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The Impact Of AI-Enhanced Social Stories On Social Skills Development In Autistic Students

Fajer Danish [1*], Nouf AlShammari [2]

[1*]Arab Open University Bahrain fajerdanish@gmail.com
[2]University of Leeds Ed16nmsa@leeds.ac.uk

Introduction:

The area of autism education has gained significant attention in recent years, mostly because of the increasing prevalence of autism in children (Bougeard et. al., 2021). The prevalence of autism has experienced a significant increase, going from 1 in 10,000 in the 1960s to a minimum of 1 in 100 at present (Hollander et. al., 2022). The neurodevelopmental condition known as Autism Spectrum Disorder (ASD) is characterized by challenges in social interaction and communication, as well as repetitive or restricted behaviors (Mukherjee, 2017). These obstacles can have a tremendous impact on an individual's social, educational, and occupational experiences, often resulting in unfavorable long-term outcomes and difficulty in social relationships and daily functioning. The most common way of thinking about AI technologies is as a set of procedures and responses that work together. Autonomy, adaptability, and interaction are seen as important parts of AI systems by researchers (Dwivedi et al., 2021; Stahl., 2021).

The area of autism education has gained significant attention in recent years, mostly because of the increasing prevalence of autism in children (Bougeard et. al., 2021). The prevalence of autism has experienced a significant increase, going from 1 in 10,000 in the 1960s to a minimum of 1 in 100 at present (Hollander et. al., 2022). The neurodevelopmental condition known as Autism Spectrum Disorder (ASD) is characterized by challenges in social interaction and communication, as well as repetitive or restricted behaviors (Mukherjee, 2017). These obstacles can have a tremendous impact on an individual's social, educational, and occupational experiences, often resulting in unfavorable long-term outcomes and difficulty in social relationships and daily functioning. Most people who study AI see these systems as a collection of steps and responses that work together. For example, Dwivedi et al. (2021) and Stahl (2021) stress that autonomy, adaptability, and interaction are among the most important parts of AI systems.

People generally recognise artificial intelligence's (AI) significant capacity to bring about profound changes in the realm of education (Williamson, 2017). AI, as an advanced technological advancement, encompasses a range of technologies designed to imitate human intellect, including machine learning, natural language processing, and computer vision (Luckin, 2018). Previous applications of these technologies, such as speech recognition and image classification, demonstrate their potential to significantly impact educational paradigms. This perspective is also consistent with the objectives of AI in education research, which emphasizes the fundamental importance of adapting to the unique requirements and behaviors of learners on a moment-by-moment basis, as evidenced by Wolf (2008).

Artificial intelligence-driven interventions have emerged as highly effective techniques to provide support for individuals with autism. Nevertheless, further investigation is necessary to explore the perspectives and firsthand encounters of instructors and educators regarding the implementation of these artificial intelligence (AI) systems (Li et al., 2024).This study aims to explore the effectiveness of AI generated SS to enable practitioners in creating social stories. Professionals have discovered that Social Stories are helpful techniques for improving the social communication abilities of autistic children in the development of support strategies. Creating a social story is a demanding task and various criteria have been employed to create them. Increasing research suggests that technology, in its broadest sense, can provide effective assistance for this specific group of people in highly regulated settings (Parsons et al., 2020). The evidence is being supported by the widespread use of diverse technologies and their utilisation for autism. Jaliawala et al (2020) assert that there is a lack of research in the field of AI assisted intervention technologies for autistic individuals. They suggest the necessity to establish a research database that focusses on successful AI algorithms to solve this gap.

This, in conjunction with AI's long-term primary objective to replicate human behaviors in socially credible manners, serves as an appealing motivation to explore the educational and interactional potential of AI technologies in developing social stories to help address social challenges in autistic children

Research aims

Despite the numerous studies conducted on autistic students and social stories, none have utilized AI-enhanced social stories. Developing a social story in a digital format would engage autistic children more, maintain their attention for longer, and make it more accessible. Nouf et al.'s (2024) findings, which reported improvements in social and behavioral skills through SS intervention in six autistic children, motivated the study. Both quantitative and qualitative data showed that social skills improved more than challenging behavior. The study contributes to the limited literature on social skills in the Middle Eastern context. Consequently, in order to add to existing literature by considering AI-directed SS, the researchers sought to create an AI-enhanced social story and subsequently examine its impact on autistic students in the context of the Middle East. The study

aims to evaluate the effectiveness of AI-enhanced social stories in improving social skills among autistic students. The study aims to use the data gathered through AI-generated SS to investigate the following questions:
1.Does AI-generated SS direct the social skills in autistic students?
2.Is AI-generated SS more effective than traditional SS intervention for autistic students?
3.What factors predict the difference between AI-generated social skills and traditional social skills in autistic students?

Literature review:
Artificial intelligence-powered interventions have emerged as promising instruments for aiding individuals with autism (Bhati et al., 2023). Nevertheless, additional research is required to investigate the perceptions and experiences of teachers and educators regarding the implementation of these AI systems (Li et al., 2024). Students who have learning difficulties and other neurodevelopmental challenges can receive advantages by utilizing Artificial Intelligence in the field of education. The research study has also identified AI as a form of assistive technology for special needs students. According to Lynch's (2021) AI has utilized Robotics to deliver continuous care for those with disabilities. AI has facilitated the use of mobile applications without the need for manual interaction. For example, the mobile assistant "Siri" has allowed users to access mobile applications without physically clicking on them. Google's "Alexa" is an example of a technology that allows individuals to request information without the need for typing on the search box(Özler., 2021). Both Siri and Alexa are AI programs that utilize speech recognition technology. These applications have the capability to offer supportive services to individuals with special needs too. Although there is potential, there is currently limited research on developing a clinically quantifiable AI-based intervention for autism (Jaliawala et al., 2019).
Several studies have assessed the use of AI in the field of education specifically for autistic children (Bhati et al., 2023). Li et al. (2024) demonstrated in their study that developers and educators must address various considerations for the successful use and implementation of AI-powered interventions for autistic students. However, the use of these interventions has reported support and positive gains such as personalized learning and student engagement. However, to realize their maximum potential, educators identified that simpler integration of AI systems into their daily practices requires technical support, adequate training, and measures to ensure data privacy. Mwangi et al. (2018) have demonstrated that autistic individuals have a strong affinity for technological devices. This includes individuals who are not inclined or willing to engage in social interactions with their peers, parents, and professionals, among others. Early studies have demonstrated the feasibility of technology-aided intervention, but existing methods have faced criticism for teaching social skills through human-to-computer interaction, paradoxically leading to increased social isolation. AI-powered interventions in autism education use artificial intelligence to create customized and interactive experiences tailored to the unique learning and social communication needs of individuals on the autism spectrum. These interventions include educational tools, therapeutic programs, and support systems. The goal is to give customised and adaptable learning experiences, enhance social interaction abilities, and provide specific assistance for cognitive and emotional growth(Li et al., 2024). AI-powered interventions for children with autism encompass virtual reality situations, interactive games, and instructional software that can adapt content in real-time based on input, providing a personalised and efficient educational approach(Barua et al., 2022).
In the context of technology-driven interventions for autistic children, digital stories are quite notable in the existing research base. In their study, Lau and Win (2018) used a specialized, interactive social story intervention for autistic children. The researchers sought to facilitate the acquisition of social skills among students through a repetitive approach and enhance collaboration between teachers and parents to enhance the social skills of autistic children. Researchers discovered that utilizing these digital social stories enhances the interactivity and efficacy of social skill acquisition, compared to the conventional method of using social stories. Ashmeade (2016) conducted research to examine the impact of digital social stories with animated avatars on participants' social interactions with their peers. The findings indicated that two-thirds of the selected participants exhibited a notable rise in social interaction behaviors and sustained these improvements over periods of unstructured play.
The utilization of digital tools, particularly artificial intelligence (AI), for the creation of narratives has received significant attention in research circles. There are certain story generators that have a broad range of uses (Alhussain and Azmi., 2021; Gervas and Concepci., 2019), while there are others that specifically cater to the ASD community (Li and Kang., 2021). Some works utilize structural models, with a primary focus on applying machine learning to sequence-to-sequence challenges. Examples of such problems include automatic language translation (Cho et al., 2014) and dialogue systems (Tran and Nguyen, 2017). Furthermore, it has been used to generate stories (Jain et al., 2017) and create interactive narratives with many storylines for autistic children aged 9–13 (Smith et al., 2021).
Within the realm of autism, artificial intelligence presents the potential to provide individualized educational opportunities that are specifically designed to cater to the distinct requirements of every child (Goodwin and Stone, 2018) AI-powered systems can observe a child's behavior and reactions to different stimuli, and then utilise this information to personalise learning materials and activities to better meet their specific needs. Furthermore, AI can also have a significant impact on improving communication and social interaction abilities, which are frequently difficult for children with autism.Goodwin and Stone (2018) created an AI-driven system named Maki that uses natural language processing to deliver customized feedback on social communication abilities. The approach demonstrated efficacy in enhancing social communication abilities in autistic children. Alzoubi et al. (2021) reported the method's efficacy in enhancing social skills and overcoming challenging behavior in young autistic children. The study analyzed an AI-driven system that utilizes virtual reality to deliver social skills training to young autistic children. Bhati et al. (2023) propose an interactive mobile application that facilitates the creation of social stories for educators and guardians of autistic children. The application combines AI processing and AI-powered audio transcription to generate stories, extract audio data efficiently, and analyze data. The learner views the stories in a slide-show format, utilizing

various modalities customized to their proficiency. An initial usability assessment of the application has been conducted, producing promising preliminary findings.

Barua et al. (2021) elucidate the use of AI in assisting children with ASDs in social skills training, specifically in recognizing and responding to social cues. The study conducted by Belpaeme et al. (2012) revealed that the robot possesses the ability to adjust to its interaction partner, thereby influencing the level of engagement among participants. The research used sensory features like voice recordings, body movements, and facial expressions to train a machine learning model (built into a robot) to study autistic children's behavior and level of engagement in therapy. Next, they trained the model by combining the input features with the target outputs, in this case, engagement markers. Therefore, showing positive impact of AI-enhanced technology as a robot.

Most previous studies have incorporated robots to enhance social engagement and natural interaction, as demonstrated by Sanghvi et al. (2011), who reported positive gains in the engagement of autistic children through the use of a robot as a game mate in a real context. In another study, Kim et al. (2017) employed audio recordings as input parameters to examine the emotional aspects of autistic children. Kim et al. (2017) utilized the support vector machine model to analyze the social engagement of autistic children during their interactions with the robots. The study explored the potential of using improved audio-based emotion prediction to facilitate a more authentic interaction between autistic children and a robot. This would allow the robot to better gauge the level of children's engagement and adjust its responses accordingly, resulting in a dynamic and interactive learning environment.

Researchers are working to develop AI-powered systems that can assist teachers and parents in delivering effective interventions for children with autism (Alibakhshi et al., 2023) and report on the effectiveness of AI-powered approaches in raising the standard of interventions administered by educators and parents. Nevertheless, there are also concerns over the possible adverse effects of AI on young autistic students. For instance, research has indicated that an overuse of AI-powered interventions may result in a decrease in face-to-face contacts and hinder the development of social skills (Lombardo et al., 2018). Moreover, there is skepticism over the possibility of AI-driven interventions to replace human instructors and professionals, which could have adverse consequences for the standard of care offered to autistic children (Goodwin et al., 2018). Zhang et al. (2021) raise concerns about the potential bias in AI-based interventions for autistic children, as the data used may not be representative or applicable to a diverse group of autistic children.

Methodology:

Participants:

Participant A 5 years old was identified for avoiding the initiation of conversations and interactions. He was further notified for staying quiet and not participating. Participant B 6 years old was reported to exhibit lack of participation in any conversation and would take time to reply and interact. The participants were put into two groups: an experimental group (using AI-enhanced social stories) and a control group (using traditional social storiess).

Design:

The design used a single-subject AB approach that consisted of two distinct phases: a baseline phase, referred to as Phase A, and an intervention phase, known as Phase B.

Hypothesis:

AI-enhanced social stories will lead to a significant improvement in social skills among autistic students compared to traditional social stories.

Intervention: AI enhanced social stories were developed to be displayed on a tablet computer. The HyperNatural application incorporates AI processing and AI-based image audio transcription to facilitate the generation of stories, the effective extraction of audio data, and the processing of data. The learner is presented with the stories in a slide-show format, with different formats adapted to the learner's abilities. The following procedure determined the specifications for AI-enhanced social stories. Initially, we identified the desired actions for the story, which included starting a dialogue and interacting with others. Secondly, we developed the story content using an AI application. Third, create a PowerPoint format sample that includes sentences and pictures. The app can adapt the stories based on the student's responses, preferences, and progress. Fourth, the stories undergo a review by the research experts in the field of social stories. Implement all the suggested comments and revisions in the fifth step. The sixth step involves developing the digital version using an AI application that provides illustrations and narratives. On the seventh step, capture voices that embody children and adults' tones for use in voiceover. Finally, place these recordings on the digital platform.

For the traditional SS intervention, the researchers adopted the SS devised by Nouf et al (2024) based on the principles outlined by Gray and Garand (1993). Furthermore, to verify the findings, teachers, assistant teachers, and parents/guardians provided input on the social stories for analysis and revision. Each narrative included cultural characteristics relevant to the participants to improve social learning and relevance. This includes using Arab customary greetings, which are important for respect and social manners. The results will help educators and practitioners understand the potential benefits of integrating AI into social stories for autistic students, providing evidence-based insights for future interventions.

Setting: The study was carried out at a dedicated facility for autistic students. The participants participated in a total of 12 sessions, which took place four times a week for a total of three weeks. During the intervention phase, we carried out the experimental intervention individually in a vacant classroom.

Intervention procedure:

The use of AI enhanced SS had a role in motivating students' conversation initiation and understanding social cues as the students showed good desire to watch the story on the tablet computer.

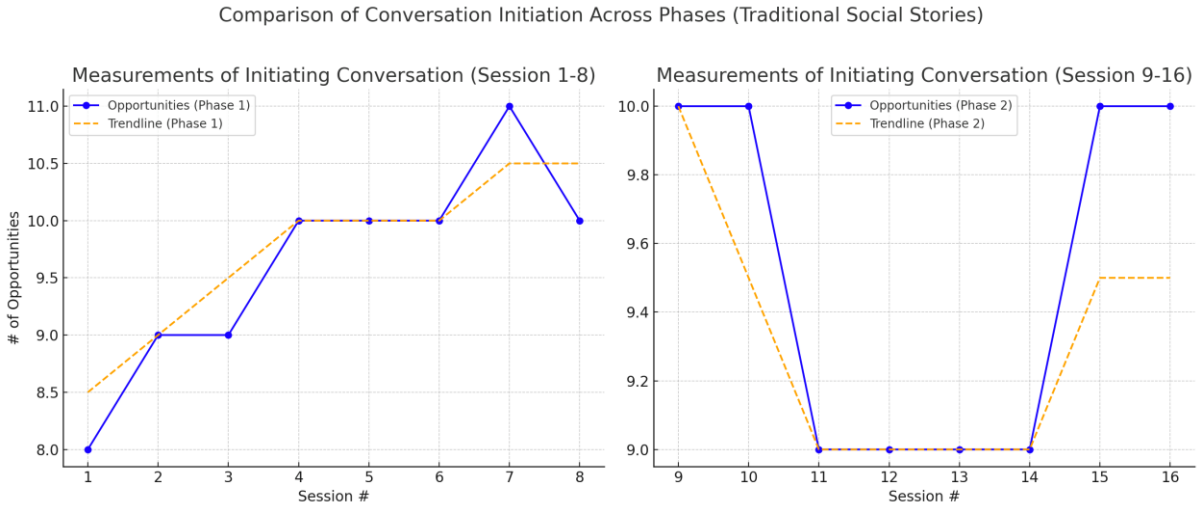
We assigned Target Behavior On*e (TB1) to Participant One,* also known as *P1*. TB1 entails the initiation of conversation and interaction when the teacher is interacting with him during a class. In Phase A, we observed TB1 participating in regular classroom activities for 20 minutes without any intervention. We conducted the observation and intervention sessions during the initial period of the student's daily school hours to mitigate the impact of external factors that could affect the observed behavior, such as the time of the session. Phase B encompassed the intervention sessions. During this phase, the student engaged in traditional SS (TSS) intervention activities with the teacher for a duration of 20 minutes. We observed the student's behavior in his regular classroom during the first period following the intervention session to gauge the immediate impact of TSS on TB1.

We observed Participant 2, also known as P2, initiating and interacting with peers and the teacher. Phase A consisted of observing TB2 without any intervention throughout the 30-minute free period in the middle of P2's school day. Phase B encompassed the intervention sessions. During this phase, the student engaged in activities utilizing the AI-powered SS (AISS) application on a computer tablet for a duration of 10 minutes. These activities took place in a one-on-one session in an unoccupied classroom. We evaluated TB2 immediately after the session, during a 30-minute free interval, to assess the immediate influence of AISS on TB2.

Participant 1 target behavior measurement: Partial interval recording was employed to gather data in Phases A and B, with data collected in 5-minute intervals, resulting in a total of 20 minutes of data. During the baseline phase, the researcher, in collaboration with the teacher, monitored the participant and documented the number of instances of TB1, as well as the frequencies of TB1 and the absence of TB1, on a data sheet. During the intervention phase, the researcher promptly gathered data following the intervention sessions through natural and spontaneous interactions in the regular classroom setting with the teacher. The data was recorded on a data sheet.

Participant 2 target behavior measurement:

The researcher gathered data during Phases A and B by observing the participant's conduct while he initiated conversation or interacted with their peers, specifically focusing on any "spontaneous opportunities to interact" that arose. The researcher observed the individual and documented whether the participant accepted the available possibilities. To verify, TB2 was monitored directly following the intervention session for a duration of 30 minutes, while engaging in natural interaction with his peers.

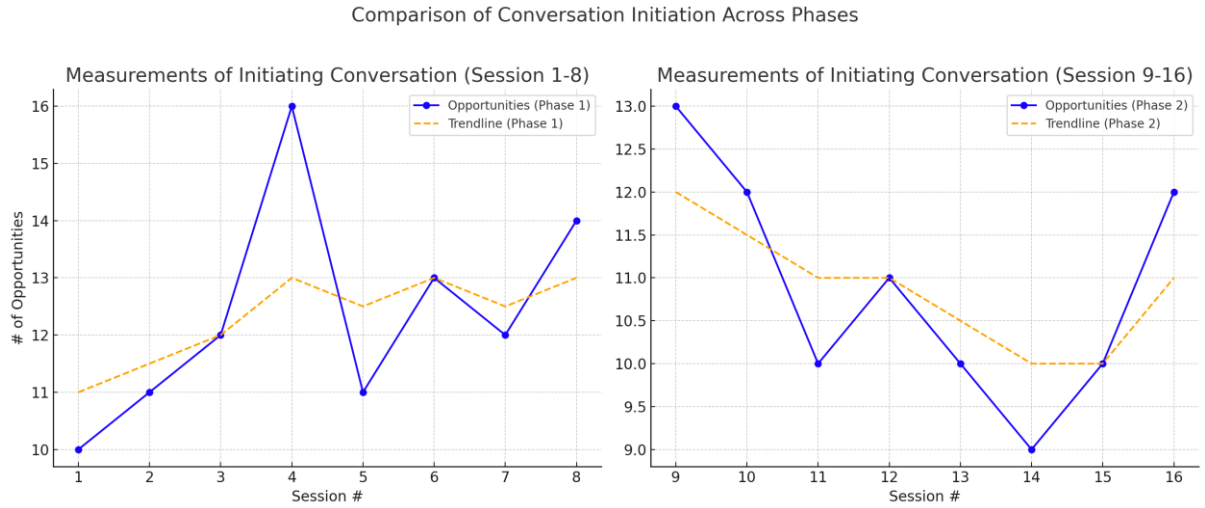


Observation P1 (Session 1-8 - Phase 1)

The above graph shows phase 11 and phase 2 observations for P1 by counting number of times TB1 was demonstrated. P1 showed gradual improvement with some stability. The opportunities for initiating conversation start at 8 and gradually increase to around 10 or 11 by the end of Phase 1. The trendline is less steep, indicating modest progress.

Observation P1(Session 9-16 - Phase 2)

There is a noticeable decline after session 10, with almost no improvement from sessions 11 to 13. Some recovery is observed towards sessions 14-16, but it remains limited compared to Phase 1. The trendline shows a decline in opportunities for initiating conversation with a slight uptick towards the end, reflecting limited progress.



Observation P2(Session 1-8): Represents Phase 1, showing a steady improvement with a noticeable peak around session 4. The trendline indicates a positive progression during this phase.

O**bservation P2(Session 9-16):** Represents Phase 2, where there are fluctuations, but the overall trend stabilizes around sessions 11-12. Despite some depressions, the trendline still shows gradual improvement towards the end.
These graphs indicate that the P2 using the AI-generated social story demonstrated notable gains in initiating conversation across sessions, with both consistent growth and some variability over time. Overall, this participant showed slower and less consistent improvement with traditional SS compared to AI-generated SS, with notable setbacks in the second phase. The smaller improvement indicates that while traditional social stories can help improve social skills, they may not be as effective as AI-enhanced stories, which provide a more tailored and responsive approach to learning. These results highlight the potential benefits of integrating AI into educational interventions for autistic students, offering a more customized and impactful learning experience.

DISCUSSION:
We sought to supplement the existing body of literature on AI-assisted intervention, specifically focusing on Social Stories (SS) for autistic children. This particular research area is currently insufficient in the Middle Eastern academic corpus. Only a small number of scholars have explored this specific field (see to Li et al 2024 for another viewpoint, which focuses on instructors and educators' perception of AI-powered intervention). As far as we know, no one has explicitly deployed it to regulate SS in the Middle Eastern setting. The purpose of our study was to examine the current literature on AI-enhanced social skills interventions, and to integrate the insights and expertise of educators and professionals in the Middle Eastern context on how it may or may not a better solution relative to standard SS. intervention to regulate the social skills challenges in autistic. children. Our aim was to identify and discuss the ethical challenges that may arise when evaluating the effectiveness of AI-enhanced interventions for children with autism.

The AI-assisted participant performed relatively better than the participant with conventional SS due to a more engaging medium and content (multimedia integration—videos, animations, and audio), which can help students better understand and retain social concepts of AI-generated SS. Additionally, the AI-powered SS intervention has the capability to modify the complexity and content of the SS in response to real-time feedback from the autistic student. When a student encounters difficulty with a specific concept, the AI can adapt by providing extra examples and explanations. Additionally, the AI-powered intervention enhances the convenience of behavioral data analysis by identifying patterns and areas where the student may require additional assistance. Furthermore, the scalability of the AI-powered SS intervention is enhanced. The scalability of the intervention can be enhanced to reach a larger number of students, thereby making personalized learning accessible to more students. Additionally, we can determine that remote access to AI-enhanced social stories is more suitable from any location, offering flexibility and convenience for learning beyond the classroom.
The present study suggests that more investigation might be conducted to assess the effectiveness of AI-enhanced social skills as a novel approach for dealing with the difficulties faced by autistic students. It further facilitates the opportunities for future researchers and research designs to investigate AI enhanced SS interventions for a diverse profile of autistic students for generalization of skills to other students. However, the study is limited in its extent as the AI-generated SS interventions for autistic children include the potential for bias and discrimination in a different context and setting. For example, if the AI system is trained with data that does not adequately depict the wide range of autistic individuals, it may not be helpful in all other contexts. Moreover, if the AI system is not designed and deployed with ethical considerations, there is a potential for reinforcing negative stereotypes or endorsing unethical behavior. Therefore, it is crucial to tackle these obstacles and concerns in order to fully use the potential of AI in managing the social communication difficulties of autistic children. Using this approach enables the creation of interventions grounded on both science and ethical standards. These interventions will facilitate personalized learning and improve social skills, while simultaneously reducing the possible drawbacks associated with the use of AI in education.

Existing studies have shown that personalized and adaptive learning technologies can significantly enhance educational outcomes by catering to individual learning needs (Li et al., 2024). Therefore, this study holds significant implications for researchers, as the integration of personalized content, interactive and engaging elements, continuous feedback, and data-driven insights renders AI-assisted intervention a promising and advanced solution for addressing the social challenges faced by autistic students. These features create a more effective and supportive learning environment, allowing autistic students to improve their social skills more significantly than with traditional methods. An additional recommended modification to this study would include assessing and monitoring an additional behavior that was not the focus of the intervention during the baseline and intervention phases. This would provide stronger evidence that the study's interventions directly caused the alteration in the target behaviors.

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APPENDIX

NARRATIVE AND IMAGES FROM AI ENHANCED SS VIDEO:

Two kids initiating a conversation. it should be a social story between two classmates for initiation of conversation.
There are many times at school when I see my classmates. Sometimes, I want to talk to them and be friendly.

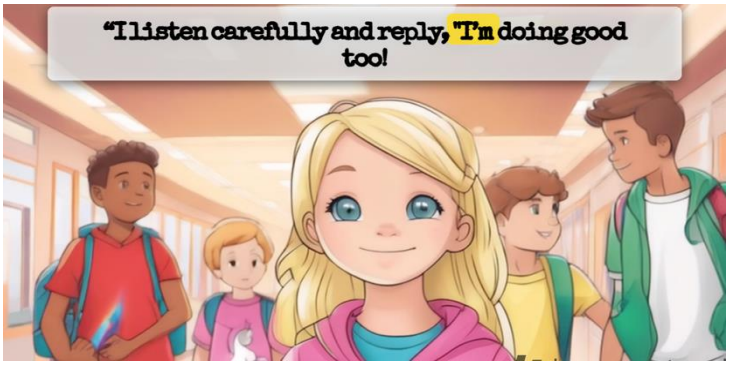
Today, I see my classmate, [Adam]. I feel like saying hello.

First, I take a deep breath and decide what to say.

I walk up to [Adam] and say, "Hi [Adam]! How are you today?

[Adam] smiles and says, "Hi! I'm doing good. How about you?

"I listen carefully and reply, "I'm doing good too! What are you going to play during recess?



"Adam tells me he wants to play on the swings. I nod my head and say,

"That sounds like fun! Can I join you?" Adam says, "Sure!"

We smile and decide to play together. It makes me happy when I start a conversation with a friend. I can try talking to my friends every day!