Research article

The effects of an educational program based on modeling and social stories on improvements in the social skills of students with autism

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ABSTRACT

Social communication difficulties are one of the most common issues among individuals with autism spectrum disorder (ASD), as ASD affects their social and academic lives and isolates them from their environment. Several studies that utilized video modeling, video self-modeling, or social stories (or social stories combined with video modeling) have yielded promising outcomes in improving the social skills of individuals with ASD. However, to date, the effects of the combination of all three strategies have not been studied. The current study aimed to examine the effectiveness of an educational program based on multiple strategies, including social stories, animated video modeling, and video self-modeling, to improve the social communication skills of a sample of six high-functioning students with ASD at the Autism Academy of Jordan. A mixed method (quantitative and qualitative) approach was used to examine the impact of the program on the experimental group. The results of the Mann–Whitney test indicated that compared to the monitoring group, all participants in the experimental group achieved significant improvements in the post-test of the Autism Social Skills Profile in both the domains of social reciprocity and social participation skills. Furthermore, the data from teachers' interviews, analyzed using WebQDA software, corroborated the results in terms of significant improvements in students' social skills after the implementation of the educational program. The implications of the study for psychological and educational interventions are addressed, and research suggestions are made to promote the personal and social development of individuals with ASD.

1. Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by two main symptoms—persistent deficits in social communication and social interaction in multiple contexts—plus restricted and repetitive patterns of behaviors, interests, or activities (American Psychiatric Association, 2013). Individuals with ASD might also show language and cognitive impairment, which are not required for an ASD diagnosis (American Psychiatric Association, 2013). The present study focuses on children with high-functioning ASD (HFASD), which are those diagnosed with ASD but have normal language and cognitive abilities (Baron-Cohen et al., 2001). These children are estimated to make up 10% of the ASD population, and they have special abilities in areas including art, music, mathematics, and memory (Bhat et al., 2014). Yet, individuals with HFASD show a deficit in social communication skills and display behavioral problems (Giambattista et al., 2019). They have trouble developing friendships and playing skills (Ulke-kurkcuoglu, 2015), show a lack of eye contact, have poor joint attention, suffer

problem-solving difficulties, have language and speech issues, and have difficulties understanding body language and expressing sympathy. Overall, these difficulties influence their social integration and academic achievement (Yeo and Teng, 2015).

In Jordan, most children with ASD obtain their education in special education centers (Rayan and Ahmad, 2018) because parents have concerns about placing them in mainstream schools (Abu-Hamour and Muhaidat, 2014). These concerns may stem from their children's social communication difficulties, which parents perceive to have an important effect on their children's relationships with teachers and peers and their learning process. This perception has prompted researchers to develop an educational program to improve the social communication skills of children with ASD and to encourage parents to place their children in an inclusive educational setting.

The framework of the present study is based on two strategies: modeling and social stories (SS). Modeling emerged from social learning theory, which stresses that observation is the main aspect of social learning (Qi et al., 2017). Bandura (1977) suggested that individuals

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acquire behaviors by observing others rather than responding to a specific environmental incentive. Thus, people repeat or avoid behaviors according to the positive or negative consequences associated with others' behaviors (Bandura, 1977, p. 2–4,6). Modeling requires four essential processes: attention, retention, motor reproduction, and reinforcement (Bandura, 1977, p. 6–8). These processes can occur in a live setting, when a child watches the model directly (Besler and Kurt, 2016), or through a video of a model (Bellini and Akullian, 2007; Besler and Kurt, 2016; Clinton, 2015) or a clip of him/herself (video self-modeling; VSM) (Dowrick, 1999) while performing the targeted behavior to be imitated and reproduced later.

In turn, SS constitutes a teaching strategy that emerged from the "theory of mind" (Premack and Woodruff, 1978) and aims to address the issues of individuals with ASD in understanding others' beliefs, behaviors, and intentions (Bawazir and Jones, 2017). SS was first developed and used with individuals with ASD by Carol Gray in 1994, who suggested using two to five sentences to describe the target skill or behavior according to a child's understanding (Sansosti et al., 2004). Scattone et al. (2002) defined SS as short written scripts designed to teach children how to behave appropriately in social situations or events.

1.1. Prior research

The literature provides strong evidence of the promising outcomes of utilizing video modeling (VM) with individuals with ASD in prompting the development of a variety of skills. Steinborn and Knapp (1982) were the first to successfully use VM to teach pedestrian skills to a young girl with ASD through a behavioral training program and a classroom-based model. Similarly, Haring et al. (1987) found that VM was effective in teaching purchasing skills to three adolescents with ASD. Some studies have reported that VM was effective in improving the social communication skills of individuals with ASD. Ho et al. (2019) examined the effects of using VM to develop joint attention and social engagement; according to their results, five out of six participants showed significant improvement in the targeted skill. VM has proven effective in improving conversation skills, such as extending and joining a conversation, responding to others (Stauch et al., 2018), greeting skills (Kouo, 2018), eye contact and turn-taking (Özerk, 2015), facial expression (Axe and Evans, 2012; Mason et al., 2012), sharing an interest with others and making a request (Wilson, 2013), gesture skills (Cardon, 2013; So et al., 2016), and personal hygiene skills (Keen et al., 2007).

Some studies have relied on SS to enhance the verbal communication of children with ASD (Amirrudin et al., 2019) by improving their conversation skills (Golzari et al., 2015) or certain social behaviors (nose-wiping and greeting others) (Karayazi et al., 2014), such as asking questions, sharing objectives, offering greetings and self-introductions, participating in activities and conversations, asking for assistance (Amin and Oweini, 2013), or reducing inappropriate social behaviors (Samuels and Stansfield, 2012). The results of these studies indicated that SS effectively improves the targeted social skills of all participants with ASD. Moreover, Almutlaq and Martella (2018) suggested that SS delivered through iPad applications is effective in improving social skills, such as "smile, giving compliments, and responding you are welcome" for all children with ASD.

Creer and Miklich (1970) were pioneers in using VSM to reduce undesirable behaviors in a young child with asthma. Similarly, VSM has been used to teach social initiation skills to children with ASD (Boudreau and Harvey, 2012; Buggey et al., 2011), and the results showed VSM was effective for all participants in the two studies. Thirumanickam et al. (2018) found that VSM achieved more satisfactory outcomes than VM in developing the conversational skills of all participants with ASD.

Radley et al. (2015, 2017) evaluated the impact of the social skills training program based on animated videos with instruction, SS, and self-monitoring cards to improve the social skills of three participants with ASD and a participant with intellectual disability (ID). Both studies demonstrated that all participants improved in the accuracy of their

social skills. Similarly, Handley et al. (2015) investigated the effectiveness of using SS or a combination of VM and SS to increase eye contact in six adolescents with ASD. Their results showed that SS achieved moderate improvements in eye contact, but VM was more effective than SS in improving targeted skills. However, the study also found that using SS and VM combined resulted in a higher level of eye contact than using VM or SS alone. A pilot study by Uzuegbunam and Wong (2018) examined the impact of SS, animated videos, and self-modeling (Me-Book) to improve the social greeting and eye contact skills of three young children with ASD. A significant improvement in the targeted skills was seen for all participants.

Acar et al. (2016) compared the effects of SS and VM developed and delivered by mothers to teach social skills to three children with ASD. VM proved more effective than SS for two participants, and SS was more effective than VM for one. Similarly, Kagohara (2013) found that VM was more effective in teaching advanced greeting skills, while SS was only effective in teaching simple greeting skills to children with HFASD. However, Malmberg et al. (2015) found that SS alone was not effective in improving the social skills of children with ASD, while VM and SS with the provision of verbal prompting and reinforcement were indeed effective in improving several social skills of all participants with ASD.

Overall, most studies utilizing VM, VSM, or SS (or SS combined with VM) have yielded promising outcomes in improving the social communication skills of individuals with ASD. However, to date, the effects of the combination of all three strategies have not been studied. Therefore, the present study determines the effects of an educational program based on SS, AVM, and VSM combined aimed at improving the social communication skills of students with HFASD. The limitations of prior research were largely avoided by applying a mixed method design, that is, a quasi-experimental method based on a pre-test and post-test for both the experimental and monitoring groups and a qualitative approach by interviewing the participants' teachers to confirm and validate the study. Our findings might encourage special education centers to adopt this kind of program for students with ASD, thereby increasing the odds of individuals with ASD being educated in mainstream schools. Jordan, in particular, is a developing country that has issued a regulation aligned with the Salamanca Statement (UNESCO, 1994) to support the inclusion of persons with special needs, but unfortunately, numerous challenges have been encountered throughout the process of attempting to ensure inclusive educational practices (Alodat et al., 2014).

1.2. Research question

What are the impacts of modeling and SS interventions on the social communication skills of children with HFASD?

The research question was divided into four sub-questions according to the Autism Social Skills Profile's (ASSP) test dimensions:

- Q1: Are there statistically significant differences between the two groups in terms of social communication skills after the application of the educational program?
- Q2: Are there statistically significant differences between the two groups in the social reciprocity dimension after the application of the educational program?
- Q3: Are there statistically significant differences between the two groups in the social participation dimension after the application of the educational program?
- Q4: Are there statistically significant differences between the two groups in the detrimental social behaviors dimension after the application of the educational program?

2. Methods

This study attempts to find the cause-and-effect relationship between variables, with the independent variable being the program and the dependent variable being social communication skills. To answer the

research question, overcome the weakness of using a single method, and increase the validity of the study (Jason and Glenwick, 2016), the researchers devised a mixed method—quantitative and qualitative—approach based on a dominant sequential design (Jason and Glenwick, 2016). A quasi-experimental method was used in the first phase, with a pre-test and post-test design for both the experimental and monitoring groups, to study the impacts of an educational program on the experimental group (Campbell and Stanley, 1963). Then, a qualitative method was used to support or confirm the results obtained with the quantitative method by interviewing the participants' teachers and treating the data from the interviews using WebQDA software (Costa et al., 2019).

2.1. Participants and setting

The study consisted of 12 participants, aged 7–12, who were diagnosed with HFASD using the Gilliam Autism Rating Scale–3rd edition (GARS-3) (Gilliam, 2014) and who attended the Autism Academy of Jordan in Amman. Parental consent was obtained from the supervisor of the special education center to conduct the study on the participants and collect the data. The participants were divided into two groups: an experimental group consisting of six male students and a monitoring group consisting of six male students. The researchers set the following criteria for the participants to control external factors that could affect the study outcomes (Shadish et al., 2002): i) had been diagnosed with HFASD, ii) had a level of intelligence above 85, iii) had a normal level of language abilities, and iv) had the ability to imitate. The researchers assessed their social communication skills with the ASSP (Bellini and Hopf, 2007) before and after the implementation of the program. The Mann–Whitney test was used to examine the impact of the educational program on the social communication skills of students with HFASD.

The scores of participants are described in Table 1 for the experimental group and Table 2 for the monitoring group.

2.2. Assessment

The ASSP is a scale developed by Scott Bellini to assess social skills deficits and measure the intervention progress of individuals with ASD aged 6–17 years. The ASSP includes 49 items divided into three domains: social reciprocity (23 items), social participation (12 items), and detrimental social behaviors (10 items). The ASSP scale has demonstrated high reliability with a Cronbach's alpha value of $\alpha = .940$. The scale's items are rated according to a 4-point Likert scale (never = 1, sometimes = 2, often = 3, and very often = 4). The examiner's response is registered by circling or placing the letter to specify how often the examinee demonstrates each behavior. The ASSP can be conducted by parents, teachers, professionals, or other familiar adults. The ASSP features a brief descriptive section where the examiner can provide further comments about the child's behaviors (Bellini and Hopf, 2007).

The GARS-3 is an assessment instrument used to identify and diagnose individuals with ASD aged between 3 and 22 years and to measure the severity of ASD. The GARS-3 considers behaviors in three areas, communication stereotype behaviors and social interaction, with each area having 14 items. The examiner should estimate each item according to the

frequency of the observed behaviors. The GARS-3 can be implemented by a well-trained person (e.g., parents, or educators) who is familiar with the examinee. The GARS-3 also has two sections for an interview with someone familiar with the examinee. In the first section of the interview, the respondent is required to answer yes or no questions related to the child's growth in the first three years of life. The second section contains a set of open-ended questions about the child's behaviors, signs of ASD, parental concerns, and medical history (Gilliam, 2014).

The Wechsler Intelligence Scale for Children, 3rd ed. (WISC-III) is a scale of high reliability (0.89) developed by Wechsler in 1991 to assess the cognitive abilities of children aged 6–16 years. The WISC-III contains two main scales: the verbal scale, including six subscales, and the performance scale, with seven subscales. The WISC-III can only be implemented by a well-trained professional who is unfamiliar with the examinee. The scale utilizes the deviation intelligence quotation (IQ; mean = 100 and standard deviation [SD] = 15). A score of 100 on verbal indicators, performance indicators, or a total of both is considered average performance (Wooger, 1991).

The ASSP scores of the experimental and monitoring groups are described in Tables 3 and 4, respectively.

2.3. Procedures

The educational program sessions (see Annex 1) were designed using the animation maker program (www.animaker.com), which is a 2D video program, with each video containing a social story with duration of 30–50 s. The researchers prepared the study sample, tools, and questionnaires and developed ethical procedures. The study was conducted at the Autism Academy of Jordan, a special school for individuals with ASD located in Amman, the capital city. The study setting was prepared for the undertaking of the study, and the teachers of the participants were rigorously informed about its nature, purpose, and procedures.

The educational program consisted of 12 sessions that lasted eight weeks, and the duration of each session was 1 h and 50 min. The program was implemented in a 4 × 6 m classroom that contained two tables and four chairs and was delivered with the assistance of a special education teacher. Each participant was asked to sit in a chair and watch the animated video about the targeted skill on a laptop. When they accepted, the instructor provided social reinforcement by saying "that's great!" or "amazing!" The videos were displayed twice and paused every time the participants shifted their attention. Afterward, the participants were asked questions about each video and then each participant was directed to play the role seen in the video with the trainer. Meanwhile, the

Table 2. The monitoring group's age, WISC-III, and GARS-3 scores.

Name	Age	WISC-III	GARS-3
Participant 1	8	90	82
Participant 2	12	85	77
Participant 3	9	93	86
Participant 4	10	98	78
Participant 5	8	86	93
Participant 6	7	85	89

Table 1. The experimental group: Age, WISC-III, and GARS-3 scores.

Name	Age	WISC-III	GARS-3
Participant 1	12	95	86
Participant 2	10	97	75
Participant 3	10	90	92
Participant 4	10	95	77
Participant 5	7	86	92
Participant 6	9	85	95

Table 3. ASSP scores of the experimental group.

Name	ASSP (pre-test)	ASSP (post-test)
Participant 1	113	160
Participant 2	116	159
Participant 3	120	166
Participant 4	117	157
Participant 5	111	148
Participant 6	110	149

Table 4. ASSP scores of the monitoring group.

Name	ASSP (pre-test)	ASSP (post-test)
Participant 1	105	107
Participant 2	101	104
Participant 3	108	113
Participant 4	109	112
Participant 5	103	108
Participant 6	102	105

participants were recorded using a Fujifilm digital camera (26X super-wide). The participants were then asked to watch their videos and reproduce the targeted behaviors (VSM).

Later, the ASSP (Bellini and Hopf, 2007) was re-applied (post-test) to measure the effects of the educational program on the social communication skills of the experimental group, and results were analyzed using SPSS software version 25. Specifically, the mean rank, sum of ranks, and Mann–Whitney U values were acquired and assessed. Finally, the qualitative method was applied by interviewing the teachers of the participants with HFASD, and the interviews were analyzed with WebQDA software (Costa et al., 2019) to validate the study and confirm the results of the quantitative method.

3. Results

The homogeneity of both groups (experimental and monitoring) for the pre-test of the ASSP was determined with the Mann–Whitney test. The results of both groups were analyzed using SPSS software version 25 to find the mean rank, sum of ranks, and Mann–Whitney U value for the pre-test of the ASSP, as shown in Table 5.

As observed in Table 5, there were no statistically significant differences at the level of significance ($p \geq 0.05$) between the experimental and monitoring groups for the ASSP pre-test. The mean rank value for the ASSP of the experimental group reached 7.33, whereas the mean rank for the monitoring group was 5.67. The Mann–Whitney U test for small samples was used to enable a comparison of the means of both groups to evaluate the homogeneity of the groups. The results gave a Mann–Whitney U value of 13.000, greater than the level of significance ($p \geq 0.05$), meaning the two groups are equivalent.

Q1. Are there statistically significant differences ($p \leq 0.05$) in social communication skills after the application of the educational program?

The Mann–Whitney test was utilized for both the experimental and monitoring groups to determine the effects of the educational programs on participants' social communication skills based on the post-test (ASSP) values for SS, AVM, and VSM, as shown in Table 6.

According to Table 6, statistically significant differences ($p \geq 0.05$) were found between the experimental and monitoring groups in terms of the ASSP post-test, and the results were in favor of the experimental group. The mean rank value for the ASSP results of the experimental group reached 9.50, while the mean rank for the ASSP results of the monitoring group was 3.50. The Mann–Whitney U test for small samples, used to compare the means of both groups on the social skills variable, gave a value of 0.000, which is below the level of significance ($p \geq 0.05$). Therefore, the educational program had a positive effect on the post-test with regard to the development of the social skills of experimental group.

Table 5. Results of the Mann–Whitney test on the pre-test of the ASSP.

Group	N	Mean Rank	Sum of Ranks	U	Z score	*p* value
Experimental group	6	7.33	44.00	13.000	-.803-	.422
Monitoring group	6	5.67	34.00			
Total	12					

Table 6. Results of the Mann–Whitney test on the post-test of the ASSP.

Group	N	Mean Rank	Sum of Ranks	U	Z score	*p* value
Experimental group	6	9.50	57.00	.000	-2.887-	.004
Monitoring group	6	3.50	21.00			
Total	12					

Q2. Are there statistically significant differences ($p \leq 0.05$) in the social reciprocity dimension after the application of the educational program?

Table 7 indicates that there are statistically significant differences ($p \geq 0.05$) in the post-test results for the social reciprocity dimension between the experimental and monitoring groups, which are in favor of the experimental group. The value of the mean rank for the ASSP results of the experimental group reached 9.50, and the mean rank for the ASSP results of the monitoring group reached 3.50. The Mann–Whitney U test for small samples, used to compare the means of both groups for the social reciprocity dimension, gave a value of 0.000, which is less than the level of significance ($p \geq 0.05$), showing that the educational program had a positive effect on the post-test results of the experimental group regarding the social reciprocity dimension.

Q3. Are there statistically significant differences ($p \leq 0.05$) in the social participation dimension after application of the educational program?

As Table 8 shows, statistically significant differences ($p \geq 0.05$) were observed between the experimental and monitoring groups for the post-test for the social participation dimension, which was in favor of the experimental group. The mean rank value for the ASSP results of the experimental group reached 9.50, and the mean rank for the ASSP results of the monitoring group was 3.50. A comparison based on the Mann–Whitney U test for small samples, with regard to the social participation dimension, gave a value of 0.000, which is below the significance level ($p \geq 0.05$). Hence, the educational program had a positive effect on the social participation dimension of the post-test for the experimental group.

Q4. Are there statistically significant differences ($p \leq 0.05$) in the detrimental social behaviors dimension after the application of the educational program?

Table 9 indicates that there were no statistically significant differences ($p \geq 0.05$) between the experimental and monitoring groups with regard to the post-test for the detrimental social behaviors dimension. The mean rank value for the ASSP results of the experimental group reached 7.58, and the mean rank for the ASSP results of the monitoring group reached 5.42. The Mann–Whitney U test for the small sample comparison of the means of both groups for the detrimental social behaviors dimension resulted in a value of 11.500, which is greater than the level of significance ($p \geq 0.05$), meaning that the educational program did not affect the post-test for the detrimental social behaviors dimension.

3.1. Study validity

The qualitative method used involved interviewing four of the participants' teachers to validate the study and confirm the data obtained from the quantitative portion of the study. The data from the interviews, treated using WebQDA software (www.webqda.com) (Costa et al., 2019),

Table 7. Results of the Mann–Whitney test on the social reciprocity dimension.

Group	N	Mean Rank	Sum of Ranks	U	Z score	*p* value
Experimental group	6	9.50	57.00	.000	-2.887-	.004
Monitoring group	6	3.50	21.00			
Total	12					

Table 8. Results of the Mann–Whitney test on the social participation dimension.

Group	N	Mean Rank	Sum of Ranks	U	Z score	p value
Experimental group	6	9.50	57.00	.000	-2.918-	.004
Monitoring group	6	3.50	21.00			
Total	12					

Table 9. Results of the Mann–Whitney test on the detrimental social behaviors dimension.

Group	N	Mean Rank	Sum of Ranks	U	Z score	p value
Experimental group	6	7.58	45.50	11.500	-1.052-	.293
Monitoring group	6	5.42	32.50			
Total	12					

supported the analysis of qualitative data in a collaborative and distributed environment developed by researchers at the University of Aveiro. The 12 interview questions (see Annex 6) were related to the social reciprocity skills of students with ASD and divided into 11 categories to answer the research question. The main category and subcategories of the data analysis are presented in Figure 1.

The results of WebQDA software analysis (Costa et al., 2019), including related sources, dimensions, categories, and the number of references, are shown in Table 10. Teachers' interviews were analyzed and divided into 11 subcategories to present the social reciprocity skills of students with ASD (see Annex 2).

4. Discussion

The current study showed that compared to the monitoring group, the educational program based on SS, AVM, and VSM combined proved effective in improving the targeted social communication skills for all participants with HFASD in the experimental group.

This improvement in social communication can be attributed to the use of SS, AVM, and VSM combined, an effective technique when teaching the targeted skills because it led learners to focus on the targeted behavior, promoting their engagement, and it allowed the possibility of repeating the video to help them retain the targeted behaviors. This gave the learners endless opportunities to watch the content and preserve the events, thus permitting them to practice and replicate the observed

Figure 1. Categories and subcategories for content analysis.

behaviors after watching the video clips. Moreover, the learners had plenty of time to repeat the targeted behavior in a safe environment, with no impending need to interact face to face with others. As children with ASD tend to be visual learners rather than verbal learners (Ozdemir, 2010; Qi et al., 2018), the very nature of VM motivates them to learn through observation. The social story could enhance these participants' capacity to understand, inspect, and arbitrate others' behaviors, beliefs, and intentions within social situations, thus helping them plan and organize their behaviors to meet the needs of others, thus decreasing their levels of anxiety (Bawazir and Jones, 2017).

Although the educational program targeted skills insofar as the social reciprocity dimension, similar results were obtained (according to the Mann–Whitney test) for the social participation dimension. The similarity of the results may be associated with the small sample size. The study involved just 12 participants with HFASD (experimental group = 6, monitoring group = 6); a larger sample size would be needed to elucidate the differences between the two dimensions. Still, the Mann–Whitney test was designed to deal with data from small and moderate sample sizes, making it the most appropriate test for our study. The fact that the Mann–Whitney test works with ranks instead of data values could explain the similarity in the results for both dimensions. The qualitative method served to overcome the potential weakness of using a single method—in conducting interviews with the teachers of the participants—and the data taken from interviews was objectively analyzed using WebQDA software (Costa et al., 2019).

The educational program based on SS, AVM, and VSM was found to be effective in improving greeting and self-introducing skills for all participants with HFASD in the experimental group, who demonstrated statistically significant differences in the post-test of the ASSP, whereas the monitoring group did not show any improvements. Furthermore, the teachers provided examples of how the participants with HFASD greeted others, saying *"Hi = Marhaba, Salam,"* or introduced themselves by mentioning their *"names, age, grade, and school."* The results of our study support previous findings, where improvements in greeting skills were associated with the combined use of SS and VM (Kagohara et al., 2013; Uzuegbunam and Wong, 2018), of VM alone (Cardon, 2013; Kouo, 2018a; So et al., 2016), or solely SS (Samuels and Stansfield, 2012; Amin and Oweini, 2013; Karayazi et al., 2014). Similar findings (Acar et al., 2016; Radley et al., 2017) in the context of teaching or improving self-introducing skills for individuals with ASD are encouraging. Some studies have found VSM to be effective in teaching social initiation skills to young participants with ASD (Buggey et al., 2011; Boudreau and Harvey, 2012).

Moreover, the results shown here point to a significant improvement in the experimental group's ability to maintain personal distance compared to the monitoring group. Teachers provided evidence of how all participants with HFASD exhibited an ability to maintain personal distance during interactions with their teachers and peers, both inside and outside of the classroom. For example, the teachers said *"The student maintains an appropriate distance when he speaks with me or his peers, and when I ask him to come to the whiteboard to solve a question, he maintains an appropriate distance."* The examples provided by the teachers' interviews thus confirmed the results of the Mann–Whitney test. Moreover, the participants demonstrated similar improvements in their listening skills on the ASSP post-test. Teachers stated that the participants with HFASD demonstrated improvement in the targeted skills: *"The student listens when you ask him a direct question, and when I explain the lesson to him, he moves his face toward the speaker, makes eye contact with him/her, and responds to the topic."* This finding is in line with those reported by Ho et al. (2019), where their participants showed improvements in joint attention and social engagement.

According to the results of the present study, all participants in the experimental group achieved substantial improvement in eye contact compared to the monitoring group on the post-test of the ASSP. Teachers further noted that participants with HFASD made more eye contact—both with teachers and peers—during conversations, lesson
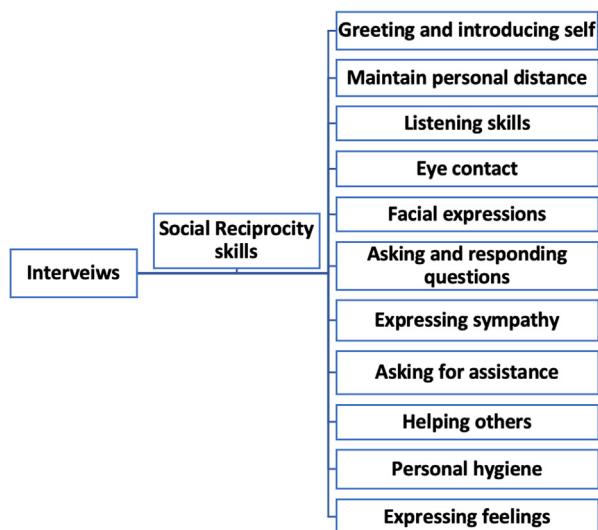
Table 10. Related sources, dimensions, categories, and the number of references.

Social reciprocity skills of students with ASD

Sources	Greeting and introducing	Maintain distance	Listening skills	Eye contact	Facial expressions	Ask/respond to Questions	Expressing sympathy	Asking for assistance	Helping others	Personal hygiene	Expressing feelings
Interview 1	7	2	2	3	3	3	2	3	3	2	3
Interview 2	4	1	1	2	3	2	1	2	2	2	2
Interview 3	4	2	2	2	2	4	2	3	3	2	2
Interview 4	5	2	4	2	3	4	2	2	2	2	4
Total of references	**20**	**7**	**9**	**9**	**11**	**13**	**7**	**10**	**10**	**8**	**11**

explanations, or classroom activities; *"The student makes eye contact when the teacher calls him, during the lesson while the teacher explains the topic, and when someone speaks with him directly."* Thus, these results support previous findings (Mason et al., 2012; Handley et al., 2015; Özerk, 2015). Axe and Evans (2012) and Mason et al. (2012) found VM to be effective in developing facial expressions for individuals with ASD. The results of both of the above studies support our findings. Moreover, teachers pointed out that all the participants showed improvement in facial expression: *"The student recognizes if people are sad, or happy, or angry. He feels happy when his peers are playing and laughing. He recognizes that his peer is angry when he takes one of his toys/tools."*

All the participants with HFASD in our experimental group achieved significant improvement when asking and responding to questions. Indeed, teachers indicated that all participants with HFASD were able to ask and respond to questions using "Can I?" "Do you?" "What?" or "How?" They also responded to questions asked by others (whether teachers or peers): *"The student asks and responds to questions that are asked by the teachers or peers. For example, he asks his peer, 'do you have a pen?' or 'Can I go to the toilet?' And he responds to questions posed by others (e.g., 'what are you doing?' 'I am painting', or 'I am playing')."* This result is consistent with previous findings in that VM proved effective in improving requesting skills (Wilson, 2013; Thirumanickam et al., 2018), responding skills (Stauch et al., 2018), or both requesting and responding skills (Radley et al., 2015). Furthermore, Golzari et al. (2015) concluded that the improvement in the conversation skills of individuals with ASD was associated with the use of SS. Almutlaq and Martella (2018) indicated that SS through an iPad application was effective in improving "smiling, giving compliments, and responding to others" for all individuals with ASD.

The experimental group with HFASD demonstrated significant improvement in expressing sympathy and feelings compared to the monitoring group on the post-test of the ASSP. Teachers provided evidence as to the fact that participants with HFASD expressed sympathy with their peers when they were upset or sad by going to them and trying to comfort them: *"When one of his mates starts crying, he goes to him and asks him to calm down. He says, 'Why are you crying?'"* Likewise, all participants with HFASD eventually showed evidence of expressing their feelings toward people or situations (e.g., *"The students expressed their anger or sadness, for instance saying they did not like to sit far away from the window, or they were sad because we could not go to the playground"*). This finding was also reported by Malmberg et al. (2015), who found that VM was effective in teaching empathy and other social skills to individuals with ASD. Moreover, Amirrudin et al. (2019) suggested that the improvement seen among individuals with ASD in terms of being sympathetic with animals and elderly people was associated with the use of SS.

Additionally, SS, AVM, and VSM were effective in improving the experimental group's ability to ask for or offer assistance, as confirmed by data from teachers' interviews, as teachers stated that all participants in the experimental group showed a willingness to ask for assistance. For instance, *"He asks for help when he needs it, for example, when he doesn't understand something in the lesson, by pointing to the difficult phrase or question, asking verbally "how do we solve this?"* Furthermore, the pupil offers help to others, for example, *"The student is willing to offer help when*

someone asks for it. He closes the door of the classroom when I ask him. He brings the ball for his peer when asked to." Such results were described by Amin and Oweini (2013) who highlighted the effectiveness of SS through peer mediation in improving asking for assistance skills. Similarly, Acar et al. (2016) found that SS and VM were effective in teaching participants with ASD to offer assistance to others.

All participants with HFASD in our experimental group showed a significant improvement in personal hygiene skills. Teachers stated that they maintained their personal hygiene: *"The student maintains good personal hygiene (e.g., he washes his hands before going to the cafeteria to have lunch and brushes his teeth after he finishes eating)."* A similar result was reported by prior studies, with VM proving effective in enhancing everyday life skills, such as handwashing (Meister et al., 2015), brushing teeth (Kellems et al., 2018), or toileting skills (Keen et al., 2007), for all participants with ASD. Karayazi et al. (2014) found SS to be effective in improving specific social behaviors (nose-wiping) for individuals with ASD.

5. Conclusion

The results of the current study indicate that the educational program based on SS, AVM, and VSM combined was effective in improving the targeted social communication skills for all the participants with HFASD in the experimental group compared to the monitoring group. In addition, the participants in the experimental group showed improvement in the social reciprocity and social participation dimensions, but no improvement was observed in terms of detrimental social behaviors. We attribute the improvement in the social skills of the participants with HFASD to the combined use of SS, VM, and VSM. Therefore, we suggest that this kind of research be divulged and encouraged to increase the odds that individuals with ASD develop skills that facilitate their participation in inclusive settings.

5.1. Limitations

We acknowledge some limitations. First, it was impossible to obtain maintenance data (follow-up) due to the COVID-19 pandemic, as all of Jordan's schools and special education centers shut down, and a nationwide curfew was imposed until the end of the school year. Second, the study entailed a small sample size because of difficulties in obtaining approval for the program's implementation from the bureaucracy underpinning special education centers in Jordan, where there may be a lack of encouragement for such programs. Lastly, parental participation in the study was weakened because of busy schedules or cultural reasons. As the researchers delivered all information through the supervisor of the center, communication with parents was not optimal.

5.2. Implications and future research

Many implications can be derived from the results of the current research endeavor, including ways to improve the social skills of individuals with HFASD in the experimental group through the program that combines the use of SS, AVM, and VSM. The application of this technique could yield promising outcomes. In developing countries,

particularly Jordan, few studies have focused on the social communication skills of individuals with ASD. Hence, there is a need to conduct more research of this nature to increase the odds that individuals with ASD obtain skills that might facilitate their participation in inclusive settings. It is also necessary to examine the impact of these programs by conducting studies that feature a large sample size and a control group, a challenge that would require studies to be conducted in diverse schools while providing teachers with training to implement this sort of program in their classrooms, giving rise to more satisfactory results. Developing accessible and suitable official assessment tools is another challenge to be faced when designing intervention programs or assessing their impact.

Finally, the participation of parents in intervention programs would contribute to the generalized maintenance of the target skills for children with ASD. Furthermore, this research could benefit from the use of advanced technology, such as 3D video programs, to create videos that would be more realistic and enjoyable for learners. Conducting a follow-up test would also provide valuable data about the level of targeted skills after program completion.

Declarations

Author contribution statement

Issa Jamil Alkinj: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Anabela Pereira; Paula Santos: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data.

Funding statement

Data availability statement

Data included in article/supplementary material/referenced in article.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at https://doi.org/10.1016/j.heliyon.2022.e09289.

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