Title	Negotiating languages and modalities: Teaching in a deaf/hearing inclusive classroom
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Abstract

In Singapore, students who are deaf and hard-of-hearing (d/hh), and who use sign language, used to attend special schools. Recently, however, d/hh (signing) students could attend mainstream primary school. This is a new development for the education of d/hh students who require the use of sign language in Singapore. This new phenomena should be looked at closely. It is especially crucial to look into how modality and languages are played out in the classroom. Narrative discourse analysis of one teacher's talk revealed a crucial information gap due to missing visual representation, which may have contributed to students' inaccurate math calculation. Although teachers may be aware of the need to present information visually to d/hh students, the analysis showed that teachers may be unaware of information gaps that arise in one modality and language, when multiple overlapping modalities and languages are used simultaneously. There is a need to help teachers use modality and language lenses to examine their classroom teaching. Future research using in-depth discourse analysis is needed to identify information presented and missing across various modalities and languages.

Introduction

This paper highlights recent developments in deaf education in Singapore for students who are deaf and hard-of-hearing (d/hh), who require sign language. It reveals the unique challenges in the current approach of mainstreaming d/hh (signing) students. It foregrounds the issue of modality and language as crucial in understanding the education of d/hh students who have very limited access to the spoken modality used in mainstream school.

A brief methods section and detailed analysis of interview talk are presented. The analysis reveals a crucial information gap. The importance of attending to visual

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information across modalities is discussed. Finally, future research directions are suggested.

Historically, students who are d/hh have been school apart from hearing peers. In the years leading up to Singapore's independence, the oral approach was taught by the Singapore Branch of the British Red Cross Society, while signing was taught by the Singapore Chinese School of the Deaf (National Archives Singapore, 2021; P. Tay & Ng, 2022). In more recent years, d/hh students at the primary levels with mild hearing loss joined mainstream schools, while those with more profound hearing loss but who could learn to perceive speech could go to Cannosian School for the Hearing Impaired (Ong, 12 February, 2019). Another special school is Lighthouse school for students with sensory impairment (Lighthouse School, 2021). Sign language continued to be offered in the Singapore School for the Deaf, also a special school, until it closed in 2017 due to dwindling numbers of students (Teng, 2017). The low numbers of students requiring sign language could in part be due to medical advances that made it possible for more students to gain speech perception. In Singapore, most of the children who received cochlear implantation were able to perceive speech and attend mainstream school (S. Y. Tay et al., 2019). However, some children continued to be unable to perceive speech despite medical interventions. For example, a study of 70 children who received cochlear implantation in Singapore reported that a few children continued to be unable to perceive speech (S. Y. Tay et al., 2019).

In 2018, elementary education using sign language was made available in a mainstream school for d/hh students who require visual means to access language (Teng, 2018). For Singapore, this is the first time that d/hh students who use sign language enter mainstream school at the elementary level. Previously, mainstream schooling was available for d/hh students at the secondary level (Ministry of Education, 2016), but at the primary level, it was only in a special school that sign language was used. But now d/hh students who required sign language joined hearing peers in a mainstream primary school (Teng, 2016). This is an new development in Singapore and should be looked at closely.

Having a group of d/hh students learning together within a majority hearing environment can have benefits—there is potential to grow a sense of belonging among deaf students while also growing in competence and confidence in their ability to communicate with the hearing world (Xie et al., 2014). However, there are inherent difficulties in communicating across signed and spoken modalities (Singleton et al., 1998). The two modalities and languages used to teach in Singapore's deaf/hearing inclusive classrooms are: Singapore Sign Language (SgSL) and English. The challenge of learning in a "bimodal-bilingual" school that uses signed and spoken modalities is access to the information presented in the other mode, encoded in another language (Priestley et al., 2017, p. 82).

Singapore's inclusive classrooms have specialized teachers who can teach using

sign language who co-teach alongside regular teachers or interpret in the inclusive classroom (Teng, 2018). This provides d/hh students with access to the lesson through SgSL. Although having signed interpretation is important (Easterbrooks, 2008), this may be insufficient especially for d/hh students at the early elementary levels—a time when they may be unfamiliar with both SgSL and English. Many d/hh students have hearing parents who do not sign proficiently, and although the Singapore Association for the Deaf (2018) offers early SgSL exposure and lessons (the "Little hands bilingual-bicultural program") for children below 7 years old, not all parents bring their child to attend the program, or only brought their child irregularly. Furthermore, simply having sign language accommodation in the inclusive classroom may be insufficient when taking into consideration the reality that unimodal sign d/hh students (who require sign language and have little or no access to the spoken modality) do worse than other d/hh students in literacy (Antia et al., 2020; Lederberg et al., 2019).

Method

Phenomenologically-oriented Interviews (Roulston, 2010) were conducted with a teacher who taught in inclusive classrooms. Details on experiences teaching d/hh students were sought. This was a life world interview produced by both interviewer and interviewee (Kvale & Brinkmann, 2009). The teacher was asked to describe what happened in an experience when there was difficulty teaching d/hh students. The meanings, contexts and stories that frame the interviewee's perspectives were important.

Each description of a time when communication had difficulty was identified as a communication event. Each communication event was analyzed as a narrative storyline (Riessman, 2008). Tan's (2021) analytical lens for in-depth discourse analysis was used, which sought to identify both information that was present and that which had been left out. This was done by juxtaposing information that different modalities presented.

Analysis and findings

This analysis is from an excerpt where the teacher described explaining subtraction to a student. It is one of the more detailed narratives, having a step-by-step explanation together with gestures and signs. The interview excerpt is provided in the appendix.

The analysis of this excerpt is presented in a table comparing the information provided in signed SgSL and spoken English, together with concrete visual representation of the numbers shown on the fingers. The juxtaposition of these three modes reveal when an information gap happens.

The teacher began the narrative event by noting a problem: d/hh students subtracting eight from fifteen often make the mistake of subtracting only five from fifteen, and

forgetting to subtract the last three. The teacher then retold the incident, performing the scenario of teaching the concept. As the teaching account is described, the teacher also acted out what was shown to the d/hh student. Table 1 (see appendix A) is the verbatim account of the explanation, laid out in columns to show what information was presented in which language and modality: in SgSL (signed), English (spoken), as well as in the concrete representation of numbers shown on each hand. Rows lay out the information presented simultaneously across the various languages/modalities. (The full transcript is provided in appendix B.)

In Table 1, the "Right Hand" column begins with a concrete visual representation (three fingers) but the rest of this column is empty. This shows that the concrete representation of "three" by the teacher's right hand goes missing after a brief appearance at the start of the explanation on subtraction. For the rest of the explanation, the right hand is used for sign language interpretation of the spoken English explanation.

Without this visual representation, it is possible that students lacked the placeholder needed to help them visualize and think through the calculation steps accurately. This gap in the visual information presented and the corresponding gap in students' calculation procedure could have contributed to the inaccurate calculation. ("Because what happens usually is that they will take away five and after that they stop there. They forgot about the three." [Appendix B, Transcript, Turn 7]).

This gap in the visual presentation of one important part of the calculation procedure was raised in the interview see Appendix B, Transcript, Turns 2, 6, 8, 12). However, the gap was not addressed; it is the studennts who "just have to remember that eight is five and three" (Appendix B, Transcript, Turn 13).

Discussion

Through a detailed comparison of information presented across modalities, gaps in the information presented can be made visible (Tan, 2021). This analysis showed that crucial visual representation of a quantity needed during the calculation process had "disappeared," and this could be mapped on to the same gap appearing in students' calculation procedure. Gaps in information presented visually means that d/hh students are not only getting less information than hearing students (Tevenal & Villanueva, 2009); they are also missing crucial parts of computational thinking.

Furthermore, although the gap was raised by the interviewer, the response could indicate a possible lack of awareness about when and where crucial gaps arise from missing visual representations. The gap revealed in this analysis suggests that teachers may lack a modality and language lens from which to examine their communication with d/hh students. A modality and language lens is necessary to help them evaluate and improve on their use of visual representations in class. Indeed, knowledge and skills in using visual tools to develop deep understanding is necessary for teachers of d/hh

students (Easterbrooks, 2008). This should be provided as on-going teacher professional development, so that teachers become able to perceive the specific information that d/hh students are accessing.

Future research should examine multiple narratives in teachers' descriptions to understand information gaps that arise from the ways that modality and language are used. Analysis of in-situ classroom talk is also important to clarify how information is being presented to d/hh students, and how d/hh students are working with the multiple modalities and languages in the inclusive classroom.

Conclusion

Singapore's new educational development of having d/hh (signing) students in mainstream school, can be seen as similar to implementing novel pedagogical innovations. Looking closely at the implementation, process and outcomes at the micro-level of the classroom is crucial because enactment can appear very different than what was initially conceptualized (Tan & Hung, 2020). Just because a "placement" view of inclusion has been fulfilled does not mean that specific students' needs have been met (Göransson, & Nilholm, 2014) sufficiently for their success in mainstream school. Fulfilling and ideology of inclusion does not automatically mean that d/hh (signing) students will succeed in mainstream school. Therefore, it is necessary to take a close look at the actual discourse being produced, the interplay between the modalities and languages, to have a clearer idea of what is taking place, so as to improve d/hh students' learning experiences in inclusive classrooms.

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Appendix A

Table 1

Signed SgSL	Concrete representation of quantity		Spoken English
	Right hand	Left hand	
	Right hand three fingers extended.	Left hand five fingers extended.	What they need to know is that eight is, on the fingers will be five and three Because what happens usually is that they will take away five and after that they stop there. They forgot about the three
Right hand shows signs "ten" beside and above ear		left hand shows five fingers extended.	So it's fifteen in the head.
	right hand three fingers extended	left hand five fingers extended	Take away eight
Right hand signs symbol for the numbers: fourteen, thirteen, twelve, eleven, ten.		Left hand brings each finger digit in, showing five, then four, then three, then two, then one and none.	(speaks slowly following each signed number) Fourteen. Thirteen. Twelve. Eleven. Ten.
Right hand signs symbols for nine, eight, seven			Nine. Eight. Seven.
			so fifteen take away eight is seven.

Appendix B

Transcription Excerpt of Participant interview

Notes on transcription:
- Conversation turns are numbered.
- "T" is the teacher and "I" is the interviewer.
- Additional information, and the description of gestures and signs, are provided in square brackets.
- Stressed words are underlined.

Transcript

1. T: for example, teaching of the concept of subtraction. You have to present in a very pictorial form. When you have a , rename, say five, it becomes fifteen. So fifteen take away eight.
So remember. remember fifteen in your head. [Signs "ten" in right hand, shows five fingers in left hand.] You take away eight. What is eight? Eight is five and three. So fifteen take away eight.
So they will have to, I would demonstrate to them. Okay that's fifteen, fourteen, thirteen twelve eleven, ten. Um, nine, eight seven. [Signs numbers on right hand] So. I even have to teach them how to count using, count, count that way.
2. I: how, how do you do that? Because just now when you were showing the counting, right, you were showing signs of the numbers.
3. T: Mm [showing affirmative]. Right.
4. I; So a lot of times, when people are doing that, they will count down using their digits as the, you know, number pieces. Rather than as symbolic
5. T: Yep
6. I: So how do you do that when you are using your hands as symbols. Because the kid will be doing this right? [Shows eight fingers and bring each finger in, one by one.] But you are showing symbols of the sign. How does that
7. T: Okay, hearing children would count using their fingers. But then HL [students with hearing loss], for example, fifteen minus eight. What they need to know is that eight is, on the fingers will be five and three. [Shows left hand flat with five fingers extended, and right hand with three fingers extended.] To know that. Because what happens usually is that they will take away five and after that they stop there. They forgot about the three.
So it's fifteen in the head. [Signs "ten," with right hand positioned beside and above right ear. Left hand shows five extended fingers.] Take away eight. [Shows left hand five fingers extended, and right hand three fingers extended.] Furteen, thirteen, twelve, eleven, ten, nine, eight, seven. [Speaks slowly, with a pause between numbers. Shows

each sign for the number.] So fifteen take away eight is seven.

8. I: so what I'm understanding from you is that hearing children will see it concretely happening in front of them. But hearing loss children, they have to hold two sets of visuals in their head

9. T: Yeah

10. I: one is the symbolic. And one is the concrete

11. T: Yep

12. I: So at first you showed them five and three. That's the concrete. [Interviewer has right hand with five fingers extended, left hand with three.This set of numbers is positioned off-centre, to the interviewer's right.] Then your hand will disappear, right? They have to

13. T: They just have to remember that eight is five and three

14. I: and then you show them the symbolic, what's happening

15. T: Right

16. I: Wow. Okay.

17. T: and when they are not, when they; so it is very important that they understand when it is six, it is six (sic. Should be five?) and one. Seven is five and two. Even that, sometimes they will forget about this [shows digits on other hand] and they stopped at just five. Yeah. And that's where they get wrong answers. So these are additional that, as a co-teacher, the skills that I have to build up.