, D. A., Beauchamp, K., Taylor, C. R., & Fischer, K. J. (2002). Increasing social initiations in children with autism: Effects of a tactile prompt. *Journal of Applied Behavior Analysis, 35*, 79-83.

Shane, H., & Albert, P. (2008). Electronic screen media for persons with autism spectrum disorder: Results of a survey. *Journal of Autism and Developmental Disorders*, *38*, 1499-1508.

Takeo, T., Toshitaka, N., & Daisuke, K. (2007). Development application softwares on PDA for autistic disorder children. *IPSJ SIG Tech. Rep., 12*, 31-38.

Xu, G., Strathearn, L., Liu, B., & Bao, W. (2018). Prevalence of autism spectrum disorder among US children and adolescents, 2014-2016. *Jama, 319*(1), 81-82.