A Case Study on the Effective Use of Applications in Class for Deaf and Hard-of Hearing Students

Miki Namatame [*]

Abstract

Recently, the main theme of information support for deaf and hard-of-hearing (DHH) students has been real-time speech-to-text systems based on voice recognition during lecture-style classes. In an educational setting, we focus on communication support during practical classes, rather than on information support during lectures. This paper reports on practical attempts to utilize the SwipeTalk user interface in the educational field. Specifically, we report on communication support between DHH students, and between teachers and DHH students during practical drawing classes. These classes were held both online and in the classroom. DHH students communicate in a variety of ways in these classes, including via sign language and oral communication using residual hearing. The practical classes using the application enabled smooth communication between deaf students who do not use spoken-language and hard-of-hearing students who cannot use sign-language. Communication activities including drawing letters, illustrations, and symbols were accepted by the DHH students and had positive impacts on their classroom learning.

Keywords: Drawing communication, Classroom, Artwork, DHH, SwipeTalk.

1   Introduction

In higher education, deaf and hard-of-hearing (DHH) students demonstrate better performance and comprehension when captioning services are used in lectures [1]. Recent advances in voice recognition technology have led to the practical application of real-time speech-to-text systems in lectures [2]. Mainly implemented in lectures, these systems have demonstrated their effectiveness in the field of education for DHH students who are relatively proficient in reading and writing English, especially in speechreading [3]. However, Berge (2016) pointed out the impediments to visual access in interpreter-mediated learning situations [4]. This problem may also apply to real-time speech-to-text services where students cannot access the text of teacher's utterances along with other visual information (the teacher's gestures) simultaneously, since DHH students can focus visually on only one source at a time. Previous studies indicate that practical classes require captioning services which do not inhibit interaction, rely on DHH literacy skills, or diffuse visual attention.

Therefore, we tried using SwipeTalk in an art drawing class. This application is equipped with the SwipeTalk user interface for tablets and smartphones based on voice recognition and translation technology [5]. Common real-time speech-to-text systems display the results of voice recognition in a designated space. However, this interface converts spoken words into letters and

[*] Tsukuba University of Technology, Ibaraki, Japan

displays them along the path traced by a finger as if you were drawing a picture anywhere you like. They can be combined with pictures, illustrations, and images to create comprehensible expressions that do not rely solely on text, consequently rendering this form of communication less dependent on reading and writing skills. Typically, real-time speech-to-text systems predominantly focus on auditory communication. This application, in contrast, allows users to choose between spoken and keyboard inputs, making it usable for non-speaking users as well. Thus, both DHH and hearing people can use this app even if they do not use spoken or sign language.
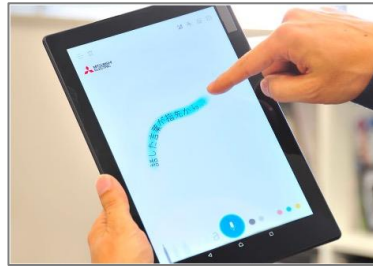

Figure 1: Snapshot of the SwipeTalk user interface

2   Study Objective

This paper reports on the practical attempts to utilize SwipeTalk in the educational field. Specifically, we report on communication support among DHH students and between teachers and DHH students during practical classes. The objectives of this study are to: 1) ensure that class interactions were active; 2) determine whether the communication activity is acceptable to DHH students; and 3) identify problems in the application usage.

3   Classroom Experiment

3.1 Overview of Artwork Class

An evaluative experiment was conducted as part of the Basic Drawing Techniques course.[1] This course comprised a mixture of online and face-to-face classes.[2] The participants included three deaf students who did not use spoken-language, three hard-of-hearing students who could not use sign-language, and three DHH students who communicated using a combination of sign language and speech. To reduce the risk of COVID-19 infection, the teacher wore a mask in the classroom. Furthermore, the subjects for drawing had to be placed at a distance so that students did not face each other. These learning conditions were a disadvantage for DHH students who use visual communication.

Figure 2 is a snapshot of the classroom, with the equipment arranged around the teaching table. From left to right are a faculty PC used for online conferencing and lecture presentations, a tablet PC with applications for communicating with students,[3] and a webcam for streaming the

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[1] This is an elective first semester course for first-year students in the Department of Synthetic Design at Tsukuba University of Technology.

[2] Two students participated online, while seven were present in the classroom.

[3] The teacher used the application for personal coaching, depending on the situation.

class online. Tablet devices equipped with the app were delivered to students from the fourth week onwards, and students used the application freely, including doodling during breaks in the classroom.

Figure 2: Snapshot of the classroom and equipment arrangement around the teaching table

3.2   Class Activities Using the App

The experiment was designed to have three activities: an activity involving a message, the next involving comments, and the last involving presentations.[4] The class consisted of two sessions per week (180 min each with 10 min break) for a total of 15 sessions. The first three sessions were used to educate students on basic drawing techniques and drawing knowledge. In the fourth session, the application was demonstrated, and at the beginning of the fifth class, activities were conducted to share botanical paintings with each other and send cheering messages. For the next four weeks, students worked on still life paintings using transparent watercolors, with two comment-activities every two weeks.[5] The final session was for presentations and the teacher's review. All students prepared their presentations using the app.

3.3   Examples of Student Activities

(a) Activity in which the entire class draws up a message of support: Using the communication function, the whole class sends a message freely to one student (Figure 3a).

(b) Comments passed among students: Each student is given a tablet with a classmate's work; they write their comments and return the tablet to the teacher. The teacher collects all tablets and shares the comments with everyone. This is done to reduce the number of works allocated to one student, and to ensure that students do not know who commented on whose work (Figure 3b).

(c) Presentation: At the final presentation, all the pictures with comments and messages on them are projected on a screen, and the works are arranged on easels to showcase each student's work. Students who have difficulty with sign language make use of points written on the tablet screen (Figure 3c).

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[4] The message activity involved botanical art, the comments and suggestions activity involved still-life-paintings made with transparent watercolors, and the presentations were given in the last session, during which the teacher reviewed the students' work.
[5] For the next four weeks, students worked on still-life-paintings using opaque watercolors. In the 14th session, all artworks had to be completed. During this time, students were free to use the application.

Figure 3: (a) Screenshot of message, (b) Screenshot of comment, (c) Screenshot of presentation

4   Evaluation

A survey was conducted after completion of classes, with nine students participating. The survey was web-based with questions about communication, clarity of instruction, giving and receiving messages, giving and receiving comments, and the use of applications for class and presentations. The results are as follows.

4.1   Communication Activity

Question 1: How did you feel about using the app to communicate with your classmates? The results show that the communication activity was easy, fun, and helped the students in making friends (Figure 4).
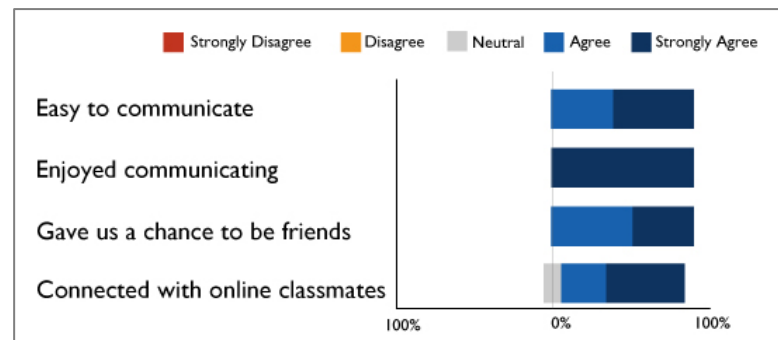

Figure 4: Evaluation of communication with the app

4.2   Clarity of Instruction

Question 2: Was the teacher's instruction easier to understand in the "app-based" or "paper-based" model? The results showed that five students chose both, four students chose the app, and none chose the paper-based instruction.

4.3   Giving and Receiving Messages

Question 3: How did you feel about sending and receiving messages among classmates? The results showed that these brought joy to both the giver and receiver, and about 90% of students felt positive about both activities (Table 1).

Table 1: Evaluation of messaging activity

	Strongly D.	Disagree	Neutral	Agree	Strongly A.
Receiving message					
Made me feel happy	0%	0%	0%	33.3%	66.7%
Made me feel positive	0%	0%	11.1%	11.1%	77.8%
Giving message					
It was enjoyable	0%	0%	0%	33.3%	66.7%
Made me feel positive	0%	11.1%	0%	22.2%	66.7%

4.4 Giving and Receiving Comments and Advice

Question 4: How did you feel about receiving or giving comments and suggestions among classmates? All students stated that the comments and suggestions were specific and helpful and that the application allowed them to receive comments and suggestions without causing stress (Table 2). When it came to writing comments, some students responded that this was a good way to learn; however, one student felt stressed by it. This student gave the following reason for his response: "It was inconvenient that it sometimes stopped or moved incorrectly." We discovered that the source of his stress was that the app would stop functioning when the classroom network was down. This made us realize a drawback of using the app for class, which is that the app does not work without a stable network.

Table 2: Evaluation of comment activity

	Strongly D.	Disagree	Neutral	Agree	Strongly A.
Receiving comments and suggestions					
It was concrete and understandable	0%	0%	0%	33.3%	66.7%
It was helpful	0%	0%	0%	11.1%	88.9%
It was stress free	0%	0%	0%	22.2%	77.8%
Giving comments and suggestions					
Made concrete comments	0%	0%	11.1%	44.4%	44.4%
Learnt a lot	0%	0%	0%	11.1%	88.9%
It was stress free	0%	11.1%	0%	0%	88.9%

4.5 Use in Presentations

Question 5: "How did you like using the application for your presentation? The was answer choices and the responses were: easy (Agree: 3, Strongly A.: 6), enjoyable (Agree: 1, Strongly A.: 8), and satisfactory (Agree: 1, Strongly A.: 8). Both groups of students, those not proficient at sign language and those not proficient at oral communication, were able to confidently present their works to classmates who had different communication methods.

4.6 Free Answers about Using the App in Class

Table 3: Free answers

Student No.	Free answers
Student 1	I really enjoyed the activity of complimenting each other's art works!
Student 2	A good part is being able to draw doodles.
Student 3	A good part is being able to communicate with everyone.
Student 4	I can draw my favorite doodles. It can deepen friendships with each other.
Student 5	I was glad that I had just started college, as I was able to communicate with everyone for the first time through the app.
Student 6	It was fun to draw interesting doodles together.
Student 7	It was fun to see all the different ways to draw the characters.
Student 8	I think it would be good if we could draw doodles together for a change.
Student 9	It was interesting to watch everyone's doodles as they were drawn. Sometimes it stopped or did not move well, so that was inconvenient.

Table 3 shows that five out of nine students mentioned "draw doodles or characters," while two students mentioned "communication." The ratings of feelings were "good"=3, "fun"=2, "enjoy"=1, "glad"=1, "interesting"=1, and "inconvenient"=1. Figure 5 is a conceptual diagram built from the free answers. The squares indicate actions within the app and yellow circles indicate feelings. Five out of nine students mentioned "drawing doodles or watching characters," and two students mentioned "communicating." Communication using doodles in the app led to a positive feeling as a class activity. Interestingly, the keywords "each other," "everyone," "together," and "friendships" were used by almost all the students. It may be inferred from this that activities such as drawing doodles were viewed favorably as a class effort.
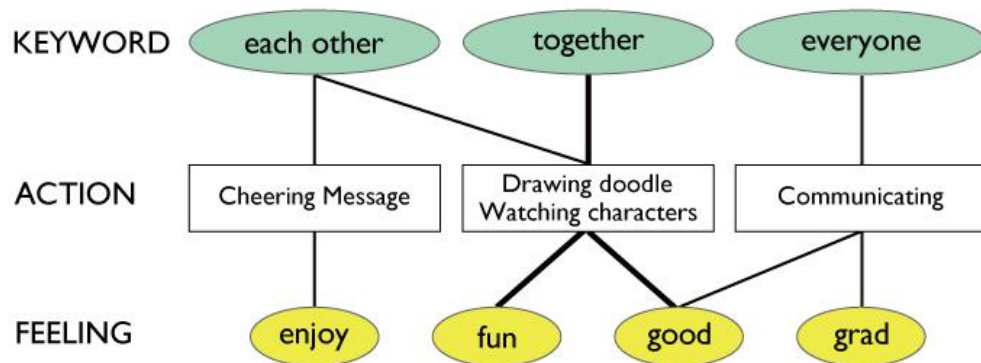

Figure 5: Conceptual diagram of free answers

4.7 Faculty Evaluation

Faculty instruction using the application was rated by students as equal to or better than traditional paper-based communication methods. We believe that for faculty, application-based instruction is superior because it allows for easy and timely instruction.

5 Results and Discussion

The responses to Question 1 demonstrated that using the application in the classroom made communication easy and enjoyable for students and provided them with an opportunity to make friends. The answers to Question 3 confirmed that exchanging messages makes students feel positive. The responses to Question 4 confirmed that receiving comments was helpful as well as educational. Since classmates have different communication methods such as sign language and speech, we believe that utilizing the application facilitated these commenting activities. Answers to Question 5 noted that using the app for presentation activities was easy, enjoyable, and comfortable. The "free answers" indicated that the doodling activity was particularly appreciated, with the words "good," "fun," "enjoy," "glad," and "interesting" appearing frequently. Furthermore, the words "each other," "everyone," "together," and "friendships" indicated that students enjoyed learning together. This means that cooperative learning was possible in a situation where behavior was restricted due to COVID-19 measures, and we believe that this is the result of using the application. Although the application was mostly highly evaluated, some students experienced stress due to network problems.

The greatest advantage of the app is its ability to mix and match text, doodles, and photos. Even though the students were physically separated, they were able to share the same visual

information and specifically point out in real-time what they wanted to pay attention to. The app's usage broke down the barriers to communication, even if the communication methods were different, such as sign language or oral communication. The free communication activity (e.g., draw doodles, send cheering messages) facilitated a good connection between students and made them feel positive. This is something that would be difficult to achieve with the teacher's guidance alone.

6   Conclusion

We used the application for tutoring group work in an artwork class. We implemented the app and validated its effectiveness for messaging, commenting, and presentation activities. DHH students using different languages could participate in the interactive activities together. The students responded positively to utilizing the app for communicative activities. Furthermore, we identified network instability as a problem with using the app in class.

The technology of information assurance for the hearing-impaired is steadily advancing [6] [7], and this study demonstrates that smooth communication between the hearing and hearing-impaired is possible using such innovations. While until now, information assurance research has focused on being accurate and eliminating time lags, future research should also consider the user's enjoyment and the degree of freedom that can be achieved through visual communication. Since this experiment was conducted with only nine participants, we would like to continue our research on this topic at a larger scale and a qualitative analysis.

Acknowledgment

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