International Journal of Learning, Teaching and Educational Research
Vol. 21, No. 10, pp. 280-295, October 2022
https://doi.org/10.26803/ijlter.21.10.15
Received Aug 17, 2022; Revised Aug 23, 2022; Accepted Oct 19, 2022

The Implementation of Assistive Technology with a Deaf Student with Autism

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Abstract. This research examined the use of assistive technology (AT) in the classroom with a deaf autistic student, and explored how the technology could support the student in acquiring sign language. It also enhanced the impact of AT on the learning progress of the student. Semi-structured interviews were conducted with one interpreter and one teacher, with the responses transcribed and coded. The use of AT in the classroom was also observed. The data analysis yielded four primary categories: teacher and interpreter use of AT and overall benefit, barriers to accessing AT, AT use for academic support, and misunderstandings about deafness and autism. The most common forms of AT used with this deaf autistic student were laptops and iPads. The results indicated that AT had an overwhelmingly positive impact on the learning and behavior of students. The school system presented the main challenge as it did not help the participants to easily access AT. There are common misunderstandings about whether sign language can be taught to deaf autistic children; however, this study's participants believed that a deaf autistic student could learn and understand the meaning of sign language. Teachers need to integrate AT into their classrooms since AT influences communication development for deaf autistic students and aids their learning progress.

Keywords: autism spectrum disorder; deafness and autism; sign language; assistive technology

1. Introduction

There is widespread concern in the U.S., as well as globally, about the number of children diagnosed with autism spectrum disorder (ASD). "In 2021, the CDC reported that approximately 1 in 44 children in the U.S. is diagnosed with an autism spectrum disorder (ASD), according to 2018 data" (Autism Speaks, 2021, para. 1). Coke and Kaneshige (2013) have stated that ASD encompasses a range or spectrum of neurodevelopmental disorders, marked by communication and social impairments, repetitive, and stereotyped behaviors. However, no specific

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behavior exists that is typical of an individual with ASD, and the disorder manifests differently across individuals over their lifetime. One possible comorbidity is hearing loss. A survey at the Gallaudet Research Institute indicated that during the 2009–2010 school year, 1 in 50 students, most of whom were 8 years of age and suffering from hearing disabilities, were also receiving services for autism (Gallaudet Research Institute, 2011; Szymanski et al., 2012).

As a result of the increasing number of deaf students with autism, how these students learn language requires investigation. Many such students can communicate very well using hand signs, gestures, pictures, and word cards. (Quinto-Pozos & Cooley, 2020). These students usually possess better or equally good skills in visual discrimination (Axelsson et al., 2019; Fan, 2012). Nonverbal autistic students can more easily process visual information than auditory information (Fan, 2012).

Carr (1979) states that there is considerable evidence suggesting that autistic children have trouble with mastering intellectual ideas and other composite linguistic skills; one of the most severe complications of ASD is a speech comprehension deficit. Because sign language relies on visual discrimination instead of hearing, it could be helpful for removing key difficulties in acquiring complex linguistic skills for students with comorbid conditions (Carr, 1979; Quinto-Pozos & Cooley, 2020). Assistive technology (AT) plays a key role in teaching sign language to these students (Axelsson et al., 2019; Carr, 1979).

Very few studies have examined the dialectal insufficiencies of signing in deaf children with autism (Carr, 1979; Fan, 2012; Shield & Meier, 2013; Quinto-Pozos & Cooley, 2020). Other researchers have solely focused on nonverbal autism, neglecting possible deafness, as there is no specific diagnosis for deaf children with autism (Dawson & Toth, 2006; Denmark, 2011; Dale & Neild, 2020). Meinzen-Derra et al. (2014) noted that both hearing loss alone and ASD alone can lead to communication and social delays. Therefore, providing a true dual diagnosis is challenging.

The qualitative study aimed to investigate the implementation of AT with one deaf autistic student, focusing on the teaching of sign language. The study investigated the types of technology that can support the student in daily communication and learning, and the understanding of the teacher and interpreter on the use of AT for deaf autistic students.

2. Literature Review

Denmark (2011) notes the various impairments that characterize individuals with ASD, including social, voiced, and nonverbal interactions and creative activities. Dawson and Toth (2006) listed other social impairments that often present with ASD, including difficulties with eye contact, joint attention, facial expression, and understanding of nonverbal communication; lack of interaction with peers; and lack of social reciprocity. Communication impairments do not solely involve language delays, but also failures in the use of language (Dale & Neild, 2020). Individuals with ASD often display atypical speech patterns, including

immediate or delayed echolalia, duplication of expressions in an abnormal manner, and infrequent prosody, among others (Dawson & Toth, 2006).

Rather than communicating through language, deaf students with autism usually communicate by pointing or leading, or through their behavior. In 2008, the study of combined autism and deafness attracted scholarly attention when specialists including Morton, Steinberg, Brice, and Miller contributed articles on the topic of New Directions in Deaf Education (Vernon & Rhodes, 2009).

Technology has been shown to ameliorate the tone of communication in real-life situations for people who experience communication disorders (Bryant et al., 2020). Unfortunately, although AT can be extremely beneficial to deaf children with autism, there has been limited research into its implementation (Nelson & Bruce, 2019). This literature review explores how ASD is diagnosed in deaf children, the characteristics of autism in deaf children, sign language studies involving autistic children, and AT studies involving deaf autistic children.

2.1. Diagnosing ASD in Deaf Children

Diagnosing ASD in deaf children is a complex task for many reasons. First, Szymanski and Brice (2008), in a review of a study by Roper et al. (2003), stated that deaf children were usually diagnosed with autism between the ages of 5 and 16, while hearing children were diagnosed at ages 4–11. Second, Szymanski and Brice (2008) noted that there have been few psychological assessments that have considered deaf children. Denmark (2011) stated that the Autism Diagnostic Observation Schedule–Generic (ADOS-G) was the only assessment for ASD in deaf children. However, Dale and Neild (2020) noted, "The ADOS-2, however, falls in line with most standardized assessments in its lack of standardization with the deaf and hard of hearing (D/HH) population. The validation sample of the ADOS-2 did not include individuals who were D/HH" (p. 477). Therefore, there is no standardized psychometrically validated assessment for diagnosing these conditions, and the ADOS-2 is inappropriate for deaf children (Dale & Neild, 2020). When autism is diagnosed late in deaf children, it makes it more difficult for parents and educators to distinguish the characteristics of deafness from those of autism (Szarkowski & Johnston, 2018) whilst also limiting the resources available for parents and teachers to identify autism and deafness (Dale & Neild, 2020; Szarkowski & Johnston, 2018; Szymanski & Brice, 2008).

2.2. Characteristics of Autism in Deaf Children

Szymanski and Brice (2008) demonstrated that the characteristics of autism can appear similar to a loss of hearing ability, and vice versa. These researchers identified potential red flag characteristics for autism in deaf children (see Figure 1).

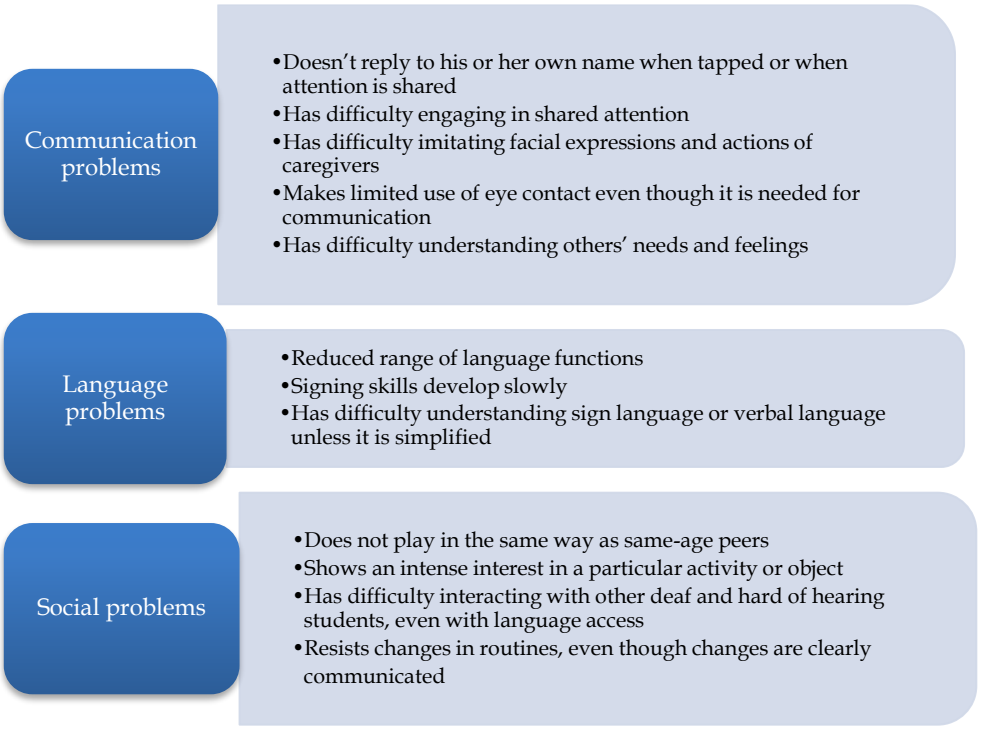

Figure 1: The characteristics of autism in deaf children: Possible red flags. Adapted from "When Autism and Deafness Coexist in Children: What We Know Now," by C. Szymanski and P. J. Brice, 2008, *Odyssey: New Directions in Deaf Education*, 9(1), pp. 10–15.

2.3. Studies of Sign Language in Children with ASD

Sign language is useful for both people with hearing loss and those with ASD, since it is an alternative form of communication that assists and encourages language development in children who go on to establish functional language (Paul, 2008). It also promotes social interactions for both autistic and deaf children who can better respond and learn quicker when information is presented visually rather than verbally (Paul, 2008; Toth, 2009). Toth (2009) supported the position that visual sign language and gesture characteristics have become a valuable communication tool for students with autism. Toth conducted a pilot study of symbol language as a communication tool for non-deaf children aged 0-6 who were diagnosed with autism or communication problems, and found that sign language and pictures eased their development of language skills rather than using the words alone. Shield and Meier (2013) supported the position that sign language was seen as a possible alternative communication system for autistic persons who had failed to acquire speech and could better handle a visual rather than an auditory modality. Conversely, several researchers have suggested that students with ASD cannot learn sign language because their ability to recognize and process information from faces is impaired (Dawson et al., 2005; Klin et al., 2002; Schultz et al., 2003).

To compare the effectiveness and efficiency of two discrete trial-teaching (DTT) processes for training receptive linguistic skills, Kurt (2011) used a single-subject design with two students with autism. First, the procedure was delivered only using verbal instructions. Second, the procedure was delivered via verbal

instructions combined with simple gestures and signs to teach receptive language skills using DTT. The results showed that spoken directives combined with simple signals and signs were more effective in promoting receptive linguistic skills for both students than verbal instructions alone. Daniels (2001) supported this position:

> "*Children who have autism have great difficulty processing verbal information and do far better responding to visual communication. Sign language, pictures, or pictographs illustrating the steps of a task are much easier for them to understand than words. Language appears to be jumbled in their heads, and sign language gives them another piece in what for them is a very confusing puzzle.*" (p. 97)

Pronovost et al. (1966) carried out a case study over a 2-year period to develop detailed descriptions of the style of speech, language conception, and general functioning of 14 youngsters diagnosed with autistic or atypical personalities. The researchers discovered that when an autistic child was given a gesture to shut the window, they willingly obeyed. However, when a similar request was made without using a gesture, the child failed to complete the action.

2.4. Use of AT with Deaf and Autistic Students

AT refers to any item that helps to improve the functional capabilities of individuals with disabilities. In all aspects of daily life, devices, whether they be low tech or high tech, should be used to develop the functional capabilities of students with autism and deafness (Fan, 2012). There has been little recent research on the implementation of AT for students with both deafness and autism (Donne, 2013), even though AT can be extremely beneficial to them (Nelson & Bruce, 2019).

A British study used experimental technology to examine if deaf students with autism conveyed emotion in British Sign Language, and found that both participant groups recognized emotions through signing (Denmark, 2011). Lartz et al. (2008) also undertook a qualitative-based study of nine deaf students attending a large hearing school, and investigated their perspectives on the use of AT. The results were recorded and then transliterated from symbol language to English. The findings indicated that AT played a crucial role in improving the lives of these students.

2.5. Research Questions

The research questions for this study were:

1. What kinds of technology do teachers use to support the needs of both deaf students and students with ASD?
2. How do teachers and interpreters use these technologies to support students?
3. Does AT help students with comorbid deafness and autism to acquire sign language, and if so, how?
4. How does AT influence deaf students with autism?

The aim of the research questions is to investigate how AT has been applied by teachers for students with deafness and autism. They highlight the technology

that is used in schools, how it impacts upon deaf autistic students, and whether these students can acquire sign language using technology.

3. Method

3.1. Design

To explore the research questions the study employed a basic qualitative design, utilizing interviews and observations. The design used subjective data, and was not restricted by definable variables, such as those found in quantitative studies (Barbour, 2014). Before the study began, permission was sought and received from the George Mason University Institutional Review Board, and informed consent was obtained from all participants.

3.2. Research Setting, Participants, and Relationships

This research took place at a public K-5 elementary school, with two classes at each grade level. The school aims to address students' educational needs from the ethnic minority group living in the area. The total enrollment was 208 White, 146 Black, 19 Hispanic, and 53 multiracial students. The school had 64 disabled students, comprising 14.8% of the school population.

The research participants consisted of one special education teacher and one interpreter. The teacher worked in a mainstream classroom that includes students with multiple disabilities, one of whom had comorbid deafness and autism. The teacher was 56 years old and had been teaching for 25 years; at the time of the study she taught K-2 and K-1 classes.

The interpreter worked with the same deaf autistic student. She graduated from college in 1987 with a degree in interpreting for the deaf and then began interpreting in the school system. At first, she worked primarily with highly functional students in high school and middle school, as well as college students. In the 8 years prior to the study, she had been working with the mentally disabled.

I had an indirect relationship with the teachers who were working with this deaf autistic student. I chose the teacher to participate in this study based on a recommendation from a past teacher. I asked the teacher to inform the student's mother about the study and received consent to observe the student. During this time, I chose the interpreter as the second participant and interviewed her.

3.3. Data Collection

Semi-structured interviews and observations were used as the data collection methods. The primary data sources were the special education teacher and the interpreter. Additional primary data was gathered by observing the deaf autistic student with her teachers.

The objective of this study was to examine the importance of using AT with this student. Observations were deemed to be the best technique for obtaining data, as it eliminates reporting and recall biases (Chandra & Sharma, 2013). I observed the teacher with the student during class hours (12:00 p.m.–2:15 p.m.). As a passive participant, I observed without disturbing the situation in any way. In addition, I observed the student during her gym lesson and took notes.

During the observation, I focused on every aspect within the student's classroom, such as the type of AT used, activities that the teacher and interpreter used with the student, the teacher's use of sign language, the interpreter's teaching style of sign language, and the student responses. I recorded observations in a notebook so that they could be coded later. The observation period lasted 2.5 hours. While gathering the data, I became aware of the relevance of Gillham's (2005) statement that "the human eye is not a camera: It does not just record but selects and interprets" (p. 166). My focus was on how the teachers used AT to help the child learn and how the student responded to the cues provided.

After the observation, I interviewed the teacher and interpreter in order to obtain factual data and supplementary information on their perceptions; this was so that I could gather an objective and comprehensive picture of the situation. Both interviews were scheduled outside of the classroom. The first interview began with an introduction of the study, followed by open-ended questions. The second interview began with open-ended questions about the participant's background and previous experience working with deaf students with autism. The interviews were conducted informally and recorded.

The teacher and interpreter were asked the same 10 interview questions (Appendix 1). During the dialogue new questions emerged, which elicited additional details and clarification supporting the research questions. The interview questions focused on the technology that the respondent regularly used with their deaf autistic student, how AT supported the student in acquiring sign language, and their perceptions of how technologies influenced the student's learning process.

3.4. Data Analysis

Data analysis "involves organizing the data, conducting a preliminary read-through of the database, coding and organizing themes, representing the data, and forming an interpretation of them" (Creswell, 2013, p. 179). After the classroom observation and interviews were completed, I listened to each interview recording several times, then transcribed them and translated them from Arabic to English. I performed the same process for my field notes. An external expert reviewed all of the English texts.

I read through the transcribed interviews and observations multiple times and identified any incidents that aligned with the research question for coding. The codes were then placed into separate categories; each category was highlighted with a different color for visual representation of the data. Tables were also created to organize all data into categories.

To check the coding processes, I selected an external expert with a Ph.D. This individual was experienced in education but was not involved with the study; they checked all of the interview and observation transcripts, as well as the lists of codes and coding categories. The expert read the codes and quotations, examined the documentation, and agreed with the coding.

4. Results

This study was conducted to learn more about whether teachers understand and use AT to help deaf autistic students acquire sign language and support them in daily communication and learning. The analysis yielded four primary categories of data: (a) teacher and interpreter use of AT and overall benefit, (b) barriers to accessing AT, (c) AT use for academic support, and (d) misunderstandings about deafness and autism. Several subcategories emerged within each of these categories, and are discussed below.

4.1. Teacher and Interpreter Use of AT and Overall Benefit

The teacher and interpreter both used AT and reported that it was both influential and beneficial to the student's learning. They implemented two forms of AT for their deaf student with autism. An iPad was the most common, and was preferred by the student as it was comfortable for both the teacher and interpreter. The iPad was used for games and educational programs, including one-on-one work with shapes, matching, and language exercises. Another type of AT used was videos on a laptop, which allowed the student to learn visually from other children who used sign language by trying to imitate them and understand their meaning. The interpreter said:

> *"She uses the laptop to watch Singing Time video. . . . She watches on the laptop and she loved it, because she visually saw the story signing in the sign language. She learned all different things through the technology. We worked with a sign language program, there are sign language stories told by deaf people, and the author's name is Peter Cook. It is under [a] website called Sign Story. She gets access to stories, YouTube, deaf interviews, storytellers, and drama."*

Both types of AT encouraged the student to become more engaged and motivated. The iPad and watching videos on the laptop were found to be useful as instructional tools that provided visual sign language and assisted their student in learning sign language. The teacher believed that AT attracted the student's attention because of the visual content, and called it a window to the world for her student. She described the benefit and impact of using AT:

> *"We also have found websites that have stories of someone signing the story. She really enjoys those stories. She really watches them. She watches the sign language. She is trying to mimic the sign in the story, and that keeps her engaged."*

Additionally, when the teacher and interpreter used AT with this student, they observed that she felt great joy. They noticed that AT increased their student's engagement and interaction, stating:

> *"She could interact with technology. She would be able to interact with the computer website with shapes. She is able to work with very simple sentences and matching the sentences with the picture. I think it's very motivating to her."*

The other impact of AT was reducing bad behavior, with the interpreter stating that "with the technology, as she just sits and does cutting or coloring, she is able to interact with the technology and that's really aspiring for her." The teacher

stated that AT increased her student's ability to connect and communicate with other students. It also helped her remain calm, happy, and motivated to do more work. Further, the teacher said:

> *"When you see her enjoying the video, you notice that she begins to communicate with other students. They are all together. If they just sit there together in my class, that is a big deal, if they are working together. When she finished with the shapes, you notice how she gets proud of herself. She wants to do five hands. She kissed me; she looked at me and grabbed my hair."*

In summary, the participants reported the use of two forms of AT, an iPad and a laptop. This had an overwhelmingly positive impact on the student's learning and behavior. They believed that AT increased the student's engagement and reduced her bad behavior. However, difficulties emerged in accessing the AT.

4.2. Barriers to Accessing AT

The main barrier identified by the participants was that the school provided insufficient AT, so that the participants had to use their own devices for teaching. The interpreter described her frustration with the school system, saying:

> *"There is one technology, it is called a smart board and the child can touch the board. It is like a laptop. It is wonderful. However, our school does not have that yet. All the other schools have smart boards, and we do not have one yet. There are not enough iPads for each student, so we have to share the iPad."*

The teacher brought her own iPad and downloaded applications to support her students' learning. She said:

> *"Then with the iPad, we do not have any of it in my room. The school does not provide it. They provide the iPad, but I brought the iPad from home and put the apps [on it] myself. It is expensive to have it. I have to admit we do not have a lot of technology for our students in Akron."*

The teacher also believed that laptops were too advanced for 5-year-old students, stating that:

> *"Because they cannot control the mouse, and I do know that they have them with touch screens, but they just want to keep moving, because they are so little. If they get older it would be different, I am sure. You know, it is hard for a little one to not keep touching all the buttons."*

Both participants reported that the school system was challenging as it did not provide easy access to AT.

4.3. AT Use for Academic Support

The teacher and interpreter both used AT to support the student's learning. First, the teacher provided the student with an iPad and opened an application that contained shapes and puzzles. The student placed every puzzle piece into its correct position. The student knew the shapes of triangles, squares, and rectangles. After the student completed this work, the teacher opened a sign language video. With the aid of the video, the student began to sign and

communicate very well with the teacher, who claimed, "She signs more pumpkin by hands. She signs the song by sign language."

In addition, the interpreter used the iPad for academic support. She allowed the student touch the screen to match numbers or letters. She described her use of AT as follows:

> *"If she touches the word three and the letter, the number three and the three pigs light up and dance. If she does not match the word and the letter three, the pig does not do anything. Therefore, she has to learn that the number three and the word three go hand by hand, and if she does not connect them, nothing happens. Consequently, she learned that if she presses on the word, the pig, and the letters P, I, and G, the picture of the pig starts to dance. Then she uses the laptop to watch video, video called Singing Time."*

4.4. Misunderstandings About Deafness and Autism

During the interviews, one theme emerged that was not considered during the development of the research questions. The theme was whether it is possible to teach sign language to deaf students with autism. As previously noted in the literature review, some scholars have argued that students with autism cannot learn sign language due to difficulties with facial communication.

The teacher reported that people assumed her deaf autistic student was not smart enough to use sign language:

> *"She was in the deaf class with a total of sign language, but because of her autism, they could not get her to do what they wanted her to do. Therefore, I think they just figured out she is not smart! They basically said with her disability of autism, she is so limited. She would not benefit from sign language."*

Both the teacher and interpreter responded to this misunderstanding by arguing that deaf students with autism needed to learn sign language to communicate. The teacher stated:

> *"I am looking at her as more of a deaf child than an autistic child, and they are looking at her as more as an autistic child, not a deaf child. I am giving her the benefit of getting around autistic world. . . . she could communicate with other people, but she needs skills. She is deaf! How is she going to do that if we do not teach her sign language? Why wait until we can prove that she is smart enough to meet it, then we could teach it to her. She could be learning it now, and there is potential with her. People do not realize when I saw her smart. Yeah, she is. She does not have any difficulties with face communication. She looks at me, kisses me."*

The teacher believed that deaf students with autism could learn sign language through observation:

> *"I am just thinking about it logically, and if a hearing child learns to speak, if they learn language from hearing it, then I would assume that a deaf child would learn the language from seeing the sign language, from seeing someone do it all the time. That is how they learn it. And I even*

> *said, we talk to a baby, even [though] a baby can't repeat what we're doing and does not understand what we're saying, but they still learn language in that way and we still talk to a baby. So it makes sense to me, and I said, I am not a deaf teacher, but it just makes sense to me that she is only going to benefit from having another teacher teaching her sign language."*

The interpreter believed the student could see her face and communicate with her through sign language: "She does focus on me with sign language. She is able to understand that we are talking a language that helps her get what she wants. She is realizing her sign language gets her what she wants." Additionally, the interpreter noted,

> *"Sign language just allows her to get her needs [met]. She is able to get what she wants to eat by signing either 'orange' or 'apple.' It is very important, for example, to learn how to use the restroom, to be able to sign 'restroom' in her hands."*

In summary, people have various misunderstandings about teaching sign language to deaf students with autism. They believe that such students have limited abilities because of their communication difficulties. However, the participants asserted that their deaf student with autism could learn sign language and understand its meaning.

4.5. Validity Issues and Limitations

This study used several measures to ensure that the findings were trustworthy. First, the data was gathered from multiple sources—both interviews and observations – thereby providing an accurate account of an extremely significant aspect of the learning environment (Baxter & Jack, 2008). All participants understood the nature of the study. Furthermore, an external expert reviewed all of the interview and observation transcripts for clarity and coding, and several codes that the expert suggested were incorporated. As Creswell and Miller (2000) wrote:

> *"The lens for establishing credibility is someone external to the study . . . is operating because of the close collaboration between the external reviewer and the qualitative researcher. This procedure is best used over time during the process of an entire study. Peer debriefers can provide written feedback to researchers or simply serve as a sounding board for ideas. By seeking the assistance of peer debriefers, researchers add credibility to a study."* (p. 129)

There are several limitations to this study. First, this research involved a student who had comorbid autism and deafness, and because of their special needs, it was very difficult to incorporate their particular view. Second, the study relied on the teacher's observations of the deaf autistic student. Third, the sample size was small and the study was based in one school.

In addition, the validity of the study may have been affected by interviewer bias on the part of the researcher in terms of deaf autistic education and acquiring sign language. As Maxwell (2013) wrote, "Two important threats to the validity of qualitative conclusions are selection of data that fit the researcher theory or

preconceptions and the selection of data that 'stand out' to researcher" (p. 108). To validate the results, when coding the transcribed interviews I included everything that the participants shared with me in the results section, since "Validity in qualitative research is not the result of indifference, but of integrity" (Maxwell, 2013, p. 108).

Another limitation was the reactivity of participants, which may pose issues with the validity of the findings. During observations, I felt that the participants modified their behaviors with the deaf autistic student as they were aware they were being watched and recorded. I also noticed during the interview that the teacher was very new to AT. She said, "I am so new to this, you know, having this technology." I avoided leading questions, which led to a more open dialogue with the teacher, who then seemed to answer the questions more honestly.

Despite the limitations of the study, as Lincoln and Guba (1985) wrote, "By describing a phenomenon in sufficient detail, one can begin to evaluate the extent to which the conclusions drawn are transferable to other times, settings, situations, and people" (p. 306). Therefore, to enable this study to contribute to scientific knowledge, plentiful descriptive information was provided about the participants and the setting. This allows readers to decide how the findings can be applied and transfer the conclusions to other settings.

5. Discussion

This study has helped to provide a better understanding of the perceptions of classroom teachers' and the implementation of AT for deaf students with autism to engage and communicate with sign language. Although there are barriers to using AT, the participants believed that AT provided a window for their deaf autistic student and helped her acquire sign language as a result of using visual content.

There were significant differences between this study's findings and those of previous research. As previously noted in the literature review, researchers have suggested that students with autism are impaired in their recognition of facial information, making them unable to see the teachers' faces when they are signing or to recognize faces when presented with a video about signing (Dawson et al., 2005; Klin et al., 2002; Schultz et al., 2003). Participants in the current study indicated that their student could learn sign language and understand its meaning, thereby contradicting previous research.

Future research should focus on how teachers can make professional use of AT and determine the best methods and strategies for working with deaf autistic students. Moreover, future studies could also examine other interventional strategies to address the needs of their students and improve their sign language skills. Additional research is required to examine special education teachers' knowledge, skills, and experience of teaching deaf autistic students and to identify the extent of their knowledge of sign language. Finally, further research could examine current educational programs for the deaf autistic population in order to help teachers specialize in the field.

This study has shown that storytelling is a crucial of component of qualitative research. Many people in our society need to have their voices heard. Storytelling through research is an extraordinary way to make this happen, especially for teachers or parents of children with disabilities who have a difficult time being heard on their own. Prasetyo (2017) notes that storytelling is part of how humans translate their individual experiences of understanding into a public culturally negotiated form. This study makes an additional and important contribution that is focused on teaching a student with both deafness and autism, a relatively rare combination of disabilities. Stories such as this may help teachers explore what works for their own students.

This study has also shown that sign language and AT may be useful ways for deaf students with autism to develop language skills. One participant pointed out a website called Signed Stories (http://www.signedstories.com/apps) as an example of how AT can be used to teach sign language. Teachers need to integrate AT into their classrooms since AT influences communication development for deaf autistic students and aids their learning progress.

There is very limited research on the use of AT to educate deaf students with autism. This study may help teachers to acknowledge the importance of integrating AT and identifying appropriate technology and software to educate this population.

Acknowledgement
The author would like to thank Deanship of Scientific Research at Majmaah University for Supporting this work under Project Number No. R-2022-327

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Appendix 1

Interview Questions

A) Group A for question one:
Do students at your school have access to assistive technology?
Do you believe that technology can help those with both autism and deafness?
What technology does the student use (computer, laptop, iPad, etc.)?
What applications does the student enjoy using (video, Facebook, learning apps, etc.), and is there any technology or software used in the school?

B) Group B for question two:
How does your student communicate with you?
Do you agree that the student needs to learn sign language? And why/how?
Do you agree that assistive technology enables your student to be able to learn sign language so that she can communicate with you? Please explain why.

C) Group C for question three:
Could you please explain your student's behavior?
How is your student performing?
Does AT help to reduce the bad behavior of your student, and how?