Using context clues to teach homographs to d/Deaf and Hard of Hearing students in Saudi Arabia

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Teaching a homograph by using context clues is more effective than just teaching vocabulary separately. The goal of the study reported on here was to teach 12 homographs to d/Deaf and Hard of Hearing (d/Dhh) students in the sixth grade by applying metacognitive skills to understand the meanings and contexts in sentences. A single case design (multiple probe design across subjects) was employed to achieve the goal of this study with 2 profoundly deaf students in the sixth grade. From baseline to follow-up, the study was completed in 4 weeks. The results show that d/Dhh students encountered challenges in their understanding of the meanings through context.

Keywords: deaf and hard of hearing students; homographic words; metacognitive skills; reading comprehension

Introduction
A substantial body of research has shown that d/Dhh students have extremely low reading achievement (Alqraini & Paul, 2020). According to numerous studies, the average d/Dhh student graduates from high school with the reading skills equivalent to those of a fourth-grader. To make matters worse, some of them leave school with reading skills equivalent to or worse than those of a second-grader (Luckner & Handley, 2008; Paul, 2009). One of the reasons that d/Dhh students face difficulties in their reading skills is their lack of knowledge about words, which creates problems for them in all aspect of language development, including reading and writing (Marschark & Hauser, 2012). For example, the English language contains more than 6,000 homographs (Marschark, Convertino, McEvoy & Masteller, 2004; Marschark & Hauser, 2012; Marschark & Spencer, 2003; Paul & O'Rourke, 1988), and other languages have even more. The majority of d/Dhh students only know the meaning of common words and this lack of knowledge can significantly affect their reading comprehension. If a student cannot understand at least 95% of the words in a text, it undermines their comprehension (Gunning, 2002). Their lack of vocabulary disrupts reading fluency and interferes with comprehension, because inferring or deriving word meanings from their context can constitute as much as 70 to 80% of the ability to understand a text (Pressley, 2002).

"This is a result of limited incidental language learning experiences and exposure to words in context, inadequate use of prior knowledge and metacognitive skills to make meaning when reading, and weak associations between concepts in the mental lexicon" (Rieger, 2016:5). d/Dhh students are more unlikely than their hearing peers to use a metacognitive strategy, such as using background knowledge to provide meaning for unfamiliar words by looking back or rereading text to monitor understanding and detect inappropriate information in a passage (Marschark & Spencer, 2003). Teaching students to comprehend homographs through their context by using metacognitive skills is an effective intervention that increases reading comprehension and should be investigated further (Aceti & Wang, 2010; Dimling, 2010; Jacobson, Lapp & Flood, 2007; Nelson & Stage, 2007; Paul & O'Rourke, 1988; Spencer & Marschark, 2010; Zipke, 2011). Teaching homographs through context by using the metacognitive strategy can be applied by a teacher to any language and any students – deaf, hearing, or those with special needs.

The Goal of the Study and Research Question
The goal of this study was to teach 12 homographs to d/Dhh students in the sixth grade by applying metacognitive skills to understand the meanings and usage in a sentence. To answer the research question, a single-case experimental design (multiple probe design among individuals) was adopted. The research question for this research was: To what extent do profoundly d/Deaf students understand the meanings of homograph vocabulary through context?

Research on Multiple-meaning Words among the Hearing and Deaf
In general, a number of words have multiple meanings (Stahl & Nagy, 2006). Paul and Gustafson (1991) indicate that two-thirds of words in primary school reading material have more than one meaning. Therefore, there is a critical need for developing efficient instruction to enhance the comprehension of commonly occurring multiple-meaning words. To become good readers, it is important to learn several meanings of words (Paul & Gustafson, 1991; Paul & O'Rourke, 1988). For example, while students might be directly taught words' definitions, they also may apply cognitive skills in order to infer the words' meanings in passages. Some empirical research that discusses these techniques is discussed below.

Graves, Slater and Cooke (1980) examined students' knowledge of multiple-meaning words in context, as well as in isolation. There were eight students, from middle to lower-middle economics classes, who attended a public elementary school in the second, fourth and sixth grades. From this group of eight students, four were labelled as low ability students and the other four were labelled high ability students. Graves et al. (1980:3) write that "students in the low ability group scored below the 25ᵗʰ percentile on the reading comprehension subtest of the California Achievement Test (1970), and students in the high ability group scored above the 75ᵗʰ percentile on the same test."

The results reveal that the low ability students showed an extremely poor ability to use context in order to infer the appropriate meaning. They obtained "only 4% more correct responses for words in context than for words in isolation" (Graves et al.,1980:6). The selection of multiple-meaning words was markedly different with regard to ability level and grade. For example, students who were classified as high ability had 75% more correct responses than students who were classified as low ability. Students who were in the fourth grade provided 50% more correct responses than students in second grade. Students in the sixth grade had 35% more correct responses than did students in the fourth grade.

Distinctly, low ability students' skill in selecting multiple-meaning words were extremely delayed compared to that of their counterparts with high ability. The high ability variable was a powerful indicator because students in the second grade who had high abilities scored 95% higher than students with low ability in the sixth grade.

In a later study, Graves (1989) investigated 216 students labelled as high, middle, and lower ability based on their composite reading scores from the Science Research Associates (SRA) achievement series: vocabulary and comprehension in second, fourth, and sixth grades. Graves gathered the data by employing a group test and individual interviews. All of the students were from the Midwest region of the United States of America (USA) and could be identified as middle class (i.e., socioeconomic status [SES]). The group test was a 36-item, multiple-choice test. In the individual interviews, the examiner asked the students to give two meanings of a word in isolation, and then use the words in sentences that would demonstrate the words' correct meanings.

In the group test, half of the students were given a listening task and the other half were given a reading task. The reading task was presented first, and then the listening task was introduced. In the reading task, the examiner read the number of each item and the alternatives to the students (i.e., the various meanings of the words). Students selected the appropriate meaning and marked it in their test booklets. In the listening task, the examiner read the number of each item, the target words being tested, and the alternatives to the students. The students were given time to select the appropriate meaning and mark it in their test booklets.

The results show that the high ability group performed better than the low ability group; students scored higher in the listening task than in the reading task. Interestingly, during the interviews, Graves found that regardless of whether students were high, middle, of lower ability, they identified multiple-meaning words in sentences much better than simply giving the words' definitions in isolation.

Paul (1984) designed a picture vocabulary test to examine 42 d/Deaf students and 42 typical literacy learners' knowledge of multiple-meaning words. The d/Deaf students were recruited from a residential school, and the typical literacy students were recruited from a general education programme in the Midwest region of the USA. The results indicate that the typical literacy students performed significantly better at choosing two meanings of multiple-meaning words than did their d/Deaf counterparts. However, both groups frequently chose primary meanings more than secondary meanings.

Over the course of an 8-week intervention period, Aceti and Wang (2010) investigated the impact of explicit instruction to teach multiple-meaning words within a metacognitively oriented curriculum. The target group was four d/Dhh students of 11 to 13 years who attended a school for d/Dhh students in the Northeast region of the USA. Two participants came from families that had immigrated to the USA, and one participant had a cognitive disability. The main communication mode in the school was Simultaneous Communication. Aceti and Wang (2010) used Paul's instrument, discussed previously; however, each word was presented by three or four pictures. The students were instructed to select two pictures that presented both possible meanings. The intervention had two parts: 1) teach seven multiple-meaning words in isolation and 2) teach students how to infer the appropriate meaning from the sentence by locating the word(s) that guided students to select the appropriate meaning.

The results showed that all of the students had 100% accuracy in selecting the appropriate pictures in a post-test in part one. In part two, students improved their scores by an average of 22% from pre-test to post-test.

Alqraini and Paul (2020) investigated whether using a vocabulary intervention to teach 24 multiple-meaning words to d/Dhh students in the fourth grade would improve their word recognition and comprehension skills. The participants were five d/Dhh students in the fourth grade with profound hearing loss studying in an urban elementary public school in the mainstream setting in Saudi Arabia.

Three of the five were assigned to receive the intervention, while the other two served as a control group and were given only the pre-test and post-test to determine the effectiveness of the vocabulary intervention. The study took 11 weeks to complete, and the results reveal that students who did undergo the intervention improved significantly in the dependent variables (recognition and comprehension of words with multiple meanings). On the other hand, students from the control group showed no improvement on their post-tests.

Reviewing the literature related to multiple-meaning words offered examples and techniques of how multiple-meaning words could be taught and assessed in isolation and in sentences. Clearly, understanding multiple-meaning words is critical in order to increase reading/listening comprehension. Consequently, d/Dhh students need to be explicitly taught multiple-meaning words in isolation and in the context of sentences (Alqraini, 2017).

Research on Metacognition with d/Dhh Students

The amount of literature concentrating on metacognition with d/Dhh individuals is limited. Strassman (1997) has conducted a systematic review of metacognition and concluded that deaf students were not involved in high-level metacognitive activities. This might indicate that teachers of the deaf or the curricula do not encourage the development of metacognitive activities, and thus these activities remain at a low level. Strassman also concludes that metacognitive skills could be improved when meaningful and purposeful instruction is employed. Al-Hilawani (2001) investigated the differences in metacognition between hearing and d/Dhh students. He found that d/Dhh students showed no significant differences.

Benedict, Rivera and Antia (2015:12) examined the use of a metacognitive strategy with d/Dhh students by employing a single-case experimental design. Their study revealed that "d/Dhh students as young as 9 and 10 years were able to learn a metacognitive strategy that enabled them to monitor their understanding of content-area text and resolve problems with comprehension."

Based on this literature review regarding metacognition, we can confidently conclude that d/Dhh students can learn in the same manner as hearing students when appropriate instruction meets their needs meaningfully and purposefully. However, further research is still needed to examine the most effective methods of instruction.

We can clearly see that deaf students can learn high-level skills when a deaf teacher knows how to communicate with them and is trained effectively in how to teach deaf students better literacy skills. Many developing countries such as South Africa and Saudi Arabia encounter some challenges in teaching deaf students in schools. For example, Parkin (2010) indicates that deaf teachers in South Africa do not know how to communicate with deaf students, which means that they do not know sign language and they lack the qualifications necessary to empower them as teachers in the classrooms for deaf students. Thus, this lack of qualifications will lead to failure in teaching deaf students.

Methodology

Participants and Setting

This study included one teacher, a Saudi man with a master's degree in Deaf education and more than 8 years' teaching experience. He instructed a reading class for d/Dhh students in the sixth grade with severe hearing loss (see demographics in Table 1).

All participants had profound hearing loss even in their better ear. Students studied in self-contained classrooms and had delayed vocabulary knowledge based on this researcher's word list pre-test. One student was the only deaf member of a family and another one had a deaf brother. These students were from middle-class families who spoke Arabic as their native tongue. There were no amplification devices (hearing aids) used by any of the students, and their medical records revealed no additional disabilities.

The study was conducted in an urban area elementary public school in Riyadh, the capital of Saudi Arabia. Total or simultaneous communications were the mandated approaches used in this school.

Table 1 Demographics for d/Dhh participants receiving the intervention

Participants	Ages	Hearing loss	Age at identification	Amplification	Age at receiving amplification
A	10 years, 3 months	Bilateral profound	Birth	Hearing aids	Not used
B	12 years, 4 months	Bilateral profound	Birth	Hearing aids	Not used

Research Design

The multiple probe design for all participants was used to measure the dependent variables. This is the most commonly used experimental design for evaluating an intervention's effectiveness, as it allows researchers to examine the impact of an independent variable through multiple settings, behaviour, and participants without having to withdraw the treatment variable. This allows the researcher to verify that any improvement is actually the result of the application of the treatment (Cooper, Heron & Heward, 2007). Therefore, in this study, the multiple probe across participants was used because skills learned by the participants cannot be withdrawn.

Independent Variable

A vocabulary intervention involving direct teaching regarding targeted words via a word web map was the independent variable. Direct vocabulary instruction was best for students with weak or delayed reading skills, such as some of the d/Dhh students, in terms of developing vocabulary knowledge. Direct vocabulary education benefits even proficient readers, as it aids in the comprehension of some complex terms (Trezek, Wang & Paul, 2010).

Dependent Variables

The dependent variable supports the comprehension of homograph words through context. The teacher showed the students two sentences and each sentence had a blank space and four words were given below the sentence. Students had to select the right word for each sentence. Each student was only given *full* credit (2 points) after he/she had selected the correct words. A student was given *partial* credit (1 point) after he/she had selected the right word. *Incorrect* credit was given (0 points) when a student was unable to select to the correct words or claimed that he/she did not know or gave no response.

Procedures for the Intervention

Each baseline, intervention, and follow-up session was conducted according to these guidelines. Prior to an intervention, at least three probes were conducted during the baseline. Student A stayed at the baseline level three times before the intervention and then received the intervention, whereas student B stayed four times before the intervention started.

The baseline teacher tested students on 12 homographs words, which were used as the targets for the intervention. The teacher used a vocabulary picture test that was designed by Alqraini (2017). During this intervention phase, the teacher provided instructions that had to be used systematically. Each intervention session had three components completed in sequential order:

1) Opening
- Gain students' attention
- State the purpose of the lesson
- Discuss the importance of the target words
- Review the last session of learned words (as applicable)

2) Modelling
- The teacher used a word map (see Figure 1) to teach target words systematically.
- *First step.* The target word was written in the centre of the board and the teacher explained that it had two meanings.
- *Second step.* The teacher displayed the first image that corresponded to one of the target word's meanings before signing that meaning. The first meaning of the word was discussed, and the second meaning was described in the same way.
- *Third step.* The teacher used the target word for the first and second meanings in sentences in order to help the student to understand the meaning thorough context (see Appendix A).
- *Fourth step.* The teacher spent more time teaching students how to know the meaning in sentences by determining keyword(s), looking at the context, and using a metacognitive strategy: making a prediction and utilising prior knowledge.

3) Closing
   The teacher reviewed what was learned.
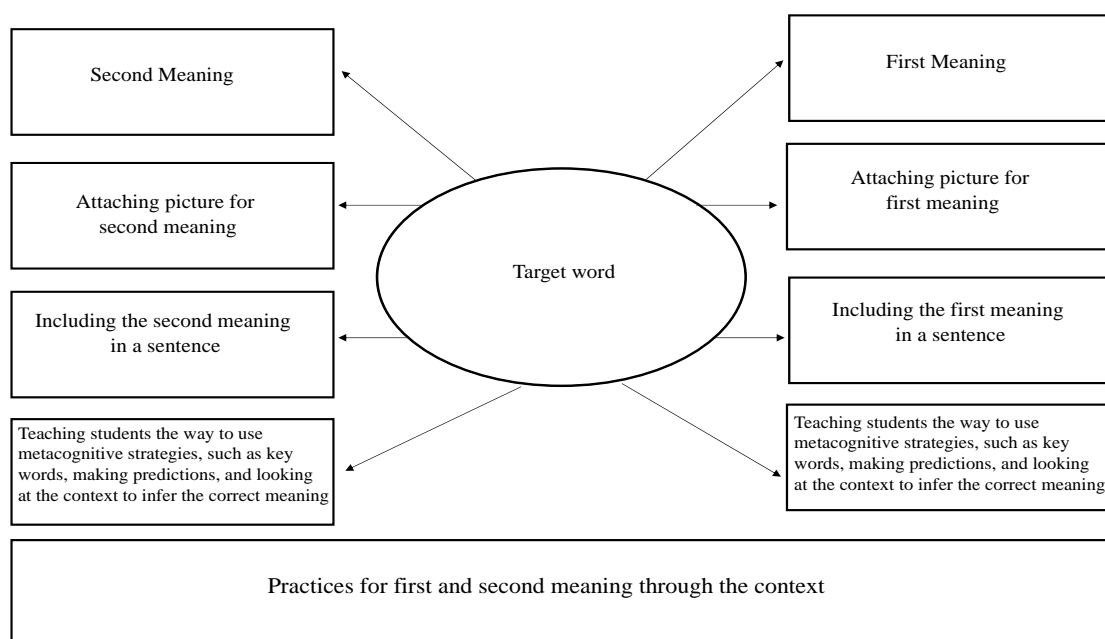
Figure 1 An example of a word map

Treatment Integrity

Direct observations of recorded intervention sessions were used to collect treatment fidelity for at least 35% of each student's two intervention sessions. To verify the correctness and delivery of the intervention components, I collected data using a treatment integrity checklist and shared it with the teacher. The teacher followed the directions to conduct the intervention in a systematic manner. Treatment integrity was determined by calculating the mean percentage of intervention sessions. The overall percentage for all students was 92% after six sessions.

Inter-rater Agreement

Data on inter-observer agreement (IOA) were gathered on homographs throughout the study, and the classroom teacher was instructed to assess students throughout the baseline, intervention, and follow-up sessions (see Table 2). The teacher was taught how to assess students solely on homographs through context during the baseline sessions. I also taught the teacher how to measure students' homograph knowledge using context during the intervention and follow-up.

To compute the inter-rater agreement, the teacher and I independently and concurrently recorded the students' responses to the questions for at least 20% of the baseline, 35% of the intervention, and 10% of the follow-up sessions. Using the point-by-point agreement approach, the inter-rater agreement was determined independently for homographs and students' understanding of homographs in isolation and in context (Kazdin, 2011).

Table 2 Inter-rater agreement percentages for baseline, intervention, and follow-up phases

	Student A	Student B	Across students
Phase	CH	CH	CH
Baseline	80%	100%	90%
Intervention	90%	100%	95%
Follow-up	100%	100%	100%

Note. CH indicates comprehension of homographs through context.

Data Analysis

In this study I used a multiple probe design across participants and examined the effectiveness of homographic interventions on teaching 12 homographs through context to students in the sixth grade. The single case design was suitable for assessing the effects of interventions on low-incidence groups such as d/Dhh students (Alqraini, 2017; Kratochwill, Hitchcock, Horner, Levin, Odom, Rindskopf & Shadish, 2010). Through a multiple probe design I assessed the effectiveness of the intervention. In this design, the intervention was not withdrawn; thus, it was appropriate for teaching academic skills such as learning to read (Kazdin, 2011). Students were methodically introduced to the intervention over different time periods. The repeated measurements of the dependent variable showed a causal relationship between the dependent and the independent variables. Each participant acted as his/her own control. A student's performance before the intervention was compared to achievement during and/or after the intervention (Horner, Carr, Halle, McGee, Odom & Wolery, 2005). I then used individual data analysis to show the effectiveness of the intervention.

Results

Comprehension of Homographs over the Context

Figure 2 displays the results of the vocabulary intervention on students' comprehension of homographs used in sentences during the baseline, intervention, and follow-up phases (see Figure 2). The specific research question was: Is it efficient to use direct vocabulary instruction by applying metacognitive skills to understand homographs through context?

The mean and range were reported, but the percentage of nonoverlapping data (PND) could be obtained. Due to the lack of data obtained in the baseline phase, the PND scores could not be calculated (Olive & Smith, 2005). If this was possible, they would automatically be 0% regardless of data points that obtained zeros in the intervention (Alqraini, 2017; Olive & Franco, 2008) in terms of comprehension of the homographs during the baseline and intervention phases.

Student A

At the baseline phase, student A was tested three times. The mean of her homograph understanding during that period was $M = 0.00$. Prior to the intervention, the baseline data were mostly steady and unchanging. During baseline the percentage of correct homographs word scores was 0.0 % (range = 0.0).

During the intervention, homograph comprehension increased quickly ($M = 2$) and ranged from 8% to 33% (range = 3). The last three data points in the baseline phase were 0.0 %, but the first three data points in the intervention phase ranged from 8% to 16 % to measure the immediacy of the effect. The intervention and baseline data did not overlap in any way.

Student A correctly understood 33% of the 12 homographs at the end of the intervention. Student A grasped correctly 0.0 % of the time during the follow-up phase, one week after the intervention, in both sessions one and two.

Student B

Student B's performance was assessed four times during baseline. The mean of his performance was $M = 0.00$. Before the intervention the baseline data

were essentially constant and invariant. During baseline, there was a 0.0% (range = 0) correct recognition of homographs. Student B's homographic scores did not instantly improve ($M = 2.1$) during the intervention. During the intervention, the percentage of homographs accurately recognised ranged from 0% to 33% (range = 4). The first three data points during the intervention varied from 0.0%

to 25%, whereas the last three data points during baseline were 0.0%. There was a similarity between the intervention and baseline data. Student B correctly comprehended 33% of the target words at the conclusion of the intervention. Student B scored 0.0% comprehension in both sessions (see Figure 2) during follow-up in 1 week and again 1 week later.
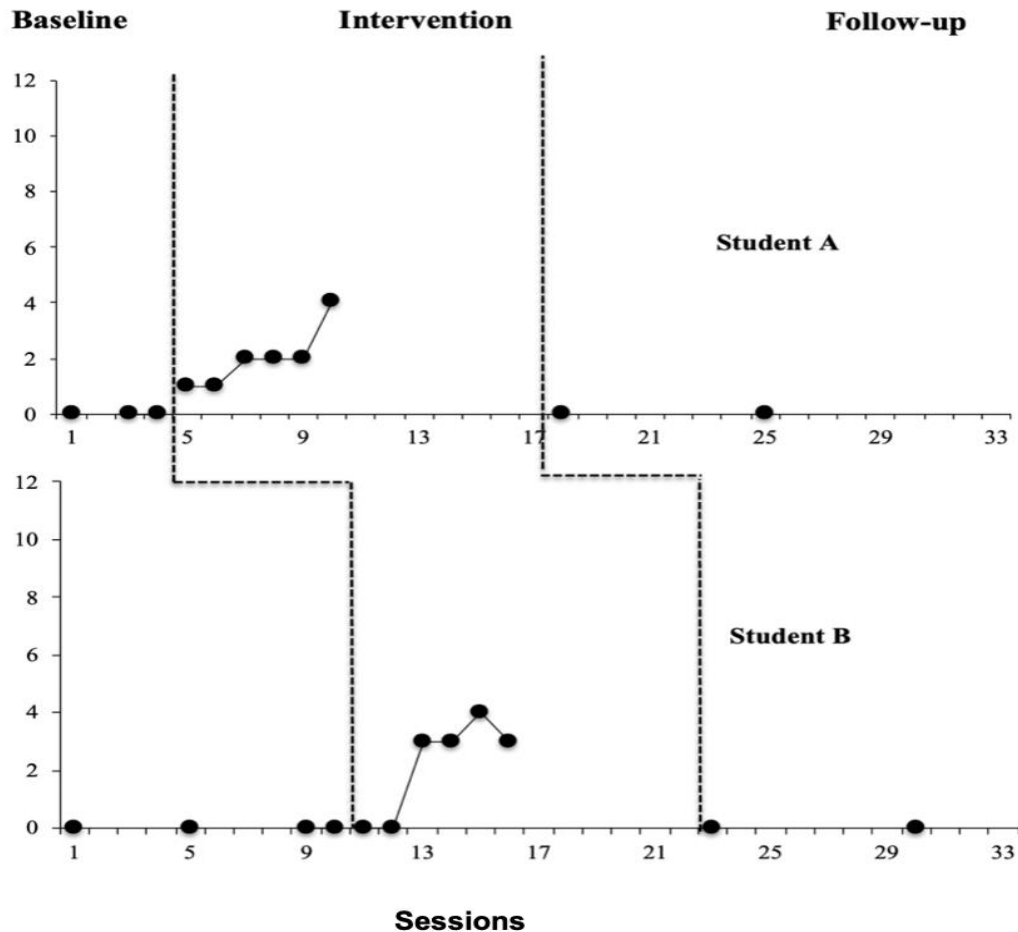
Figure 2 Results in participants' comprehension of homographs in sentences

Social Validity
The teacher interviewed participants about their perceptions of the intervention as well as their level of acceptance of the intervention and its outcomes. The data show that all participants strongly liked the intervention.

Discussion of Findings
The study empirically assessed whether direct vocabulary instruction by applying metacognitive skills to understand homographs in insolation and through context would have an effect on d/Dhh students in the sixth grade. Our primary research question was:

- To what extent do profoundly d/Deaf students understand the meanings of homograph vocabulary through context?
  We addressed this question using a multiple probe across participants single-case experimental design. A functional relation was not significantly found with understanding homographs through contexts for many reasons.

The data reveal that students A and B, in comprehending homographs through context, showed that they were able to understand meanings – but at a slow speed. None of the participants exceeded 33%. They faced difficulties in understanding homographs through context. During the follow-up phases, they did not provide any

correct answers. One reason that the intervention was not completely successful for students A and B was that the teacher did not use this strategy with these d/Dhh students in his class. All he did was focus on lower-order thinking skills during the reading session. Thus, using a metacognitive strategy in reading was considered a new strategy.

As for to the weakness in teacher preparation programmes in many developing countries, Parkin (2010:491) indicates that South Africa "is seriously lacking in its support, inspection, and control of teachers of the Deaf in different aspects, such as curriculum implementation, teaching methodology, and qualification requirements; many teachers enter the classroom for Deaf learners with little or no experience with deafness nor are they required to have any." No doubt, this lack of support in many countries negatively affects the students' educational outcomes (Magongwa, 2010).

Some studies found that d/Dhh students can learn to use metacognitive strategies in reading. Strassman (1997) conducted a systematic review on metacognition, concluding that deaf students were not involved in high-level metacognition activities. This might indicate that teachers of the Deaf or the curricula do not encourage the development of metacognition activities, and thus activities remain at a low level. Strassman also concluded that metacognitive skills could be improved when meaningful and purposeful instruction was employed. Al-Hilawani, (2001) also investigated differences in metacognition between hearing and d/Dhh students. He found that d/Dhh students showed no significant differences. Moreover, Benedict et al. (2015:2) examined the use of a metacognitive strategy with d/Dhh students by employing a single-case experimental design. The study revealed that "d/Dhh students as young as 9 and 10 years were able to learn a metacognitive strategy that enabled them to monitor their understanding of content-area text and resolve problems with comprehension."

However, some studies found the opposite results. Graves et al. (1980) examined students' knowledge of homographs in context, as well as in isolation. There were eight students from middle to lower-middle economic classes who attended a public elementary school in grades 2, 4, and 6. From this group, four were labelled as low ability students and four were labelled as high ability students. The results reveal that the low ability students showed extremely poor ability to use context in order to infer the appropriate meaning. Additionally, Aceti and Wang (2010) examined the effects of explicit instruction in teaching multiple-meaning words within a metacognitively based curriculum over an 8-week intervention period. The target group was four d/Dhh students ages of 11 to 13 years who attended a school for d/Dhh students in the Northeast region of the USA. The results show that all of the students had 100% accuracy in selecting the appropriate pictures in a post-test in part one. In part two, students improved their scores by an average of 22.5% points from pre-test to post-test.

In terms of the rate of vocabulary acquisition by deaf children, several longitudinal case studies have documented this rate among deaf and hard of hearing children in hearing families. The results of these studies vary. For example, in Ertmer and Mellon's (2001) longitudinal case study, the researchers spent 1 year observing the vocabulary growth rate of a deaf toddler who received a cochlear implant at the age of 20 months. The results indicated that the child learned almost 90 words after having the implant for a year, indicating a learning rate of one to two words per week. Ouellet, Le Normand and Cohen's (2001) longitudinal study included 18 months of observations of five deaf children who received cochlear implants at ages ranging from 1 to 4 years. The results reveal that two children with severe hearing loss showed no signs of improvement during the 18-month period, while the other three (no degree of hearing loss was reported) improved steadily. Gregory and Mogford (1981) studied eight orally trained deaf and hard of hearing children between the ages of 15 and 18 months. Two deaf children (with profound hearing loss) had not learned even 10 words by age 4. The other six children who had less than profound hearing loss learned more than 10 words before they were 4. Students in the study reported on here learned approximately two to six words per week, more than that documented in previous longitudinal case studies.

Limitations

This study had number of limitations: small sample size (*n = 2*) and intervention length. Single-case experimental design is appropriate for a small sample size, but the results cannot be generalised due to the small number of participants. The intervention was short (six sessions), and at each session students were taught two homographs. Students A and B, during the second session, did exceed 33% of what was taught. Future researchers may want to try teaching the intervention for a semester (15 weeks) to assess how students grow over time. To resolve these limitations, future researchers should replicate this work.

Conclusion

d/Dhh students in this study experienced difficulties in comprehending homographs through context. Understanding word meanings through context are critical for reading comprehension. The data reveal that the d/Dhh students could learn the same as their typical hearing peers, but they needed much more time and had to make a greater effort. Students' progress was similar to that found with the Qualitative Similarity Hypothesis (QSH), which

hypothesises that the acquisition of literacy skills by d/Dhh is qualitatively similar to that of those with typical hearing. However, quantitatively, this acquisition is delayed to the level of someone learning English as a foreign language (Alqraini, 2018; Paul, 2010).

Acknowledgement

Notes

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Appendix A

Directions: Circle the word that best completes BOTH sentences.

د	ج	ب	أ	الجملة
D	C	B	A	Sentence
نام	قص	يأكل	يلعب	١. ـــــ المعلم القصة للطلاب.
Sleep	Cut	Eat	Play	٢. ـــــ أحمد الورقة.
				1) … a teacher a story for students.
				2) … Ahmed a paper.
الصحراء	غار	السن	العين	١. ذهبنا إلى مكة، وزرنا ـــــ حراء.
Desert	Cave	Tooth	Eye	٢. ـــــ أخي الصغير من أختي.
				1) We went to Makkah to visit … of Hira.
				2) My little brother is … of my sister.