Impact of Music Education on the Developmental Skills of Students With Autism Spectrum Disorder

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Abstract
Autism Spectrum Disorder (ASD) presents a complex neurodevelopmental challenge impacting social interaction, communication, emotional expression, and cognitive abilities. The continuous rise of this population, this topic has become a growing interest for educational and governmental bodies to explore effective and innovative approaches to support those affected individuals. Researchers have suggested music education as an emerging technique due to its inherent appeal and multifaceted engagement. However, implementing music education as an intervention strategy is still a fertile area in the literature that demands more research and investigation before putting it into practice, therefore the purpose of this study is to investigate the impact of music education on the developmental skills of individuals with ASD. The research conducts a comprehensive review of case studies involving general music lessons, instrumental training, and integrated music in education. Through a detailed analysis across social, emotional, cognitive, and motor skill domains, the study unveils how music education fosters social interaction, emotional expression, concentration, and motor coordination among individuals with ASD. The immersive nature and universal appeal of music offer promising pathways to enhance developmental capabilities in this population. Synthesizing these findings underscores the positive impact of music education on ASD developmental skills, advocating for its integration into tailored intervention plans to optimize learning experiences. However, further research remains essential to establish precise links between music techniques and targeted developmental needs, facilitating the design of more effective and personalized intervention strategies.

Keywords: Autism Spectrum Disorder, Music Education, Intervention, Developmental Skills

Introduction

Autism spectrum disorder ASD is characterized as a neurodevelopmental disorder that affects individuals mentally and physically from early childhood till late years of life (Joon et al., 2021). The developmental disorder manifests a wide range of symptoms that varies from a person to another and can evolve over time. Based on the American Psychiatric Association (2013), people with ASD commonly display a deficit in social interaction and communication. They struggle in sharing attention, exchanging conversations, and have a lack of interest in interacting with others (Liu et al., 2021). Another symptom of ASD is emotional understanding deficit particularly having trouble in expressing feelings and sharing emotions with others (Joon et al., 2021). Moreover, the mental disorder of ASD affects the intellectual abilities of this population in regard to the process of thinking, maintaining information and concentration (World Health Organization, 2021). All the above symptoms are mainly associated with motor abnormalities that target the physical strength and body synchronization in addition to hands and visual coordination, accompanied with motor repetitive behaviours (Staal, 2015). As a result of its core symptoms, ASD negatively impacts person's quality of life through limiting day-today functions and learning abilities (Joon et al., 2021).

Thus, ASD has recently become a growing area of interest due to the continuous rise of this population (Preis et al., 2015). Based on the World Health Organization (2021), 1 child in every 160 in the world is classified as having ASD. These statistics have led educational systems and governments to take actions in terms of including these individuals in schools and designing appropriate strategies to support their learning. For example, The United Arab of Emirates government has initiated several programs and rules to improve the quality of life and education for children with ASD (UAE government, 2021). In particular, the UAE federal law No.29 2006 protects the rights of people of determination including ASD, to receive equal learning opportunities and guarantees the resources needed to maximize their education. It states that all schools are required to make modifications in their teaching and learning to cater the needs of this population (UAE government, 2021). In 2021, the Minister of Community Development in UAE have also launched 14 new initiatives under the national policy of autism (UAE Ministry of Community Development, 2021). It focuses on educating the community through creating reliable information and guidelines about this spectrum. Additionally, starting new intervention centres to support early diagnosis, high quality intervention plans as well as guidance in their future journey (UAE Ministry of Community Development, 2021).

Moreover, researchers have been remarkably interested in examining a variety of intervention approaches to identify effective plans on individuals with ASD. Findings in the literature proposed different strategies that are deemed to be beneficial on the developmental skills of persons with ASD (National Autism Centre, 2009). For instance, story-based intervention consists of narrating or acting stories to teach children with ASD appropriate behaviours and responses in daily living and learning situations (Wong et al., 2015). Another example is the antecedent package strategy that aims to modify the environment of children with ASD to maximize their learning. This can be applied through reducing factors that trigger symptoms, including the learner's preferences in the choice of peers, resources, and toys in addition to including visuals in instructions (Will et al., 2018).

Music education has been also suggested in the literature as an emerging technique in addressing core deficits of the disorder as well as increasing learning abilities of students with

ASD (National Autism Centre, 2009). Researchers have recommended music as an intervention strategy due to various reasons. To begin with, children are surrounded by music since they are born, and they are observed to be naturally sensitive to it and capable of emotionally responding to it (Constantin et al., 2015). For example, a calm music can sooth them down to sleep or a happy music can lift their mood and increase their interaction. On top of that, music is considered as a universal language that is understood and well received by all children from all ages and abilities (Preis et al., 2015). It is mainly a source of entertainment and interest that can spontaneously trigger attention and focus. It creates an intrinsic motivation that is powerful in terms of enhancing engagement and modifying behaviors (Lakes et al., 2019). Furthermore, practicing music provides a neurological stimulation as it requires a sequence of sensory, auditory, and cognitive skills in addition to motor movement and imitation (Bacon et al., 2020). This multi-engagement of different body and brain parts may have a potential benefit on the developmental skills of children with ASD (Schwartzberg & Silverman, 2016).

Music can become an appealing technique to be adopted by teachers who are facing challenges in finding evidence-based interventions that meet the needs of pupils with ASD. However, implementing music education as an intervention strategy is still a fertile area in the literature that demands more research and investigation before putting it into practice (Dumont et al., 2017). Therefore, the research question of this study is: What is the impact of music education on the developmental skills (social, emotional, cognitive, and motor) of students with ASD. The purpose of this study is to review and examine case studies in the literature to provide more quality evidence in this field and answer the research question. The selected articles are aligned with the research question and cover different techniques in music education: general music lessons, instrumental lessons, and integration of music in other school subjects. The paper will first unpack the results of the studies under 4 different themes: social, emotional, cognitive, and motor. Afterwards, a discussion is presented to summarize the findings, analyse it, and generate new results that will answer the proposed research question.

Body

Research in the field of ASD, have focused on the active use of music education as an intervention strategy for students with ASD, ranging from singing, listening, playing instruments, music-based movements as well as including it in curriculum subjects (Bacon et al., 2020). Researchers state that there is an existing relation between music and autism as they share overlapping mechanisms (Bacon et al., 2020). As a way of explanation, musical practices activate multiple skills such as interaction with musicians, sensory and auditory stimuli through listening and reading music, executive functions through memorizing, and analysing music, in addition to physical movement through playing instruments and dancing. All of the mentioned skills are found to be core deficits in children with ASD. Therefore, researchers declare that music depends upon several physical and mental capabilities that can particularly target the skills of individuals with ASD (Schwartzberg & Silverman, 2016). Hence, this part will present case studies in the literature that investigated the impact of music education on the developmental skills of ASD: social, emotional, motor, and cognitive.

Social

Due to their developmental disorder, students with ASD lack the ability to communicate with their environment (American Psychiatric Association, 2013). They have deficit in the skill of

cocreating meaning of an object or event with another human. In other words, they cannot share attention or thoughts with their entourage, which prevent them from verbally or physically responding (Vivanti et al., 2017). Thus, students with such condition are unable to socially interact with their peers during learning nor participating in any collaborative tasks (Liu et al., 2021). Studies in the literature have discussed the impact of learning music on the social capacity of students with ASD.

For example, the study of Vaiouli et al. (2015) have examined the benefit of implementing music lessons on the social development of 3 autistic kindergarten children in a special education class. Vaiouli et al. (2015) stated that the participants used to only communicate in basic situations such as saying good morning, requesting for something by pointing at it, and their main struggle was to engage in back-and-forth conversations or taking turns in a certain activity. During collaboration time, they avoided participation and displayed aggressive behaviour such as biting and kicking. They have attended 9 months of music classes that consisted of interaction-based activities such as singing, responding to songs with actions, and interplaying instruments with the teacher and other students.

The findings reveals that students' level of engagement has noticeably increased shortly after the implementation. Vaiouli (2015) declared that students were highly enjoying music which spontaneously stimulated their interest and attention to their entourage. They started focusing on faces, singing with their peers, holding their hands, and even initiating conversations. Those findings are aligned with the study of Lakes et al. (2019) which indicates that during music class, the level of engagement of 8 autistic students aged 7 to 12, were similar to typical developing children. Lakes et al. (2019) argued that their amusement in music has involuntarily involved them in group activities which have regulated their social skills and limited their disruptive behavior.

The above-mentioned study of Vaiouli (2015) also discussed another social benefit of music education which is nurturing social relationships. During interviews, parents of the participants have explained that their children are using music as a communicative tool with their peers which helped them in making friendships for the first time. For example, they call their friends in school or their siblings at home to make music performances and sing together. These views echoes the findings of Cook et al. (2018), which argued that the synchronization of singing and moving to music as a group have removed boundaries between students and facilitated their social communication. In other words, music has enabled students with ASD to bond and be friends with typical students inside and outside the classroom.

Furthermore, the study of Cook et al. (2018) highlighted that engaging in music lessons develops the prosocial skills such as displaying positive behaviour and volunteering to help peers in class. Similar findings were concluded in the study of Lowry et al. (2018), which discussed the positive impact of playing the drums on all 18 participants aged 7 to 9, in terms of taking initiatives in class to support their peers and the teacher. The study of Draper (2021) on two G1 ASD students also indicates that taking music lessons have made them feel successful and capable like other students. As a result, they became confident enough to redirect their friends, offer to model how to play the violin and even lead music groups through hand movements.

Verbal expression in conversations have also been examined as one of the benefits of music education on this population. For instance, the above-mentioned study of Lowry, reported

that group drumming have played a role in making students feel that they are part of a community. It has decreased their social anxiety and supported them in becoming more vocal through expressing their needs and communicating with their entourage. Similar findings were present in the study of Foley (2017) which indicated that learning music requires a lot of interaction through speaking such as requesting the desired instrument, asking which rhythm to play, and counting the beats. Students were practicing those skills one class after the other, which has developed their ability of using the appropriate words in each social situation. It should be noted that the teacher was aware of the social difficulties of the 9 participants through observing them in action and reviewing their intervention plan prior to the study. Thus, the teacher has focused on practicing verbal communication based on their needs and embedding it as part of their class routine.

On the other hand, there is a limited number of studies in the literature that have demonstrated negative or neutral impact of music education on social skills of individuals with ASD. As an example, Preis et al. (2015) argued that listening to music have shown no remarkable improvement on the engagement nor the social responsiveness of 5 boys with ASD aged 4 to 6. The teacher have put background music during learning time for 28 weeks, where the chosen playlist was a mix of songs without words and from three different styles: reggae (Jamaican rhythmic music), classical and for kids. The results showed that students could not build any connection with the selected music as there was a lot of different styles and songs that they are not familiar with. Thus, background music did not contribute to any major changes in their social behaviour compared to their learning time without music.

Another example is the study of Mössler et al. (2020), that was conducted on 48 kindergarten students with severe ASD symptoms. The findings revealed that considering music as an intervention was not successful in developing social skills nor increasing participation in class. Although the teacher was well trained in delivering interactive activities, but students' abilities were very low and not receptive to such instructions. Mössler et al. (2020) argued that students with strong ASD symptoms require first lessons that focus on body and vocal expression such as moving around in a big space and singing loudly, which was not present in this study.

Emotional

It is generally recognized that autism is associated with a deficit in emotional processing, particularly understanding own and others' emotions (Elmose, 2016). By way of explanation, students with ASD fail to identify and label their feelings which results in poor and incoherent emotional expression (Costa et al., 2017). On the other hand, they fail perceiving emotions of other people especially reading face expressions, which limit their ability to respond appropriately (Griffiths et al., 2017). Given the emphasis of music as an art of expressing emotions (Tan et al., 2018), many researchers were interested in examining the role of music in addressing emotional problems in this population.

For instance, Wagener et al. (2020) conducted a study on 19 students with ASD aged 9 to 12, to examine the effect of listening to background music on recognizing angry, sad, and happy faces. The researcher selected compatible music for each photo that shows a person doing a face expression. For example, a calm slow music for a sad expression and fast jazzy music for a happy face. The results revealed that students were strongly influenced by the music they were listening while looking at the photos. They demonstrated higher ability of facial expression recognition compared to the same activity without music. Wagener et al. (2020)

argued that music and emotions are interconnected therefore it is recommended to integrate listening to music more in lessons such as storytelling and role play. The findings of this study are consistent with the ones of Brown (2017). It applied the same procedure on 20 elementary and middle schoolers students with ASD and compared it to the response of 30 other neurotypical students. The results indicated that students with ASD were able to identify face expressions while listening to music, like students with typical development.

Katagiri (2009) directed a similar study that investigated the effect of two music techniques on face expression recognition: listening to background music and singing songs about each emotion. After attending 8 lessons of emotional understanding, the findings revealed that both techniques are more beneficial than verbal explanation, whereas background music is found to be the most effective. According to Katagiri (2009), background music stimulates the emotions of students with such condition and allow them to connect it to the body expression or the situation they see. During interviews, parents explained that they rarely show their children any sad or angry feelings which has made it challenging on them to understand it in their social life. Parents believed that background music aided their children to be exposed to such feelings and to read the body language related to it.

Another challenge in the emotional domain of autism is the expression of own emotions (Huang et al., 2017). Individuals with ASD know when they are experiencing a certain feeling, but they are not aware whether it is sadness, happiness, or anger (Elmose, 2016). Hence, they face difficulty in recognizing, describing, and expressing their emotions (Huang et al., 2017). Several studies have found that music is a successful tool to help students in encoding their emotional state. To give an example, the study of Constantin (2015) revealed that after attending intensive music lessons of singing, dancing, and playing instruments, 9 special needs students with high emotional deficit, became capable to identify their emotions in situations that occurred in class. They have also chosen singing and drawing as ways to express it. However, most of the students have displayed difficulty in speaking and choosing the right words to describe what they feel. Constantin (2015) stated that music is a vital tool in encouraging special needs students to build a process of emotional expression, but it does not support them in verbalizing it.

Furthermore, lacking the ability to understand their own feeling is mainly correlated to poor self-regulation of emotions (Cai et al., 2018). Children with ASD get exposed to high pressure when they cannot relate to what they are going through, and lose control over their emotions (Nuske et al., 2017). As a result, they experience high anxiety and display aggressive behavior such as crying, screaming, and hitting (Beck et al., 2020). Researchers considered music as a potential tool of treating the poor regulation of negative feelings of this population.

For example, Rose et al. (2018) declared that taking Horn (blowing instrument) lessons in school have been emotionally beneficial for CB, an 8-year-old boy diagnosed with ASD. It has created in him a self-accomplishment feeling which has reduced his negative feelings and boosted his emotional well-being. His parents declared that CB suffers from anxiety and depression accompanied by aggressiveness, but as a result of Horn sessions, CB became more in control of those feelings and less agitated in public. It is also reported that CB started using his Horn as an outlet of his feelings in school and at home. Whenever he is stuck with his emotions and not able to translate it, he would go to the music room and play the Horn as a way of getting distracted from what he is going through. Additionally, the results showed that performing the horn in front of the class, has lifted CB’s confidence, and trained him to

find adaptive strategies in challenging situations. For example, during a class concert, instead of screaming or crying to express his stress, CB has shared a laugh with his friends, which has protected his feelings and calmed him down to resume his performance. Having said that, Rose et al. (2018) argued similarly to Constantin (2015), that music supports students with ASD in choosing better ways to control and express their emotions, but it does not fully help them in verbalizing or solving their negative feelings.

Motor

Individuals with ASD are generally characterized by a delay in their motor function due to a neurodevelopmental disorder (American Psychiatric Association, 2013). It affects gross motor skills such as physical activity and body coordination, which are often accompanied by motor repetitive behaviors like body swaying, tapping hands and rocking feet (Hollander et al., 2018, p. 146). They also experience problems in fine motor skills such as hands movement, visual coordination and words pronunciation (American Psychiatric Association, 2013). These issues have troubled their daily living in terms of limiting their independence in school tasks and their participation in activities (Memari et al., 2015). Literature have discussed music as a beneficial technique on the gross and fine motor skills of students with ASD.

For example, Woodman et al. (2018) investigated the effect of music on the physical activity of 13 ASD students between 5 and 13 years old in a private special education school. The purpose of the study was checking the changes that occurred on their morning jog after combining it with listening to music. Data of the study were collected from observing students, checking their waistbands, and interviewing their teachers. The results highlighted motivational impact of slow music on the intensity and speed of their physical ability. Woodman et al. (2018) stated that slow music has aided students to regulate their strength and enable their focus. Woodman et al. (2018) also recommended including slow in any sort of movement lessons, in the purpose of not only increasing their physical intensity but also strengthening their motor skills and body muscles.

Similar findings were present in the study of Imankhah et al. (2018) that aimed for embedding music in an intervention plan for 30 Grade 3 students with ASD. High experienced music educators created 15 music lessons aligned with the “Orff” teaching approach. It is based on delivering music in an active setup where the body is engaged in intense movements such as dancing, singing, and playing percussion instruments. The results reported a progress in the motor involvement and body coordination of the participants. Imankhah et al. (2018) argued that students were naturally understanding and following the rhythm while applying all music instructions. This sort of rhythmic practice has balanced their body posture and movements. In addition, listening and playing music stimulated all their sensory functions which maintained their focus during music activities. For example, when playing a triangle, its high pitch triggered their listening and awakened them to stay on the rhythm. Their consistent repetition of fast responses contributed to adapting their body to voluntary well-rhythmic actions such as symmetrical walking, turning, and bending.

In support of those findings, Sanglakh et al. (2017) argued that musical rhythmic activities are more efficient on motor proficiency than free movements. In this study, 22 elementary participants with ASD, were blindly assigned to two groups, one experimental that consists of playing percussion instruments, and another control group of only movements such as hopping, crawling, and climbing. The results documented a progress in both groups, whereas

the experimental group displayed higher effectiveness. As students were shaking or banging the drums on beats, their upper limbers have noted to be strengthened. Moreover, the structured movements based on music beats improved their motor timing which created a sense of balance between their body and time and reduced their repetitive behaviors. For example, when an individual with ASD is trying to eat, he will be aware of his movement towards his mouth and understand when the next movement should be done. He will no longer expresses confusion about motor functioning which will limit his irrelevant pattern of behaviors.

Furthermore, research studies have investigated the influence of learning music instruments on the fine motor skills of this population. The previously mentioned study of Rose et al. (2018) stated that playing the Horn, like all wind instruments, requires blowing, lips vibration and fingers pressure, which triggers the face, tongue, and hands muscles. As a result, CB (8 years old boy diagnosed with ASD) have displayed improvement in daily motor skills such as catching a ball, whispering, and articulating words. Moreover, reading music notes and concentrating on different signs on music sheets, resulted in reinforcing CB's visual coordination and enhancing his control over his eyes in tasks and during conversations.

Those results match the study of Spak and Card (2019), which conducted a 1-year intervention plan of drumming sessions for a 12-year-old boy with severe motor impairments. The outcome of the study revealed that after few months, Reily attained remarkable progress in his hands and feet movements such as speed control, catching, grabbing and balanced jumping. Additionally, playing on a full drum set involved Reily in different actions at the same time. He was asked to kick the pedal with his feet while flipping the stick or banging the drums with his hands. Spak and Card (2019) stated that the multifunction of different body parts during drumming have extended Reily's perception and allowed him to view and anticipate the motions around him.

This study does not reflect the findings of Lowry (2019), which indicated no significant changes on the fine motor skills of 18 elementary students with ASD, after participating in 10 drumming lessons. Lowry (2019) declared that those results are due to different reasons. First, the starting point of the participants is very low as music is not embedded in the curriculum and students were never exposed to any music lessons before. In addition, students were showing signs of worry and anxiety before and during the lesson because of all the changes that they were experiencing. They were not only disturbed by the sound of the drums but also the lessons were delivered by new teachers and in a different setup from what they are used to. Lastly, the drumming exercises were not complex enough to target all fine motor skills of the students. Therefore, Lowry (2019) recommended further research in this domain while taking in consideration all those limitations.

Cognitive

For ASD individuals**,** impaired cognitive development is one of the core symptoms resulting from brain disfunction. They experience a difficulty in processing information leading to a restriction in several cognitive skills such as memorizing, spatial ability, problem-solving, and language acquisition (Åsberg Johnels et al., 2021). To elaborate more, children with ASD are unable to maintain information in their memory, connecting it to other ideas and generating new concepts based on previous knowledge (Ramain et al., 2021). Those problems are preventing students with ASD from having a purposeful learning experience and high academic achievement (Erickson & Geist, 2016). Supporting the developmental

cognition of this population requires a learning experience that emphasizes on language, communication, and teaching of symbols, which can occur in music education (Erickson & Geist, 2016). Thus, researchers were interested in assessing the effect of music on different cognitive abilities of this target group.

For instance, Koolidge and Holmes (2018) explored the impact of three musical conditions on the spatial ability of 87 primary students in a private school. Participants were asked to complete a 12 pieces jigsaw puzzle while listening to music without words, music with words and without music. The purpose of this study was to check their ability of recognizing different shapes, memorizing it, and connecting it together. The choice of the music was based on children's preferences and parents' advice to establish familiarity. It is important to mention that researchers have met several times with the participants and played with them to build a trusting relationship and ensure that they are ready to participate in the game. The findings demonstrated that listening to background music without vocals was the most beneficial condition, whereas the two other conditions presented the same low results. Koolidge and Holmes (2018) indicated that there are several factors associated with the superiority of background music. First, music with words exhausts the brain and consumes the focus needed for the task whereas background music decreases external distractions and sustains their focus-task. Second, the familiarity of the song enabled students to connect to the music which facilitated their concentration. Lastly, the joyful background music has boosted their mood and aided the performance of their cognitive skills.

Literature have also reported the benefit of music-based learning on the cognitive skills that contribute to academic achievement of this population. Mastropieri and Scruggs (1997) consider reading comprehension as one of the most essential learning skills in schools. In fact, children with ASD might be able to read accurately, however they lack the skill of forming connections and structure of what they read (Ramain et al., 2021). Hence, Schwartzberg and Silverman (2016) conducted a study to compare the comprehension of reading a short story for 3 days on two groups: control group with no music and experimental group with listening to the story in sort of singing. The story chosen included visuals in addition to being short and with appropriate vocab to meet the needs of the participants. The results revealed that the experimental group have displayed higher potential of comprehension than the control group.

Schwartzberg and Silverman (2016) hypothesized that the stimulation of multiple auditory senses through singing and visuals, activated the nervous system and enabled different cognitive domains specially the ones responsible for memory, concentration, and speech. Moreover, the memory retrieval of the participants got associated with the music they hear and the photos they see, which have facilitated the process of comprehension.

Those findings are in line with the study of Simpson et al. (2013) which argued that language acquisition increased when embedding singing in lessons. This study aimed to compare learning new vocabulary in verbal explanation and sung condition. Twenty-two participants received 15 lessons of learning about the theme garden using the music of "Twinkle Twinkle" where the lyrics was replaced by the lesson explanation. The results show a higher acquisition of language in the sung condition. Simpson et al. (2013) indicated that the engagement of students with the music have maintained their concentration for a longer period and enhanced their memory function. Additionally, the familiarity of the song "Twinkle Twinkle" has also contributed to increasing their interest on the new terms.

Similarly, Said and Abramides (2020) investigated the impact of music lessons on reading and writing of 40 students with ASD. The outcome of the study documented higher academic achievement in both skills compared to other 40 participants who are not exposed to music lessons. Said and Abramides (2020) declared that learning music pushes the brain to work in a network, where the students are reading notes, sending messages to the brain to play it, translate it through a hand movement and then listening to it. As a result, a communication is built between different areas in the brain responsible for verbal language, memory, and analysis.

Furthermore, several studies have considered music as potential strategy to improve problem-solving in this population. For example, Rose et al. (2018), a previously mentioned study, indicated that after few months of taking Horn lessons, CB's IQ has elevated as well as his skills in problem solving and far transfer effects. In other words, CB became capable of adapting to any new challenge, analyzing it, and finding appropriate solutions. For example, during Horn practices, CB struggled in reading the music notes, but he came up with a solution for himself by color coding the lines and spaces on the staff. According to Rose et al. (2018), his cognitive skills and specially reasoning has reached the same level of a typical developing child.

This finding is consistent with another previously mentioned study of Foley (2017) which explains that after implementing music lessons for 3 elementary students with ASD, their problem-solving skills were noted to be developed. For example, when the teacher gave Alberto a new complex rhythm to play on the drum, he analyzed the previous rhythm content and successfully solved the task. Another example was during Casper's practice on the instruments where he was meant to hit a tambourine every time the teacher gives a sign. Casper was struggling to pick and hit the tambourine on time, so he figured out a way to solve this issue, by putting the tambourine on the desk as it closer and will take less time to grab it.

Discussion

The overall findings generally present positive impact of music education on all developmental skills of students with ASD. First, it indicates that learning music enhances different social aspects in this population: engagement, interaction, verbal conversation, social bonding, and prosocial attitudes (Vaiouli et al., 2015; Cook et al., 2018). Moreover, the results show that music supports children with ASD in emotional understanding of their own feelings and others' facial expressions (Rose et al., 2018; Wagener et al., 2020). However, the insights of some studies confirm that music only aids in venting emotions but has no role in encouraging children with ASD to verbally express it (Constantin, 2015; Lowry 2018). Furthermore, the findings prove that music provides opportunities for individuals with ASD to increase their physical ability, body coordination and synchronization in addition to reinforcing fine motor skills such as hands movement, speech control, and visual coordination (Sanglakh et al., 2017; Spak & Card, 2019). Lastly, music activities stimulate a range of cognitive skills in the brain such as concentration, memory, spatial task, language acquisition and problem-solving (Simpson et al., 2013; Schwartzberg & Silverman). There were very few results that presented no significant impact of music education but that was mainly due to some limitations within the studies. For example, design of music lessons that does not meet the age and needs of the participants (Lowry et al., 2019). Another existing limitation is the wrong choice of music that students were not able to connect to (Preis et al.,

2015). Lastly, the limited access to resources that prevented teachers and students from reaching their full potentials (Mössler et al., 2020).

Moreover, based on the analysis of the findings, several music techniques are observed to be more beneficial on some developmental skills than others. For example, music lessons that include collaborative singing and movement, are found to be the most efficient on the social capacity of this population (Vaiouli et al., 2015; Foley, 2017). On the other hand, instrumental practices are reported to serve the gross and fine motor skills in terms of rhythmic body movement and muscles training of hands, feet, face ad eyes (Rose et al., 2018; Spak & Card, 2019). Additionally, instrumental lessons are observed to enhance the brain function and cognitive skills due to the requirement of several intellectual and sensory function. Regarding integrating music in other subjects, listening to slow joyful music is noted to be effective in maintaining students' focus, reducing distractions, and enhancing emotional understanding (Woodman et al., 2018; Wagener et al., 2020). Whereas, singing spoken songs is mostly beneficial in lessons that demand new vocabulary acquisition such as reading and science (Simpson et al., 2013; Schwartzberg & Silverman., 2016).

On top of that, the analysis of the results allows us to point at several factors that are responsible for successful implementation of music practices for students with ASD. First, it is essential to build a positive relationship with the students before starting music lessons as they need time to adapt to new faces and new routines (Koolidge & Holmes, 2018). Second, taking in consideration the music preferences of the students contribute to building familiarity and optimizing their execution (Simpson et al., 2013). Third, incorporating other sensory stimuli with music such as photos and videos raises the involvement and response of this population (Wagener et al., 2020). Lastly, music teachers must be aware of students' intervention plan, their weaknesses, and strengths in order to design lessons that focus on solving their difficulties and meeting their needs (Foley, 2017).

To sum up the discussion of findings in correspondence to the research question, music education has a positive impact on the developmental skills (social, emotional, cognitive, and motor) of students with ASD. The new concluded results provide teachers with evidence to consider music education as part of the designed intervention plan for these individuals. Additionally, it redirects their planning and teaching strategies to the right music technique based on the skill that they are working on improving. Lastly, it gives them factors to consider and other mistakes to avoid, to ensure a successful implementation of the music practices.

Conclusion

ASD is defined as a neurodevelopmental disorder causing impairments that are observed on individuals from an early age and continues later in their adulthood (Joon et al., 2021). Children with ASD exhibit a wide range of symptoms that mainly consists of social interaction deficit, lack of emotional understanding, limited intellectual abilities and motor abnormalities (American Psychiatric Association, 2013). The severity of the symptoms changes from a person to another but can improve with appropriate interventional strategies (World Health Organization, 2021). Therefore, researchers were interested in investigating several intervention techniques to improve the skills of this population as well as their learning experience. Given the enjoyment approach of music and its multiple engagement of several physical and mental functions, researchers recommended music education as one of the promising strategies to be applied on students with ASD (Bacon et al., 2020). Hence, this

study aimed to examine existing case studies in the literature and connect its findings to answer the research question: What is the impact of music education on the developmental skills (social, emotional, cognitive, and motor) of students with ASD?

The findings of this study show that music lessons unvoluntary engage students with ASD in social interaction, remove the social barriers between peers and facilitate their communication (Vaiouli et al., 2015; Cook et al., 2018). Moreover, music is a beneficial tool in teaching students how to label their emotions, express it and decode the emotions of others particularly face expressions (Rose et al., 2018; Wagener et al., 2020). Regarding cognitive skills, music is responsible for limiting distraction and reinforcing concentration during tasks. In addition, the involvement of several tasks during music practices provokes the brain function and ameliorate intellectual skills such as memory, spatial tasks, problem-solving and literacy (Simpson et al., 2013; Schwartzberg & Silverman). Lastly, findings present that rhythmic music contributes to balancing the body coordination and symmetric movements. Additionally, the occupation of different body parts such as hands, mouth and eyes during instrumental lessons reinforce fine motor skills, eye control and words articulation (Sanglakh et al., 2017; Spak & Card, 2019).

Considering all the given findings and discussions in this research, we can conclude that music education has a positive impact on the developmental skills (social, emotional, cognitive, and motor) of students with ASD. It allows us to recommend music education as an intervention tool to be adopted in schools to meet the educational needs of this population and improve their learning experience inside and outside the classroom. However, further research is needed to validate the proposed connection between the music technique used and the desired developmental skill to facilitate the process of designing interventional plans where the music practices match the targeted need.

References

American Psychiatric Association. (2013). DSM-5 Diagnostic Classification. *Diagnostic and Statistical Manual of Mental Disorders*, *25*(5), 50–59. https://doi.org/10.1176/appi.books.9780890425596.x00diagnosticclassification

Åsberg Johnels, J., Fernell, E., Kjellmer, L., Gillberg, C., & Norrelgen, F. (2021). Language/cognitive predictors of literacy skills in 12-year-old children on the autism spectrum. *Logopedics Phoniatrics Vocology*, 1–5. https://doi.org/10.1080/14015439.2021.1884897

Bacon, A., Beaman, C. P., & Liu, F. (2020). An exploratory study of imagining sounds and "hearing" music in autism. *Journal of Autism and Developmental Disorders*, *50*(4), 1123–1132. https://doi.org/10.1007/s10803-019-04346-w

Beck, K. B., Conner, C. M., Breitenfeldt, K. E., Northrup, J. B., White, S. W., & Mazefsky, C. A. (2020). Assessment and treatment of emotion regulation impairment in autism spectrum disorder across the life span. *Child and Adolescent Psychiatric Clinics of North America*, *29*(3), 527–542. https://doi.org/10.1016/j.chc.2020.02.003

Brown, L. S. (2016). The influence of music on facial emotion recognition in children with autism spectrum disorder and neurotypical children. *Journal of Music Therapy*. https://doi.org/10.1093/jmt/thw017

Cai, R. Y., Richdale, A. L., Uljarević, M., Dissanayake, C., & Samson, A. C. (2018). Emotion regulation in autism spectrum disorder: Where we are and where we need to go. *Autism Research*, *11*(7), 962–978. https://doi.org/10.1002/aur.1968

Constantin, F. A. (2015). Emotional Effects of Music Therapy on Children with Special Needs. Journal Plus Education / Educatia Plus, 12A, 178-183.

Cook, A., Ogden, J., & Winstone, N. (2018). The impact of a school-based musical contact intervention on prosocial attitudes, emotions and behaviours: A pilot trial with autistic and neurotypical children. *Autism*, *23*(4), 933–942. https://doi.org/10.1177/1362361318787793

Costa, A. P., Steffgen, G., & Samson, A. C. (2017). Expressive incoherence and alexithymia in autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *47*(6), 1659–1672. https://doi.org/10.1007/s10803-017-3073-9

Draper, A. R. (2021). Music education for students with autism spectrum disorder in a full-inclusion context. *Journal of Research in Music Education*. https://doi.org/10.1177/00224294211042833

Dumont, E., Syurina, E. V., Feron, F. J., & van Hooren, S. (2017). Music interventions and child development: A critical review and further directions. *Frontiers in Psychology*, *8*. https://doi.org/10.3389/fpsyg.2017.01694

Elmose, M. (2016). A conceptual framework for understanding characteristics of self-awareness associated with autism spectrum disorder. *Scand. J. Child Adolesc. Psychiatr. Psychol.* 4, 109–114. doi:10.21307/sjcapp-2016-017

Erickson, K. A., & Geist, L. A. (2016). The profiles of students with significant cognitive disabilities and complex communication needs. *Augmentative and Alternative Communication*, *32*(3), 187–197. https://doi.org/10.1080/07434618.2016.1213312

Foley, S. V. (2017). *He Benefits of Music Education on Academic, Behavioral, and Communicative Skills with Middle School Students with Autism Spectrum Disorder* (thesis). Graduate Master's Theses, Capstones, and Culminating Projects.

Griffiths, S., Jarrold, C., Penton-Voak, I. S., Woods, A. T., Skinner, A. L., & Munafò, M. R. (2017). Impaired recognition of basic emotions from facial expressions in young people with autism spectrum disorder: Assessing the importance of expression intensity. *Journal of Autism and Developmental Disorders*, *49*(7), 2768–2778. https://doi.org/10.1007/s10803-017-3091-7

Hollander, E., Hagerman, R., & Fein, D. (2018). *American Psychiatric Association Publishing.* (1st ed.). American Psychiatric Association Publishing.

Huang, A. X., Hughes, T. L., Sutton, L. R., Lawrence, M., Chen, X., Ji, Z., & Zeleke, W. (2017). Understanding the self in individuals with autism spectrum disorders (ASD): A Review of Literature. *Frontiers in Psychology*, *8*. https://doi.org/10.3389/fpsyg.2017.01422

Imankhah, F., Hossein Khanzadeh, A. A., & Hasirchaman, A. (2018). The effectiveness of combined music therapy and physical activity on Motor Coordination in children with autism. *Iranian Rehabilitation Journal*, 405–412. https://doi.org/10.32598/irj.16.4.405

Joon, P., Kumar, A., & Parle, M. (2021). What is autism? *Pharmacological Reports*, *73*(5), 1255–1264. https://doi.org/10.1007/s43440-021-00244-0

Katagiri, J. (2009). The effect of background music and song texts on the emotional understanding of children with autism. *Journal of Music Therapy*, *46*(1), 15–31. https://doi.org/10.1093/jmt/46.1.15

Koolidge, L., & Holmes, R. M. (2018). Piecing it together: The effect of background music on children's Puzzle assembly. *Perceptual and Motor Skills*, *125*(2), 387–399. https://doi.org/10.1177/0031512517752817

Lakes, K. D., Neville, R., Vazou, S., Schuck, S. E., Stavropoulos, K., Krishnan, K., Gonzalez, I., Guzman, K., Tavakoulnia, A., Stehli, A., & Palermo, A. (2019). Beyond Broadway: Analysis of qualitative characteristics of and individual responses to creatively able, a music and movement intervention for children with autism. *International Journal of Environmental Research and Public Health*, *16*(8), 1377. https://doi.org/10.3390/ijerph16081377

Liu, Q., Wang, Q., Li, X., Gong, X., Luo, X., Yin, T., Liu, J., & Yi, L. (2021). Social synchronization during joint attention in children with autism spectrum disorder. *Autism Research*, *14*(10), 2120–2130. https://doi.org/10.1002/aur.2553

Lowry, R. G., Hale, B. J., Draper, S. B., & Smith, M. S. (2018). Rock drumming enhances motor and psychosocial skills of children with emotional and behavioral difficulties. *International Journal of Developmental Disabilities*, *65*(3), 152–161. https://doi.org/10.1080/20473869.2018.1429041

Mastropieri, M. A., & Scruggs, T. E. (1997). Practices in promoting reading comprehension in students with learning disabilities: 1976 to 1996. *Remedial and Special Education, 18*, 198–213.

Memari, A. H., Panahi, N., Ranjbar, E., Moshayedi, P., Shafiei, M., Kordi, R., & Ziaee, V. (2015). Children with autism spectrum disorder and patterns of participation in daily physical and play activities. *Neurology Research International*, *2015*, 1–7. https://doi.org/10.1155/2015/531906

Mössler, K., Schmid, W., Aßmus, J., Fusar-Poli, L., & Gold, C. (2020). Attunement in music therapy for young children with autism: Revisiting qualities of relationship as mechanisms of change. *Journal of Autism and Developmental Disorders*, *50*(11), 3921–3934. https://doi.org/10.1007/s10803-020-04448-w

National Autism Center. (2009). National standards report. Retrieved March 21, 2022, from http:// mn.gov/mnddc/asd-employment/pdf/09-NSR-NAC.pdf

Nuske, H. J., Hedley, D., Woollacott, A., Thomson, P., Macari, S., & Dissanayake, C. (2017). Developmental delays in emotion regulation strategies in preschoolers with autism. *Autism Research*, *10*(11), 1808–1822. https://doi.org/10.1002/aur.1827

Preis, J., Amon, R., Silbert Robinette, D., & Rozegar, A. (2015). Does music matter? the effects of background music on verbal expression and engagement in children with autism spectrum disorders. *Music Therapy Perspectives*, *34*(1), 106–115. https://doi.org/10.1093/mtp/miu044

Ramain, J., Mohr, C., & Abu-Akel, A. (2021). How cognitive control, autistic and schizotypal traits shape context adaptation of divergent thinking. *The Journal of Creative Behavior*, *55*(3), 783–799. https://doi.org/10.1002/jocb.489

Rose, D., Jones Bartoli, A., & Heaton, P. (2018). Learning a musical instrument can benefit a child with special educational needs. *Psychomusicology: Music, Mind, and Brain*, *28*(2), 71–81. https://doi.org/10.1037/pmu0000209

Said, P. M., & Abramides, D. V. (2020). Efeito da Educação musical na promoção do Desempenho Escolar em Crianças. *CoDAS*, *32*(1). https://doi.org/10.1590/2317-1782/20192018144

Sanglakh, G. A. A., Akbarfahimi, M., & Alizadeh, Z. M. (2017). The effect of movement activities in synchronization with music on motor proficiency of children with autism. *Journal of Advanced Medical Sciences and Applied Technologies*, *3*(2), 61. https://doi.org/10.18869/nrip.jamsat.3.2.61

Schwartzberg, E. T., & Silverman, M. J. (2016). Effects of a music-based short story on short- and long-term reading comprehension of individuals with autism spectrum disorder: A cluster randomized study. *The Arts in Psychotherapy*, *48*, 54–61. https://doi.org/10.1016/j.aip.2016.01.001

Simpson, K., Keen, D., & Lamb, J. (2013). The use of music to engage children with autism in a receptive labelling task. *Research in Autism Spectrum Disorders*, *7*(12), 1489–1496. https://doi.org/10.1016/j.rasd.2013.08.013

Spak, D., & Card, E. (2019). Music, movement, and mind: Use of drumming to improve strength, balance, proprioception, stamina, coordination, and emotional status in a 12-year-old with agenesis of the corpus callosum: A case study. *Journal of Holistic Nursing*, *38*(2), 186–192. https://doi.org/10.1177/0898010119871380

Staal, W. G. (2015). Autism, DRD3 and repetitive and stereotyped behavior, an overview of the current knowledge. *European Neuropsychopharmacology*, *25*(9), 1421–1426. https://doi.org/10.1016/j.euroneuro.2014.08.011

Tan, D., Diaz, F. M., & Miksza, P. (2018). Expressing emotion through vocal performance: Acoustic cues and the effects of a mindfulness induction. *Psychology of Music*, *48*(4), 495–512. https://doi.org/10.1177/0305735618809873

UAE Government. (2021). *Education for people of determination*. Education for people of determination - the official portal of the UAE Government. Retrieved March 25, 2022, from https://u.ae/en/information-and-services/education/education-for-people-with-special-needs

UAE Ministry of Community Development. (2021). *The National Policy for Autism*. The National Policy for Autism | Autism | People of Determination | Target Audience | About MOCD | Ministry of Community Development. Retrieved March 21, 2022, from https://www.mocd.gov.ae/en/about-mocd/autism/the-national-policy-for-autism.aspx

Vaiouli, P., Grimmet, K., & Ruich, L. J. (2015). "Bill is now singing": Joint engagement and the emergence of Social Communication of three young children with autism. *Autism*, *19*(1), 73–83. https://doi.org/10.1177/1362361313511709

Vivanti, G., Fanning, P. A., Hocking, D. R., Sievers, S., & Dissanayake, C. (2017). Social attention, joint attention and sustained attention in autism spectrum disorder and Williams Syndrome: Convergences and divergences. *Journal of Autism and Developmental Disorders*, *47*(6), 1866–1877. https://doi.org/10.1007/s10803-017-3106-4

Wagener, G. L., Berning, M., Costa, A. P., Steffgen, G., & Melzer, A. (2020). Effects of emotional music on facial emotion recognition in children with autism spectrum disorder (ASD). *Journal of Autism and Developmental Disorders*, *51*(9), 3256–3265. https://doi.org/10.1007/s10803-020-04781-0

Will, M. N., Currans, K., Smith, J., Weber, S., Duncan, A., Burton, J., Kroeger-Geoppinger, K., Miller, V., Stone, M., Mays, L., Luebrecht, A., Heeman, A., Erickson, C., & Anixt, J. (2018). Evidenced-based interventions for children with autism spectrum disorder. *Current Problems in Pediatric and Adolescent Health Care*, *48*(10), 234–249. https://doi.org/10.1016/j.cppeds.2018.08.014

Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., Brock, M. E., Plavnick, J. B., Fleury, V. P., & Schultz, T. R. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of Autism and Developmental Disorders*, *45*(7), 1951–1966. https://doi.org/10.1007/s10803-014-2351-z

Woodman, A., Breviglia, E., Mori, Y., Golden, R., Maina, J., & Wisniewski, H. (2018). The effect of music on exercise intensity among children with autism spectrum disorder: A pilot study. *Journal of Clinical Medicine*, *7*(3), 38. https://doi.org/10.3390/jcm7030038

World Health Organization. (2021). *Autism spectrum disorders*. World Health Organization. Retrieved March 21, 2022, from https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders#:~:text=Epidemiology,figures%20that%20are%20substantially%20higher

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