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Using tablet assisted Social Stories™ to improve classroom behavior for adolescents with intellectual disabilities

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ABSTRACT

The present study examined the use of tablet assisted Social Stories™ intervention for three high school students with severe intellectual disabilities whose problem behavior interfered with their learning and caused classroom disruptions. A multiple probe design across participants was employed to test the impact of the tablet assisted SS on the participants' target behaviors. During intervention, the participants read the Social Stories that were created on Prezi and accessed via Quick Response (QR) codes using a Galaxy Tap smart tablet before participating in an academic period. Data indicated that the SS intervention decreased disruptive behavior and increased academic engagement in all three participants. All three demonstrated generalization of behaviors to a nontargeted academic period and maintenance of improved behaviors at the 2-week follow-up.

1. Introduction

Individuals with intellectual disabilities (ID) have difficulty applying knowledge to new problems and situations (Smith & James, 2005) and effectively communicating with others (Cheslock, Barton-Hulsey, Romski, & Sevcik, 2008; McLean, Brady, & McLean, 1996; Lindsay, 2002). These deficits in cognitive and communication skills often manifest themselves in severe problem behavior in home, school, and community settings (Carr, Newsom, & Binkoff, 1980; Gardner & Griffiths, 2005). In a large school-based sample, it was found that the prevalence of behavior problems was high in adolescents with ID (Oeseburg, Jansen, Dijkstra, Groothoff, & Reijneveld, 2010). Problem behaviors such as aggression, property destruction, and self-injury have been found to be common in individuals with ID (Allen, 2008; Gardner, 2007; Rojahn & Esbensen, 2002). Such behaviors can interfere with successful participation in academic activities in school and can be challenging for teachers.

A variety of empirically validated interventions have been attempted for children with ID who display problem behavior during classroom activities and routines. These interventions include visual support (Dettmer, Simpson, Myles, & Ganz, 2000; Irvine, Erickson, Singer, & Stahlberg, 1992), video modeling (Hammond & Whatley, 2010; Norman, Collins, & Schuster, 2001), functional communication training (Durand & Merges, 2001), curriculum and instruction adaptations (Browder, Jimenez, & Trela, 2012; Knight, Spooner, & Browder, 2013), choice and preference (Foster-Johnson, Ferro, & Dunlap, 1994), noncontingent reinforcement (Borrero & Vollmer, 2006), differential reinforcement (Chowdhury & Benson, 2011), peer-mediated intervention (Carter, Sisco, Chung, & Stanton-Chapman, 2010; Peck, Sasso, & Jolivette, 1997), and positive behavior

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support (Carr et al., 1999). These interventions have been linked to positive student outcomes, including increased student academic engagement and decreased problem behavior.

1.1. Social Stories™

One empirically validated intervention that has been found to be effective in improving behavior in children with disabilities, including ID, is Social Stories™ (Gray, 2004). Social Stories™ (SS) has been used for a variety of purposes including increasing task performance or compliance (Hagiwara & Myles, 1999), social interaction (Barry & Burlew, 2004; Crozier & Tincani, 2007; Delano & Snell, 2006), and engagement in activities and decreasing problem behavior (Brownell, 2002; Crozier & Tincani, 2005; Ozdemir, 2008). However, a meta-analysis by Kokina and Kern (2010) indicated that SS intervention is more effective for behavior reduction than for teaching appropriate behavior, and that studies rarely targeted academic skills. In addition, SS has primarily been used to address social difficulties of children with autism spectrum disorders (ASD). In one study, SS was successfully used to increase self-determination related knowledge (i.e., knowledge of adult outcome areas and opportunities) in youth with ID (Richter & Test, 2011).

However, due to very limited research on this population, the extent to which SS can benefit children with ID in the school setting is not clear. Several researchers argued that SS was more likely to benefit children with basic language skills and higher intelligence (e.g., Kuoch & Mirenda, 2003; Reynhout & Carter, 2006). Reynhout and Carter (2008) used SS to address academic engagement (i.e., looking at a book) during group reading time for an 8-year-old child with autism who had limited language skills and intellectual disability. The results indicated that the SS intervention was not successful in increasing the child's target behavior.

SS is commonly read immediately prior to the targeted situation or activity and incorporates several well-researched antecedent-based interventions such as activity schedule and priming in which future events are previewed so that they become more predictable (Duttlinger, Ayres, Bevill-Davis, & Douglas, 2013; Ivey, Heflin, & Alberto, 2004). SS is typically written from the first- or third-person perspective and presented in a written format with or without visual illustration (Gray, 1998). However, the results of a meta analysis by Kokina and Kern (2010) indicated that SS utilizing visual illustrations resulted in better outcomes than SS with no illustrations. In addition to visual illustrations, computer assisted SS that utilized multimedia was found to be effective in promoting social skills in children with ASD (Hagiwara & Myles, 1999; Mancil, Haydon, & Whitby, 2009; Sansosti & Powell-Smith, 2008) and self-determination related knowledge in youth with ID (Richter & Test, 2011).

1.2. Tablet assisted interventions

In recent years, smart tablets such as the Apple iPad and iPod Touch have emerged as a popular educational technology for children with disabilities because of the touch screen that makes the devices highly accessible, and visual displays that are often highly appealing and motivating for children with disabilities (Zaranis, Kalogannakis, & Papadakis, 2013). For some children with disabilities, tablets can provide an economical, flexible, and socially acceptable means of communication, extending beyond augmentative communication devices (Sennott & Bowker, 2009). Although the outcomes of using smart tablets have not been reported in the SS literature, studies have used augmentative and alternative communication (AAC) systems via iPod Touch to increase communication skills of children with ASD (Achmadi et al., 2012; Flores et al., 2012; Kagohara et al., 2010, 2013; Sennott & Bowker, 2009) and video modeling via iPad to improve transitioning behavior, communication skills, and academic skills for children with ASD (Burton, Anderson, Prater, & Dyches, 2013; Cihak, Faherenkrog, Ayres, & Smith, 2010; Jowett, Moore, & Anderson, 2012). The iPad has also been used to deliver academic activities such as handwriting and color matching which was successful with language arts instruction for children with language disorders (Cumming & Rodriguez, 2013), reading instruction for children with ID (Kwon, 2011), and decreasing challenging behavior and increasing academic engagement for students with ASD (Neely, Rispoli, Camargo, Davis, & Boles, 2013). However, research on the use of tablets and mobile devices as educational and intervention tools for children with disabilities is in its infancy. As discussed above, the motivational aspect of the tablets has the potential to increase attention and reinforcement during story reading and instructional time for children with disabilities who have a reduced motivation for social interaction (Neely et al., 2013). In addition, since children can easily navigate the story using the touch screen display, the tablet-assisted SS may increase self-directed learning and independence (Rodriguez, Strnadova, & Cumming, 2013).

1.3. Current study

The current study was conducted in South Korea where technology integration into curriculum activities has been emphasized to support students with disabilities. Tablets have been used in South Korea as AAC devices and instructional materials for children with disabilities (Han, Kim, & Park, 2012; Joe, 2012; Lim & Park, 2011). In several studies, SS with multimedia or videos were delivered via computer to reduce problem behavior and teach functional communication skills (Jeong & Jeon, 2010, 2011), social communication skills (Lee, Lee, & Joe, 2007; Lee & Moon, 2011), self-determination skills (Kim, 2005), and academic skills (Kim & Lee, 2012) for children with ASD. However, addressing problem behavior and promoting academic engagement in children with disabilities by using tablet assisted SS have not been reported in the Korean literature.

The purpose of the current study was to address such gaps in the literature by evaluating the use of tablet assisted SS for students with ID who had difficulty engaging in academic activities due to problem behavior and whose problem behavior caused disruption in the classroom. Specifically, the study attempted to answer the following questions: (1) will tablet assisted SS result in reduced disruptive behavior and increased academic engagement of students with ID; (2) will decreases in disruptive behavior and increases in academic engagement generalize to nontargeted instructional time periods; and (3) will changes in disruptive behavior and academic engagement be maintained when the SS intervention is withdrawn?

2. Method

2.1. Setting and participants

This study took place in an 11th grade classroom of a private special school in South Korea for students with severe ID. Through financial support from the federal government, the school was providing free educational services to over 160 students in 31 classrooms from preschool to high school, with 69 high school students receiving services in six classrooms. Additionally, the school was providing free vocational education services to 60 transition-aged youth in six classrooms. The participants' classroom consisted of eight students (four males and four females) and was staffed by a paraprofessional and a special education teacher who had three years of teaching experience with students with ID, and is a Ph.D. student in special education and the first author. The room contained individual student desks and chairs and a computer center. There was an adjacent room used as the classroom teacher's office; a door separated the office from the student work area. The classroom special education teacher taught functional academic and life skills to the classroom students, focusing on vocational development. Each target student participated in SS intervention sessions delivered by the teacher in the morning before the start of academic activities. The sessions were conducted in the teacher's office, while other students participated in independent game activities assisted by the paraprofessional. Data were collected following the SS sessions during the first regularly scheduled morning academic time period. Depending on the day of the week, the students participated in functional academic activities in the areas of reading, writing, and math during that period. Regardless of the academic subjects, the participating students engaged in high levels of problem behavior during the morning class.

The study participants were three 17-year-old students with severe ID who were served in the classroom. The students were targeted for intervention due to off-task and disruptive behavior during academic activities. For inclusion in the study, participants: (a) had a current diagnosis of severe ID provided by the school district evaluation team; (b) comprehended kindergarten level reading materials; (c) had no dual diagnosis of sensory or physical disability; (d) had no prior experience with SS intervention; and (e) had good school attendance. Once a participant was identified, the first author provided the participant's parent with information on the study purpose and procedures during a 15-min face-to-face meeting and obtained consent for allowing their child to participate in the study. It was explained that the research team would maintain the privacy or confidentiality of their child and that the web-based SS materials were stored in a secured website and would be password protected.

All of the participants were familiar with the Samsung Galaxy Tab, a smart tablet used in the current study. None of the participants received medication of any type. All had been placed at the current school since age three when they were diagnosed as having severe ID by the school district multi-discipline evaluation team and started receiving early childhood special education services. They had received a Full IQ score of under 55 ($M = 100 \pm 15$) on the Korea Institute for Special Education-Korea Intelligence Test for Children (KISE-KIT; Park, Jeong, & Jeong, 2002), and received instruction on functional academic skills at the pre-primer level.

H.A. was a 17.7-year-old male student. He communicated using short sentences and had received low scores in adaptive skills (Composite Score of 49, $M = 100 \pm 15$) on the Korea Institute for Special Education-Scales of Adaptive Behavior (KISE-SAB; Jeong, Kang, Kim, Park, & Jeong, 2003). H.A. could read simple familiar texts with repetitive words and sentence patterns with verbal prompts and responded to verbal questions using 3–5 word sentences. H.A. liked to imitate the behavior and speech of other people. During instruction periods, H.A. often engaged in inappropriate vocalization such as talking, singing, and screaming, played with clothes or threads, and had difficulty completing tasks independently. He frequently left his seat, pushed worksheets away, and screamed when given nonpreferred tasks. In addition, H.A. engaged in self-stimulatory behavior such as wiggling his legs, scratching his body, and smelling pencils and activity materials.

K.Y. was a 17.1-year-old female student who communicated in phrases and short sentences and followed two-step directions. She had a Composite Score of 73 on the KISE-SAB. K.Y. could comprehend text read aloud and answer questions using 2–3 word phrases. K.Y. liked to play with peers; however, she touched peers' arms or leaned against them without permission, which was disruptive during activities. She frequently wanted to go to the bathroom when there was no urgent need and required frequent prompts to engage in activities. K.Y. also engaged in stereotypical behavior such as rubbing her eyes with her fingers and palms, twisting her mouth, and rocking her body.

R.E. was a 17.6-year-old male student who spoke in short phases or gestures and communicated with some teachers and peers. R.E. received a Composite Score of 76 on the KISE-SAB. He could comprehend text read aloud and answer concrete comprehension questions about text paired with pictures using 1–2 word utterances or gestures. R.E. rarely looked at teachers during instruction and engaged in problem behavior; he often engaged in giggling while looking at peers, touching peers' materials, or looking outside when given worksheets, which required constant teacher prompts and corrective feedback. Although he had difficulty engaging in independent seatwork and group learning activities, R.E. liked computer and art activities.

2.2. Response measures and interobserver agreements

The dependent variables for all three participants included disruptive behavior and academic engagement. The percentage of intervals during which each response occurred was measured. Disruptive behavior included off-task, disturbing others, and making disruptive noises that were incompatible with learning. Off-task behavior was defined as leaving their seat or classroom without permission, turning head away from the teacher and looking at peers or engaging in motor movement (e.g., biting nails, smelling papers, putting things in the mouth, wiggling legs) during the majority of intervals while the teacher is giving a lesson. Disturbing others was defined as toughing peers or their belongings with hands or feet that resulted in peer screaming. Disruptive noise was defined as banging or moving items, clapping loud enough to produce a sound, singing out loud, screaming, or talking to peer when the expectation is to work independently or while the teacher is giving a lesson.

Academic engagement included paying attention to teacher's lesson, working on assigned academic tasks, and asking for assistance (Walker & Severson, 1991). Paying attention to teacher's lesson was defined as looking at the teacher or paying attention to the material or task when the teacher is giving a lesson to the whole class or individuals, or making appropriate motor or verbal responses (e.g., writing, computing, answering questions).

A 10-s partial interval recording procedure was used to collect direct observational data during 20-min instructional time periods, where the data collector observed for 8 s, then recorded for 2 s for every 10-s interval. Entire observation sessions were video recorded using a digital camera for future scoring. The first author and a trained graduate student independently measured disruption and academic engagement while viewing video recorded data during 30% of the sessions distributed across all study phases to assess interobserver agreements (IOA). The graduate student was a doctoral student in special education, who was familiar with direct observation procedures including the interval recording procedures. Before beginning data collection, the observers practiced data recording by viewing video recorded sessions with nonparticipating students in the classroom until they reached an agreement level of 90%. IOAs were calculated by dividing the number of intervals with agreements by the number of agreements plus disagreements and multiplying by 100%. The overall mean IOA was 91.2% (range = 90.5–94.2%) for H.A., 92.7% (range = 90.8–94.1%) for K.Y., and 93.9% (range = 91.7–95.7%) for R.E. The mean IOAs were 92.3% (range = 91.1–93.1%) for baseline, 92.8% (range = 90.5–95.7%) for intervention, 94.2% (range = 93.7–94.6%) for generalization, and 91.3% (range = 90.8–91.7) for the follow-up phase.

2.3. Treatment integrity and social validity

To assess treatment integrity, two trained graduate students scored the researcher's SS implementation sessions using an integrity checklist. The checklist included the following eight intervention steps: (1) prompt (provide verbal prompting) to turn on tablet; (2) prompt to execute the story book by using a Quick Response (QR) code; (3) explain the story topic while having the student look at the cover; (4) explain pictures included in the story while manipulating Prezi slides; (5) prompt student to read the story while operating the tablet; (6) ask comprehension questions; (7) deliver verbal positive or corrective feedback contingent on response to each comprehension question; and (8) summarize the story. Treatment integrity data were collected during 40% of the treatment sessions, and 100% of the intervention steps were implemented correctly across sessions.

To assess the clinical significance of students' gains and the acceptability of the treatment, six observers (one parent of each participant, two teachers, and a guidance counselor) who did not participate in implementation of the SS intervention were asked to view six randomly selected video clips (two each from baseline, intervention, and generalization) and complete a social validity questionnaire. The questionnaire consisted of five questions concerning the importance of the target skills, acceptability of the intervention strategies, effectiveness of the intervention, and usefulness of the intervention. The questions were rated using a five point Likert-type scale from 1 (negative) to 5 (positive).

2.4. Experimental design and procedures

The study employed a multiple-probe design across participants in which data were not collected in every session in order to avoid unnecessary repetition (Gast, 2009). The experimental conditions consisted of baseline, intervention, generalization, and follow-up. Intervention was introduced in a staggered fashion across participants where one participant served as a control for another participant. Before baseline data collection, functional behavior assessment was conducted during instructional time periods across two days (two observations each day) for each participant through an Antecedent-Behavior-Consequent observation procedure (Bijou, Peterson, & Ault, 1968) to corroborate the teacher's reports with regard to social and automatic reinforcement functions of the participating students' disruptive behaviors. The FBA results confirmed that H.A.'s disruptive behavior functioned as avoiding activities and tasks while K.Y.'s and R.E.'s disruptive behavior functioned as gaining access to teacher attention. The classroom staff allowed H.A. to have access to his preferred activities when he engaged in disruptive behavior and provided attention in the form of reprimanding or providing assistance with activities. Both K.Y. and R.E. often received teacher attention when they engaged in disruptive behavior. Although the teacher's reports indicated that automatic sensory reinforcement

maintained disruptive behavior, their self-stimulatory behavior occurred at high rates during interactions with classroom staff indicating socially mediated reinforcement contingencies in the occurrence of self-stimulatory behavior.

2.5. Design of SS

Based on guidelines recommended by Gray (1998), individual SS were developed, which included three types of sentences: descriptive, directive, and perspective. Each story was written in the third person with participant's name and in a ratio of one directive sentence to two or three descriptive and perspective sentences. Most directive sentences were written in positive terms. To address the function of each student's disruptive behavior, the stories focused on teaching target alternatives or replacement behaviors by providing scripts that the student should do instead of engaging in disruptive behavior. The SS included photos of the students engaging in target replacement skills.

For example, the SS for H.A. focused on teaching alternative behaviors, such as paying attention to teacher's lessons, raising hand to ask questions or respond to questions, and working on activities or worksheets to replace his attention-maintained disruptive behavior. The focus was teaching alternative behaviors that evoked the same consequences as the targeted disruptive behavior. The SS included the following sentences: (1) Page 1 (title page) – H.A. Listens to Teacher and Completes Worksheets; (2) Page 2 – Teacher gives a lesson during class, and students sit at their desks. H.A. needs to sit quietly, look at the teacher, and listen carefully during this time (photo of H.A. sitting and looking at teachers). Teacher praises H.A. when he sits quietly and listens to teacher lessons; (3) Page 3 – Teacher also assigns activities and tells students to do the activities with friends. Sometimes, H.A. wants to touch peers, play with clothing, or scream when given activities. H.A. needs to participate in the activities with friends (photo of H.A. and peers working on activities together). It makes teachers and friends happy when H.A. works on his worksheets; (4) Page 4 – Sometimes, teacher asks questions of students during class. H.A. needs to raise his hand before answering the questions (photo of H.A. raising his hand). Sometimes, H.A. has questions during class. H.A. needs to raise his hand if he has a question, and teacher will explain the answer; and (5) Page 5 – Teacher also gives H.A. worksheets to do. H.A. needs to finish the worksheets (photo of H.A. completing a worksheet). Teacher praises H.A. when H.A. finishes the work (the Social Stories for other participants are available from the authors upon request). As stated in each page, H.A.'s SS provided guidance on how to appropriately participate in instructional activities by telling him what to do instead of what not to do (e.g., not to talk, scream, touch peers, leave his seat, push worksheets away). The story also delivered a message on what reinforcer H.A. would receive when he engaged in appropriate, alternative behavior.

The stories were created on 'Prezi,' a cloud-based presentation tool. Prezi is an interactive presentation tool that uses zooming and spatial relationships to present information and can be shown on any computer or tablet that has web access. Desktop application versions of Prezi are currently available which work both on and offline. It allows incorporation of various types of media including web links to create more dynamic presentations and more effectively engage students than is possible with static presentations created by other presentation software (Bender & Bull, 2012). SS on Prezi can be accessed by entering the URL in a web browser; to further increase participant interest in reading SS, the first author created QR (Quick Response) codes for participants to scan with a tablet and access the web link. QR codes are two-dimensional barcodes that can be read using tablets and smart mobile phones and provide direct and instantaneous access to the web-based materials. In designing the QR codes, we used different colors to increase participant interest and engagement in SS activities. The SS webpage was secured because it contained relevant participant photos that required protection. A password was used to enable access into the SS webpage. To facilitate participant access, the password was embedded in the tablets to enable direct access whenever a participant scanned the QR code. When the participant touched the Prezi play, forward, and back buttons, the SS slides advanced at the participant's pace. Prezi allowed the author to present slides in 3D with rotation and zoom and allowed the author to embed pictures so that presentations were more dynamic than traditional 2D slides. These capabilities allowed the author to deliver a more artistic presentation that engaged the participants and kept their interest. Participants accessed the zoom and rotation capabilities by using common skills and interfaces for accessing typical multimedia.

Before developing the SS, the author participated in a training course on ''smart-learning'' offered by a local school district, which focused on the use of tablets, QR codes, and Prezi in education. The third author and one special education teacher who were familiar with using SS intervention reviewed the initially developed SS to validate the content of each SS. They checked for adherence to Gray's sentence ratio and guidelines and the addressed target behaviors. They agreed that the stories contained the correct sentence ratio, met the guidelines, addressed the functions of each student's disruptive behavior, and were high quality.

2.6. Baseline

Baseline data were collected during the targeted morning academic time period until stable patterns or trends of the target behaviors were established. Depending on the participant, three to six probing data were collected in baseline. Of the 40 min academic time period, data were collected for 20 min, starting 10 min after the class began during which disruptive behavior occurred at a high rate. During baseline, classroom staff used verbal and physical prompts to promote participant engagement in activities and responded to disruptive behavior by calling their name, giving a warning, providing assistance with tasks, or time-out to stop the behavior. Staff used positive reinforcement such as verbal complements contingent on

appropriate behavior. A token system was used where students earned playtime with the tablet or computer during lunchtime based on the number of tokens earned.

2.7. Intervention

Before implementing the SS intervention, the classroom teacher (first author) taught participants the basic skills for accessing the web-based SS on Prezi, such as locating and scanning the QR code with the tablet and touching the Prezi play button to start the SS. Since the participating students were familiar with tablets, the training was brief, less than 10 min. During intervention, the teacher verbally prompted the individual student to turn on the tablet, scan the QR code to access the story on Prezi, and start the story by touching the play button at the beginning of each session. The teacher modeled reading the story once and then provided prompting and modeling to help the student read it aloud to facilitate shared and independent reading. No reinforcement was provided during the SS reading. At the end of the story reading, the teacher asked the students four who, what, when, and why questions (e.g., "What do you need to do when it is time for class?") to aid their comprehension of the story and provided verbal positive feedback (e.g., "That's right!") for correct responses. If the participant answered the question incorrectly, the teacher opened the story to the correct response and provided corrective feedback (Schneider & Goldstein, 2010). The intervention was delivered during approximately 10-min sessions in the teacher's office adjacent to the classroom. The token system that was used in baseline continued to be implemented in intervention. The participants earned playtime with the tablet or computer during lunchtime based on the number of tokens earned. They were allowed to read the SS again if desired during this time.

2.8. Generalization and follow-up

To examine generalization of target behaviors to a nontargeted academic time period, all participants were observed in the afternoon during an academic activity time. Three probes were conducted for a period of two weeks after the students engaged in less than 30% of intervals for disruptive behavior and more than 70% of intervals for academic engagement over three consecutive sessions. Following the generalization probes, three follow-up data points were collected beginning two weeks after the final intervention session and for a period of two weeks to evaluate the maintenance of increased academic engagement and reduced disruptive behavior in the absence of the SS intervention.

3. Results

3.1. Disruptive behavior and academic engagement

Fig. 1 presents the percentage of intervals with disruptive behavior and academic engagement for each participant across experimental phases. The data indicated that for all participants, the tablet assisted SS led to positive outcomes. When the intervention was implemented, the participating students' disruptive behavior decreased and academic engagement increased. The results were immediate and profound.

For H.A. the mean percentages of intervals of disruptive behavior and academic engagement during baseline were 91.9% and 25.5%, respectively. As shown in Fig. 1 and Table 1, the levels of each target behavior were similar across sessions during baseline. During SS intervention, the mean of disruptive behavior decreased to 47.7% while the mean of academic engagement increased to 69.8%. Although the disruptive behavior increased and academic engagement decreased unexpectedly in the first intervention session (Session 4), a dramatic decrease of disruptive behavior and increase of academic engagement emerged in Sessions 5–6. Although there was some variability in the data, the trend continued over the next several sessions, followed by a rapid decline in disruptive behavior to 24.2% and incline in academic engagement to 98.3% in Session 12. These levels maintained during the remaining sessions with relatively low variability. Except for the first intervention session, there were no overlapping data points between baseline and intervention conditions for both behaviors.

K.Y. displayed relatively consistent, high levels of disruptive behavior and low levels of academic engagement during baseline. Upon implementation of the tablet assisted SS intervention, there was an immediate decrease in disruptive behavior and increase in academic engagement. The data showed a rapid decreasing trend for disruptive behavior and increasing trend for academic engagement during baseline. K.Y.'s mean level of disruptive behavior decreased from 96.7% during baseline to 46.1% during intervention, while the mean level of academic engagement increased from 46.7% to 84.9%. Zero percentage of the intervention data overlapped with baseline for both behaviors.

Similarly, R.E. displayed consistently high levels of disruptive behavior and low levels of academic engagement during baseline. Upon implementation of the intervention, R.E. demonstrated an abrupt decrease in disruptive behavior and increase in academic engagement. Specifically, from the last baseline session to the first intervention session, there was a 32.5% decrease in disruptive behavior (from 83.3% to 50.8%) and a 21.8% increase in academic engagement (from 36.7% to 58.5%). R.E. also demonstrated a rapidly decreasing trend for disruptive behavior and increasing trend for academic engagement during baseline. The mean percentages of intervals of disruptive behavior and academic engagement were 83.1% and 30.8% during baseline, and 34.2% and 75.4% during intervention, respectively. There were no overlapping data points between baseline and intervention conditions.

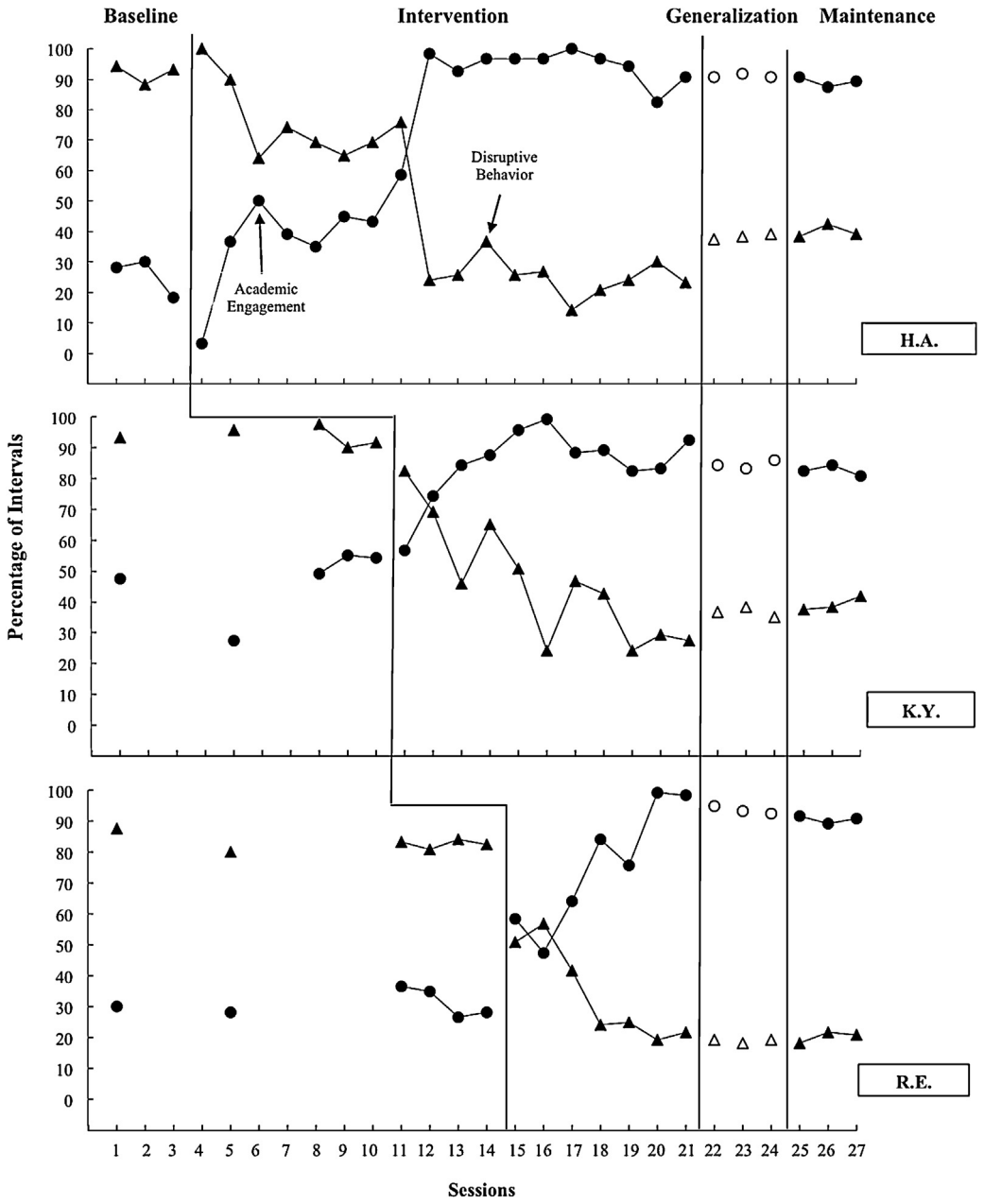

Fig. 1. Percentages of intervals with disruptive behavior and academic engagement during each experimental condition across participants.

3.2. Generalization and maintenance of changes in target behaviors

Fig. 1 and Table 1 present data on target behaviors across participants during generalization and maintenance sessions. The data reflects high levels of generalization of behaviors to the nontargeted afternoon academic time period for all three participants. The levels of participants' disruptive behavior and academic engagement during the generalization time period were similar to those during the targeted morning academic time period in intervention. H.A., K.Y., and R.E. exhibited an average of 38%, 37%, and 19% disruptive behavior and an average of 91%, 84%, and 94% academic engagement, respectively (see the range information in Table 1).

At the 2-week follow-up, a series of four probe observations were conducted. The data demonstrate that maintenance of behaviors continued during the 2-week follow-up period. After withdrawal of the intervention, all three participants continued to demonstrate low levels of disruptive behavior and high levels of academic engagement. Follow-up data were relatively stable for both behaviors across participants. As shown in Table 1, the mean percentages of disruptive behavior

Table 1
Mean and range (in parentheses) percentages of intervals with disruptive behavior and academic engagement for each participant by phase.

Phase	H.A.		K.Y.		R.E.	
	Disruptive behavior	Academic engagement	Disruptive behavior	Academic engagement	Disruptive behavior	Academic engagement
Baseline	91.9 (88.3–94.2)	25.5 (18.3–30)	96.7 (90–97.5)	46.7 (27.5–55)	83.1 (80–87.5)	30.8 (26.7–36.7)
Intervention	47.7 (14.2–100)	69.8 (3.3–100)	46.1 (24.2–82.5)	84.9 (56.7–99.2)	34.2 (19.2–56.7)	75.4 (47.5–99.2)
Generalization	38.3 (37.5–39.2)	91.1 (90.8–91.7)	36.7 (35–38.3)	84.4 (83.3–85.8)	18.9 (18.3–19.2)	93.6 (92.5–95)
Follow-up	40.0 (38.3–42.5)	89.2 (87.5–90.8)	39.2 (37.5–41.7)	82.5 (80.8–84.2)	20.3 (18.3–21.7)	90.6 (89.2–91.7)

further decreased to 20.3% (from 34.2% in intervention) and academic engagement increased to 90.6% (from 75.4% in intervention). Furthermore, 100% of the follow-up data overlapped with the intervention phase, and 0% of the follow-up data overlapped with the baseline phase.

3.3. Social validity

Results from social validity ratings, which were obtained by having three parents, two teachers, and one guidance counselor view six randomly selected video segments of sessions (two each from baseline, intervention, and generalization), indicated that all of reviewers rated SS intervention as having high levels of social validity for all three participants. The mean rating of social validity statements was 4.4 (range 4–5 across questions) across participants. Of particular interest, all reviewers indicated that they "strongly agree" that the SS had a positive impact on the students' behaviors and that during intervention their disruptive behavior decreased and academic engagement increased significantly.

4. Discussion

This study aimed to examine the impact of tablet assisted Social Stories™ (SS) intervention on disruptive behavior and academic engagement of three high school students with severe intellectual disabilities (ID) in South Korea. The results of the study suggest that the tablet assisted SS may have a positive impact on improving behaviors in adolescents with severe ID; the SS resulted in decreased disruptive behavior and increased academic engagement within one or two sessions for all participants. Changes in their behaviors were generalized to other academic time period and maintained two weeks after the completion of intervention. The tablet assisted SS demonstrated high levels of procedural integrity and social validity. The parents and school personnel indicated that the SS intervention was effective in improving the participants' target behaviors.

The current study extends previously conducted research on SS utilizing technology. As demonstrated by several studies (e.g., Hagiwara & Myles, 1999; Mancil et al., 2009; Richter & Test, 2011; Sansosti & Powell-Smith, 2008) and confirmed by this study, the use of computer or multimedia to implement SS has the potential to improve a variety of behaviors and skills in children with developmental disabilities. Specifically, this study extends the literature on the use of computer-based SS for individuals with ID (Richter & Test, 2011).

The current study is the first to investigate the use of smart tablet assisted SS. In particular, the study explored the use of QR codes accessing web-based SS on Prezi. Anecdotal observations indicated that the smart tablet assisted SS on Prezi that were activated by QR codes stimulated participant interest and active engagement in SS reading. It was observed that when the participants were allowed to take the lead for story reading by having them operate the tablet, scan the QR code, and play Prezi slides for themselves, they were excited and read the stories with little teacher prompting. This may imply that the participants' motivation and active engagement in reading the SS enhanced the outcome of SS. In addition, the use of the computer or tablet assisted SS may increase the consistency of intervention implementation (Sansosti & Powell-Smith, 2008).

Creating the Social Stories that incorporates the QR code and Prezi software into the smart tablet requires some advanced technical skills. However, considering the current advances in technology and the fact that children with developmental disabilities often prefer mobile devices or computer assisted instructions, there is a need for more studies on tablet assisted or web-based SS utilizing QR codes. Web-based materials can be accessed via QR codes using any smart mobile device or tablet independent of location in time or space (Lai, Chang, Li, Fan, & Wu, 2013), and thus have the great potential for enhancing a variety of outcomes for children with disabilities. To date, studies on the use of QR codes for children with developmental disabilities have not been reported in the literature.

The current study supports the findings of previous research that examined the effects of computer assisted SS utilizing visual support (Sansosti & Powell-Smith, 2008). Sansosti and Powell-Smith used computer-based SS with Mayer-Johnson picture symbols (Mayer-Johnson, 1994) combined with video modeling to teach social communicative skills of three high functioning children with ASD. In the current study, photos of participants with and without peers are used instead of picture symbols. According to anecdotal observations, in every session the participating students completed reading of the SS by manipulating tablets, remaining in their seats, and rarely engaging in disruptive behavior. The addition of pictures to the tablet assisted SS may have increased the outcomes of the SS intervention for the students with severe ID. It was observed that one of the participants, R.E. who rarely communicated verbally, described his behaviors in photos of the story using

gestures and short phrases and practiced target appropriate behaviors while reading the story with the teacher. It was also observed that H.A. often stated verbally at the beginning of class, "I will not sing. I will sit quietly during class." Given the fact that individuals with severe ID have difficulty understanding verbal and written language, visual aides may have increased their understanding of the story message, in addition to making the story more appealing to the reader.

This study also demonstrates the potential benefits of using SS to teach academic behaviors to children with ID. Although studies on SS rarely targeted academic behavior in the United States (Kokina & Kern, 2010), a few unpublished Korean studies used SS to increase academic behavior for children with ID such as paying attention to teacher instruction, asking questioning and answering questions, and performing tasks (Han, 2010; Jeong, 2011; Joe, 2010).

Although this study contributes to the existing literature on SS, it has limitations. First, it is unclear as to whether the results of the study were because of the unique combination of SS and technology or the SS component in particular. In addition, the study included photos of participants and peers within the story. Future research should examine the relative contributions of each component in the SS package. Second, generalization probes were not taken during baseline. Although the generalization data showed stable patterns and similar levels of behaviors to the intervention session data during the targeted setting, without baseline probes it cannot be conclusively determined that participants' improved behaviors generalized to novel situations. Third, the study collected only 2-week follow-up data; thus, it is difficult to determine whether the tablet assisted SS can promote maintenance of behaviors after the intervention has been terminated for individuals with ID. Finally, the small sample size limits the generality that can be made to a wider range of individuals. Further research using a larger sample of participants, additional measures of skill generalization, and long-term follow-up assessment would increase confidence in the findings.

Despite its limitations, this study offers a significant contribution to the body of research on SS and technology-based education and intervention for children and adolescents with disabilities. This study is the first study to evaluate the potential efficacy of tablet assisted SS, particularly, utilizing QR codes and Prezi for adolescents with ID. This study is also one of the few studies that have implemented SS for improving academic behavior. Future research that can examine the efficacy of the tablet assisted SS intervention may substantially increase the number of intervention options for adolescents with ID.

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