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PROMOTING SKILLS IN CHILDREN AND TEENS WITH AUTISN SPECTRUM DISORDER THROUGH PLAY AND STEAM

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Abstract
Individuals with autism spectrum disorder (ASD) have a low employment rate. This is caused by a lack of support from employment resources and the negative stigma associated with common characteristics associated with ASD. With limited career-building activities and events, it is difficult for individuals with ASD to identify their skills, strengths, and career opportunities. Parental support is crucial when seeking employment opportunities for their children. Through the use of play, children with ASD engaged and explored their skills with science, technology, engineering, arts, and math-centered activities. This paper highlights the events and shows the proposed redesign for an additional workshop.

Key-words: Autism spectrum disorder, STEAM, Workforce development, Inclusion, Accessibility

1. INTRODUCTION

Many adults with autism spectrum disorder (ASD) are unemployed; however, most show interest in securing employment [1]. Work is vital to an individual's independence, self-esteem, and social status [2]. According to the CDC, in 2000, 1 in 150 eight-year-olds were diagnosed with ASD, and in 2018 the number increased to 1 in 44 [3]. ASD is characterized as a neurobiological disorder with varying degrees of social behavior, communication, repetitive sensory-motor behaviors, anxiety, phobias, depression, emotional dysregulation, and difficulty understanding thoughts, emotions, and intentions [4,5,1]. An often-overlooked aspect of ASD is cognitive and emotional overload associated with excess stress and autonomic nervous system involvement. This dysregulation can cause discomfort and, at times, debilitating, leading to inappropriate social behavior [6]. ASD is considered a spectrum due to the difference in symptoms and co-morbidities (additional conditions). Often the inabilities outshine the strengths and skills associated with ASD. Common strengths associated with ASD include excelling in areas of interest and exceptional acuity with enhanced visual, attention, memory, and sensory perception, contributing to high performance in technology, math, and creative endeavors [7]. There has been research correlating stronger systemized mechanisms and better math skills. Systemizing is observing relationships between events, detecting patterns, and being drawn to predictable systems like machines, tools, and timetables [8]. Individuals with ASD have been associated with exhibiting hyper-systemizing traits [8,9].

Despite skills and strengths, individuals with ASD face workforce and career development barriers. Some challenges include a lack of skill and career development activities, parental support, and self-efficacy [1]. Transitioning from adolescence to adulthood is a critical developmental period, especially for those with ASD. A time when opportunities for career

exploration and development are needed but often not offered to individuals with disabilities [10].

Parent expectations and educational and occupational skills strongly influence adolescents' and adults' outcomes, opportunities, and achievements. Lower expectations equate to a restrictive view of capabilities surrounding autonomy and can lead to limited activity participation [11]. Parents report that they continuously face professionals underestimating their children as strengths and abilities are often overshadowed by the negative generalized characteristics of ASD [7]. It can lead to limited beliefs of their child's capabilities. However, when parental support is high, there is a stronger outcome for employment or continued education after high school. Therefore, parents must have the opportunity to observe their child's skills and strengths and reinvent the narrative that they have been told.

The combined lack of career development and parental support can lower self-efficacy surrounding work-related skills and abilities for individuals with ASD [1]. Self-efficacy is the judgment that one has regarding what one can accomplish with current skills. It is a feeling of competence in a specific field or area and not in another. In general, people tend to be more motivated when they believe they will be successful with the outcomes [12]. Elevated self-efficacy is critical in work as it helps employees make good decisions and take appropriate action [13].

This paper aims to share the redesign of a Science, Technology, Engineering, Arts, and Mathematics (STEAM) workshop created for informal career exploration to build on students with ASD strengths. The workshop aims to engage the participants in skill-building activities that help develop self-efficacy and showcase the participant's strengths and abilities to their parents/caregivers. The activities will be centered around science, technology, engineering, arts, and math (STEAM) in a playful and supportive environment. The workshop will be designed based on previous STEAM-based activities and events that resulted in positive outcomes for children with ASD and their families.

Section two of this paper the term STEAM is defined and highlights the importance of the "arts" integrated into traditional STEM activities. Section three explores the valuable component of play as a learning tool. Section four describes the importance of designing activities that are accessible to all learners. Section five explores events designed for children and teens with ASD and their families. In section six designs for future STEAM-based activities are discussed.

2. THE "A" IN STEAM

The link between prosperity and knowledge-driven jobs ignited STEM as an academic focus in the early 2000s. Furthermore, a report predicting negative economic consequences if students were not adequately prepared for workforce jobs caused STEM education to be implemented in multiple countries [14]. STEM is an acronym for science, technology, engineering, and mathematics. It is difficult to pinpoint the exact induction of art as part of this interdisciplinary force and change the acronym to STEAM.

Nowadays, it is difficult to truly define the arts [15]. There are several definitions and philosophies surrounding art due to the evolution of art and the broad scope that art encompasses [15-17]. According to the Merriam-Webster dictionary, the arts are activities executed by people with skill and imagination and refers to painting, sculpting, literature, and music [18]. However, that definition just barely scratches the surface. Tatarkiewicz and Munro seem to capture the arts more in depth. Tatarkiewicz defines the arts as the conscious human activity of reproducing,

constructing, or expressing experiences or forms that evoke an emotional response [17]. Munro references the arts to a variety of mediums such as visual art, verbal compositions, music, dance, functional art, interior design, landscaping, public performance, entertainment, and cooking and baking [16].

Incorporating the arts into STEM education enhances the application. STEM subjects tend to be very formal with methods and procedures. Students lose interest due to detachment from the lesson and its relevance to personal life [19]. However, art education students are taught to experience the world using sense perception. Students then interpret their perceptions and create a representation through a chosen media. Students spend more time with the material through experiencing, interpreting, and representing [20]. Through exploration, they find new and unique ways to apply the material, which cultivates creative problem-solving and critical-thinking skills. Increasing relevancy as the material is applied to the real world.

Individuals with ASD tend to do well with patterns, formulas, and predictable systems, which allow them to thrive in a STEM environment. However, characteristics of ASD, visual thinking [21, 22] and sensory perception [7], lend themselves to the arts. Visual thinking is when visual memories and images are categorized. When asked to recall an object or thing, memories and images cycle through their mind. Visual thinkers tend to visualize in detail mentally and can transpose them into drawings [23]. Art can be a way of communicating for visual thinkers and those who are non-verbal. Art offers a different avenue of communication. Not everyone with ASD excels in drawing and visual thinking but can benefit from the use of fine motor skills, and making art can be an avenue to relieve excess stress or energy and aid in self-regulation [22]. Including art within educational subjects and non-educational environments can be a way for individuals with ASD to process information, enhance communication, and apply educational material in unique ways.

3. PLAY: THE NECESSARY COMPONENT

Art creates space to experience, interpret, and apply the learning material through a different lens. An additional component that can enhance the understanding of STEAM subjects is play. Play supports the learning of foundational concepts and is one of the earliest forms of instruction. It is a valuable component regarding overall development as it supports a range of intellectual, social, and emotional abilities [24]. Usually, play is reserved for children, but the natural outcomes can benefit adolescents and adults.

Play is a platform for self-awareness, experimentation, and exploration [25]. Play requires a certain level of risk, a vital component of development as it helps to learn about one's potential [26] and an avenue to identify abilities and self-efficacy. The self-directing nature of play provides autonomy in making decisions in a particular moment [27]. Play exposes players to the unexpected and enhances creative thinking, self-esteem, and divergent thinking [28]. Educational games can be seen as a set of rules and motivational affordances [29] and have been successful in teaching/learning complicated concepts [30].

Psychological research has acknowledged five fundamental types of play. Physical, play with objects, symbolic, socio-dramatic, and games with rules. Physical play refers to active exercise and fine motor play, like coloring. While playing with objects, the child familiarizes themselves with the object's texture, weight, and response. Symbolic play includes spoken language, music, and reading. This type of play assists in developing communication and

understanding of emotions. Socio-dramatic play builds cognitive and social abilities through role play and pretending. Children use games with rules to understand their world [24].

Play is often used in autism assessments and therapeutic settings. However, play equally belongs outside of structured therapy sessions. Play is fun and includes flexibility, active engagement, and motivation [31]. Play flexibility is vital for those with ASD because it allows them to experience and comfortably interact with the world.

4. ACCESS TO LEARNING

Learners must engage and have access to the learning materials during instruction. It is equally critical that designers take extra steps to ensure that all students can participate and have an equal learning opportunity. It holds for workshops and activities outside of the typical school setting. Universal Design of Learning (UDL) has been slowly gaining steam since the 1970s when Ron Mace developed Universal Design for architecture – ensuring that building designs met accessible criteria [32]. Transitioning from buildings to curriculums, UDL offers multiple ways of representing and engaging in the content and assessments [33]. It encompasses the instructional practices for all students – those with and without disabilities [32].

All aspects must be considered when designing a curriculum, from the learning material to the environment. For learners with ASD, it is important to identify strengths and provide alternative methods and material delivery.

5. COMMUNITY AND ACADEMIA: CASE STUDIES

Several STEAM events were geared towards children and adolescents with ASD and their families. The idea was to expose the children to STEAM activities to showcase their abilities to themselves and their parents. The events and workshops were Steam on Spectrum, Night on Spectrum, Virtual Steam on Spectrum, and STEAMclusive. To help shape the redesign the following framework has been applied. An analysis of the goals, general design, learner analysis (the participants), workshop context, content, objectives, and learning strategies will be completed for each event and workshop.

5.1 STEAM on Spectrum

The goal of STEAM on the spectrum was to open up a typical engineering laboratory space to children with ASD and their families to engage in STEAM-based activities through the use of play. The attendees consisted of children and adolescents with ASD, their siblings, and parents/caregivers. This was a one-day event (4 hours). There were a series of activities and games throughout the building, and attendees could move from activity to activity at their leisure. Each activity had its own dedicated space. The activities included video games, robotics, simulators, 3D printing, building with blocks and Legos, making puppets, VR painting, and Painting with paintballs. The atmosphere was welcoming and supportive. Parents watched as their children engaged in technology, physics, and art. A parent stated, "First, you must believe that they belong here. You must convince yourself that they can do this. They can do this, don't sell them short. I am not going to underestimate him" A father stated that he was blown away by watching his son interact with the activities, and his wife stated that their son could be an engineer [34]. There was no specific educational content. The overall objectives were to allow all

levels of children and adolescents with ASD and their families to meet other families. Children demonstrate their skills through various activities.

5.2 Night on Spectrum

The goal was to offer a relaxing event where parents and children could socialize with their peers and to offer parents respite and time with other adults. The children were in one area watching movies and engaging in games while the parents had their own dedicated space to socialize and enjoy an instructional painting activity. Children and adolescents with ASD, their siblings, and parents/caregivers. The parents were upstairs, and the children were downstairs with volunteers. The adults were provided with painting materials (paint, brushes, and canvas). The adults participated in an instructional painting class while the children watched a movie and participated in volunteer-led games. The learners produced a completed painting and socialized with other parents of children with ASD.

5.3 Virtual STEAM on Spectrum

Virtual STEAM on Spectrum occurred during the height of COVID-19. The goal was to engage the community in various online skill-building workshops. There were three sets of workshops – painting with watercolors, improv, and camera phone photography. The watercolor classes were pre-recorded and offered on YouTube. The improv and camera phone photography workshops were conducted over zoom. Each workshop lasted, on average, 2 hours.

The painting classes were geared towards anyone interested in painting with watercolors. The improv workshop consisted of 8 pre-teens – adults with various disabilities. The photography workshop consisted of six participants. The ages ranged from teen to young adult. Many participants had previous theatre experience, although it was not a prerequisite. Each learner provides materials for the painting workshops and camera phone photography. The painting class required watercolor paint, brushes, and canvas. The camera phone photography workshop required that all learners have access to a smart-phone with a camera feature. The pre-recorded painting classes included step-by-step instructions on painting landscapes using watercolors. The improv workshop engaged the learners in various improv games. The instructor showed various photography techniques in the camera phone photography workshop using PowerPoint slides. Throughout the workshop, the learners would have 15 minutes to take photos using the techniques from the previous slides, and they would email their photos to the instructor. The instructor would show the photos to the learners, and they would critique and discuss each. The learners produced a completed watercolor painting, dramatized different characters and scenarios, produced photos based on techniques learned during the workshop, and identified photography techniques during the critiques and discussions.

5.4 STEAMclusive

STEAMclusive was a workshop that connected weekly skills with Minecraft activities, games, and simulations. This was a 4-week workshop with one session per week. Each session was 2 hours long. At the end of each session, two learners were awarded prizes for exhibiting the week's skills during the workshop. There were 8 participants in the pre-teens to teens age range. More than half of the participants had ASD. All of the learners exhibited full mobility and verbal communication skills. There were games and simulations in one area and a separate section

where the learners engaged in Minecraft. It was a technology-based workshop. The learners used laptops to participate in Minecraft activities. The learners rotated through three technology-based games. At the beginning of each week, the learners were presented with two skills. The skills were explained, and the learned discussed how to engage in each skill. The volunteers observed the learners and acknowledged when they participated in each skill. In the first part of the workshop, the learners rotated through each game. In the second half of the workshop, the learners participated in Minecraft activities, where each learner was given a set of tasks to complete. The objects of the workshop were to Apply soft skills to Minecraft activities and other technology-based games. The volunteers observed the learners and noted who exhibited what skills and then determined who were the winners of that week. The winners received a prize. We found that this technique was not as successful. It was hard to choose two winners, especially if more than two learners applied the weekly skills just. It was designed that each learner would eventually get a prize, but some of the learners became upset at the end of the session when they did not win. Learning strategies: Repetition was used to reinforce the weekly skills, and at the start of a new session, the previous week's skills were discussed.

6. RE-DESIGNED STEAM-BASED WORKSHOP FOR ADOLESCENTS WITH ASD

To foster self-efficacy, individuals with ASD need to discover their strengths through the performance of their skills. Then matching their strengths with employment opportunities and environments [10]. The redesign aims to develop a workshop using the positive elements from the previous events and workshops and address the observed gaps. Table 1 lists the learning strategies, goals, and benefits that directly impact the learners and the parents/caregivers.

6.1 Strengths from the Workshops and Events

Each of the volunteers, therapists, and instructors created a supportive environment. The staff members acknowledged, cheered on, and motivated the learners. Many of the activities were loosely structured, allowing the learners to explore skills while interacting with the games, activities, and objects. Play was a vital part. The events and workshops included the fundamentals of play references earlier in this paper. The staff and learners had fun while engaging in the activities. Both technology and arts were present at all of the events. Incorporating soft skills and the staff's encouragement helped the learners realize when and how they were applying the skills. Utilizing technology as children and especially individuals with ASD, typically excel in technology.

6.2 Gaps

The workshops succeeded, and the learners and families enjoyed the events. Nevertheless, no alternate activities or accommodations were in place for those who needed them. Therefore, the next will implement UDL principles to accommodate the learners. The activities were either playful, exploratory, or direct instruction, where each learner completed their tasks. Therefore, the new workshop will include a project the learners complete together. The learners are working towards a common goal and communicating the process. This was touched on slightly during the STEAMclusive workshops. On the last day, the learners introduced the parents/caregivers to the games they had been playing during the sessions. Building from this concept, the learners will

communicate their process throughout the workshops and again at the end for the parents/caregivers.

6.4 Redesign Elements

The goals leading the new workshop are as follows: learners apply current skills to solve a real-world problem. Identify skills and develop self-efficacy. Showcase the skills of the learners to the parents/caregivers. This workshop would be a 5-week workshop with one 2-hour session per week. The workshop format would be introductions, warmups (this would include self-regulation techniques), and activities, and the last 30 minutes would be dinner and socializing. This workshop will be designed for pre-teens and teens with ASD. The learners will fill out intake forms containing questions that will clarify any learning, sensory, communication, and physical needs or barriers. This will help to ensure that the learning techniques, materials, and activities will be accessible to all learners.

This workshop will be conducted in the Hampton Roads Biomedical Research Consortium (HRBRC). A large room with tables and chairs opens the kitchen and a gathering area. For this workshop, the learners will be provided paper, crayons, pencils, and whiteboards as an alternate way to communicate their thoughts and ideas to the group. 3D printers will be used to print out the final design created by the learners. The learners will be tasked with a real-world problem. Through independent and collaborative activities, the learners will create a design and prototype to solve the problem. Initially, the learners will be involved in an exercise that mimics the workshop process (come up with ideas based on a prompt, communicate the ideas, and work as a group to make something from those ideas). The workshop will include activities that prompt learners to think, generate ideas, categorize concepts, and design prototypes. Then showcase and communicate the final deliverable to their parents/caregivers. Improv games will help execute previous knowledge and create new ones. The objectives are the learners will be able to demonstrate their knowledge and apply it to a design. The learners will be able to classify concepts. The learners can construct a prototype and final product through independent and group work. Learners can communicate their process to the group and their parents/caregivers. The learning strategies are as follows: Inquiry-based learning, identifying previous knowledge, repeating information, identifying concepts and categorizing, cooperative learning, immediate feedback, play-based learning, and think pair sharing. In this workshop, the learners will engage in activities about STEAM subjects.

Table I. shows a breakdown of each of the events/workshops including the plans for the re-designed workshop.

Event	Strategies	Goals	Direct Benefit for Children/Teens with ASD	Direct Benefits for Parents and Caregivers
STEAM on Spectrum	Exploration of skills in a supportive environment	Open up a typical engineering laboratory space to children with	Played games and engaged in different activities in a judgment-free environment.	Experienced the skills and abilities of their children.

	Play-based learning Discovery learning Parent and community engagement	ASD and their families to engage in STEAM-based activities through the use of play Connect with community members Introduce various activities and technologies to the community.		
Night on Spectrum	Respite for parents. Direct instruction Play-based learning	Offer a relaxing event where parents and children can socialize with their peers.	Socialized with their peers Engaged in relaxing activities	Socialized with their peers
Virtual STEAM on Spectrum	Direct instruction Scaffolding	Engage the community in various online skill-building workshops while staying safe during the COVID-19 pandemic.	Learned skills from the safety of their home	Learned skills from the safety of their home
STEAMclusive	Repetition Game-based learning	Connect weekly skills with Minecraft activities, games, and simulations.	Played and interacted with others Identified how well they applied soft skills	Witnessed the skills that their children had learned during the workshop

Re-designed STEAM workshop	Inquiry-based learning	Apply current skills to solve a real-world problem	Apply their knowledge to a real-world problem	Learn the process of their child's final design
	Identifying previous knowledge	Identify skills and develop self-efficacy	Create a design based on their independent and collaborative efforts	Witness their child applying their skills in a design process
	Repetition of information	Showcase skills		
	Identify concepts and categorize		Play games	
	Co-operative learning		Socialize with peers	
	Immediate feedback			
	Play based learning			
	Think pair share.			

6.4.1 UDL Design Features

It is not easy to understand the learners' specific needs during the initial design phase and before meeting the learners. The design will consider the general characteristics of ASD, which include varying degrees of social behavior, repetitive sensory-motor behaviors, difficulty understanding thoughts, emotions, and intentions, hypersensitivity, emotional dysregulation, and cognitive and emotional overload. The design should consider the typical strengths of individuals with ASD who excel in their targeted areas of interest and exhibits enhanced visual, attention, memory, and sensory perception. Many individuals with ASD tend to do well with patterns and repetition. Once it gets closer to the workshop, intake forms will be sent out. They will include questions regarding learning accommodations, communication preferences, and if there is anything that may cause a trigger (loud noises, bright lights, smells). Since food will be served, a question regarding allergies (food and air born) will be asked. After receiving the intake forms, there will be time to adjust the activities. This design will include lesson flexibility, alternative communication needs, and special attention to the environment.

Since this workshop resides outside of the restraints of an academic setting, there is the freedom to alter the activities associated with the design of the activities. Even after considering the general characteristics of ASD and with information from the intake forms, adjustments may need to be made after the first session. Extra time will be allotted to make changes between sessions.

The environment of the workshop needs to be carefully planned out. This workshop will include a separate area designated as a quiet area for those become overstimulated and need a quieter to self-regulate. There will be mentioned in the registration and intake forms that headphones and other noise-reducing devices are welcomed.

Communication can be difficult for some individuals with ASD and will be considered during the workshop design. The intake form will include a question regarding communication needs, including sign language. The learners will be able to use drawings or written text instead of verbal communication, and paper and whiteboards will be available.

7. CONCLUSION

Individuals with ASD are underrepresented in the workforce. Often the negative characteristics of this bio-neurological condition outshine the skills and strengths of the individuals. Few activities and events promote skill-building and career exploration for individuals with ASD. This hinders their opportunity to explore the boundaries of their skills and career interests. The constant adverse reports from medical and educational professionals can decrease parental support regarding career opportunities. Which can culminate in a lack of self-efficacy, and the cycle continues. In response, a workshop focusing on solving a real-world problem includes room to explore and demonstrate skills to the parents/caregivers. Important features of this workshop include skill-building activities focused on STEAM subjects, incorporating fun and playful activities, and time to think and generate ideas and then communicate those ideas. The activities will be flexible by design, allowing alterations to occur as the session progresses. Learners communicating the process to the group and the parents will help the individuals identify and understand their skills and abilities. An area where individuals can self-regulate if they become overstimulated will be provided. The curriculum will include UDL to ensure the learners' needs are met and everyone can participate. Data will be collected to measure the success of the workshop and the various elements. Future research will be conducted on learning strategies, activities, and the premise of solving a real-world problem, along with this workshop's current and future impact.

REFERENCES

[1] Griffiths, A.J; Giannantonio, C.M.; Hurley-Hanson, A.E.; Cardinal, D. N. (2016). Autism in the workplace: assessing the transition needs of young adults with autism spectrum disorder. *Journal of Business and Management*, Vol. 22, No.1, 5-22.

[2] Hedley, D.; Cail, R.; Uljarevic, M.; Wilmot, M.; Spoor, J.R.; Richdale, A.; Dissanayake, C. (2018). Transition to work: Perspectives from the autism spectrum, *Autism*, *22*(5), 528–541. doi:10.1177/13623613166876

[3] Center for Disease. Data & statistics on autism disorder, from *Data & Statistics on Autism Spectrum Disorder | CDC,* accessed on 06-03-2023

[4] Drahota, A.; Wood, J.J.; Sze, K.M. (2011). Effects of cognitive behavioral therapy on daily living skills in children with high-functioning autism and concurrent anxiety disorders, *Journal of Autism Development Disorders*, Vol. 41, 257–265. doi:10.1007/s10803-010-1037-4

[5] Lord, C.; Elsabbagh, M.; Baird, G.; Veenstra-Vanderweele, J. (2018). Autism spectrum disorder, *Lancet,* Vol. 392, 508-520. doi.org/10.1016/ S0140-6736(18)31129-2

[6] Hufnagel,C.; Chambres,P.; Bertrand, P.R.; Dutheil, F. (2017). The need for objective measures of stress in autism, *Frontiers in Psychology*, Vol. 8, doi:10.3389/fpsyg.2017.00064

[7] Lee, E.A.L.; Black, M.H.; Falkmer, M.; Tan, T.; Sheely, L.; Bölte, S.; Girdler, S. (2020). We can see a bright future": parents' perceptions of the outcomes of participating in a strengths-based program for adolescents with autism spectrum disorder, *Journal of Autism Developmental Disorders*, Vol. 50*,* 3179–3194. doi:10.1007/s10803-020-04411-9

[8] Bressan, P. (2018). Systemisers are better at maths. *Scientific Reports*, Vol.8, 1-5. doi:10.1038/s41598-018-30013-8

[9] Boren-Cohen, S., Theories of the autistic mind, from *https://www.bps.org.uk/psychologist/theories-autistic-mind*, accessed on 15-03-20

[10]   Thompson, C., Bo¨lte S., Falkmer, T., Girdler S. (2018) To be understood: Transitioning to adult life for people with Autism Spectrum Disorder. *PLoS ONE*, Vol.13, No. 3, doi: 10.1371/journal.pone.0194758

[11] Doren, B.; Gau, J.M.; Lindstrom, L.L.; (2012). The relationship between parent expectations and postschool outcomes of adolescents with disabilities*, Council for Exceptional Children*, Vol. 79, No. 1, 7-23

[12]Van der Bijl JJ, Shortridge-Baggett LM. The theory and measurement of the self-efficacy construct. Sch Inq Nurs Pract. 2001 Fall;15(3):189-207. PMID: 11871579.

[13] Heslin, P.A.; Klehe, U.C. (2006). Self-efficacy. In S. G. Rogelberg (Ed.), Encyclopedia of Industrial/Organizational Psychology (Vol. 2, pp. 705-708). Thousand Oaks: Sage.

[14] Hallinen, J. "STEM*", https://www.britannica.com/topic/STEM-education.* accessed on 20 March 2023.

[15] Adajian, T. The Definition of Art, *https://plato.stanford.edu/archives/spr2022/entries/art-definition/>.accessed* on 12 March 2023.

[16] Munro, T. (1957). Four hundred arts and types of art: a classified list. Wiley, 44-65

[17] Tatarkiewicz, W. (2016). What is art? the problem of definition today, *The British Journal of Aesthetics*, Vol. 11, No. 2, 134-153, doi: 10.1093/bjaesthetics/11.2.134

[18] Merriam-Webster. (n.d.). The arts, from https://www.merriam-webster.com/dictionary/the%20arts, accessed 25-03-2023

[19] Fishwick, P. (2018). How art changes math & computer science education, https://medium.com/creative-automata/how-art-changes-math-computer-science-education-afa90b8b9249 accessed on 20-03-2023

[20] Fishwick, P. (2019). Art completes STEM learning, https://medium.com/creative-automata/art-completes-stem-learning-b00753b3677e, accessed on 20-03-2023

[21] Kunda, M; Goel, A., K. (2011). Thinking in pictures as a cognitive account of autism, *Journal of Autism and Development Disorders*, Vol. 41, 1157-1177, doi: 10.1007/s10803-010-1137-1

[22] Alter-Muri, S. B. (2017). Art education and art therapy strategies for autism spectrum disorder students, *Art Education,*Vol. 70, No. 5, 20-25, doi: 10.1080/00043125.2017.1335536

[23] Grandin, T. (2009). How does visual thinking work in the mind of a person with autism? a personal account, *Philosophical Transactions: Biological Sciences*, Vol. 364, No. 1522, 1437–1442.

[24] Whitebread, D., Basilio, M., Kuvalja, M., Verma, M. (2012*)* Importance of play. *Toy Industries of Europe,* 3-54.

[25] Banerjee, A.M.; Ray, S. G. (2013). Development of play therapy module for children with autism, *Journal of the Indian Academy of Applied Psychology*, Vol. 39, No. 2, 245-253

[26] Herrington, S.; Brussoni, M. (2015). Beyond physical activity: the importance of play and nature-based play spaces for children's health and development. Current Obesity Reports. 2015 Dec;4(4):477-83. doi: 10.1007/s13679-015-0179-2. PMID: 26399254.

[27] Weisberg, D. S.; Kittredge, A. K.; Hirsh-Pasek, K.; Golinkoff, R. M.; Klahr, D. (2015). Making play work for education. *Phi Delta Kappan*, Vol. 96, No. 8, 8–13. doi:10.1177/0031721715583955

[28] Guirguis, R. (2018). Should we let them play? Three key benefits of play to improve early childhood programs. *International Journal of education and Practice,* Vol. 69, No.4, 43-49. doi: 10.18488/journal.61.2018.61.43.49

[29] Hamri, J.; Koivisto, J.; Sarsa, H. (2014). Does gamification work?- a literature review of emperical studies on gamification. *Hawaii International Conference on System Science*. doi:10.1109/HICSS.2014.377

[30] Padilla, J.; Lynch, C.; Diallo, S.; Gore, R.; Barraco, A.; Kavak, H.; Jenkins, B. (2016). Using simulation games for teaching and learning discrete-event simulation. *Proceedings of the 2016 Winter Simulation Conference* 10.1109/WSC.2016.7822368.

[31] Reikerås, E. (2020). Relations between play skills and mathematical skills in toddlers, *the international Journal of Mathematics Education,* Vol. 52, No. 4, 703-716, doi:10.1007/s11858-020-01141-1

[32] King-Sears, M. (2009). Universal design for learning: technology and pedagogy. *Learning Disability Quarterly*, Vol. 3, No. 4, 199–201, Doi: 10.2307/27740372

[33] Rose, D. (2000). Universal Design for Learning, *Journal of Special Education Technology,* Vol.15, No. 4, 47-51.

[34] Digital Senses Lab. STEAM on spectrum (long), from https://www.youtube.com/watch?v=oRyLClSkkus, accessed 11-03-2023