Collaborative Writing in the Postsecondary Classroom: Online, In-Person, and Synchronous Group Work with Deaf, Hard-of-Hearing, and Hearing Students

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Abstract

This project investigated the use of alternate methods of classroom interaction and communication to foster collaborative learning in diverse classrooms. Deaf, hard-of-hearing (DHH), and hearing students taking a graduate course in teacher education participated in lab sessions where interactions occurred via articulated speech and/or sign language and text-based chat interactions. The students interacted further using a collaborative tool to co-construct a group document. Results suggest that including this kind of tool in the classroom can significantly increase access to collaborative learning opportunities for students with a variety of special needs. While this study used DHH and hearing students who worked together in groups as the test case, the findings may be applicable to other groups with communication or language difficulties.

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Cooperative group learning is one of the most widely used and effective teaching strategies in the field of education (Felder & Brent, 2007; Johnson, Johnson, & Stanne, 2000; Smith, Sheppard, Johnson, & Johnson, 2005; Springer, Stanne, & Donovan, 1999; Terenzini, Cabrera, Colbeck, Parente, & Bjorklund, 2001). Unfortunately, many students with communication and learning disabilities, as well as students who are English language learners, often face barriers to full participation during group learning opportunities, which results in their being isolated and having lower levels of academic success. This project investigated the use of alternate methods of classroom interaction and communication to foster collaborative learning in diverse classrooms. Deaf, hard-of-hearing (DHH), and hearing students taking a graduate course in teacher education participated in lab sessions where classroom interactions occurred via articulated speech and/or sign language, and text-based chats. They interacted further using a collaborative tool to co-construct a group document. The results suggest that including this kind of tool in the classroom can significantly increase access to collaborative learning opportunities for students with a variety of special needs. While this study used DHH and hearing students who worked together in groups as the test case, the findings may be applicable to other groups with communication or language difficulties.

Today's teachers are challenged by the need to instruct learners who have a variety of skills, languages, and cultural backgrounds. This variety is due in part to the increasing presence of students with disabilities in general education K-12 classrooms (Wolford, Heward, & Alber, 2001), including a large percentage of students who are DHH. For example, in fall 2011, 74% of all students classified as having a hearing impairment and receiving services through the Individuals with Disabilities Education Act (IDEA) spent at least 40% of their school day in a general (not special) class in a regular elementary or secondary school (National Center for Education Statistics, 2015). The proportion of DHH students in mainstream classes at the postsecondary level is even greater (Richardson, Marschark,

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Sarchet, & Sapere, 2010). This study addressed the following question: Does adding online opportunities for collaborative interaction help level the playing field for diverse learners? Findings for groups that included both DHH and hearing students may be applicable to other groups whose members have diverse communication characteristics, such as students with a learning disability.

The current supports available for DHH students are inadequate. These services include frequency-modulated systems, personal hearing devices/hearing aids, sign language interpreting, cued speech and/or oral interpreting, note-taking, and real-time speech-to-text classroom captioning (Hastings et al., 1997; Schick, 2008; Stinson, 2010). Despite this array of services, there is concern about whether DHH students are fully able to participate in classroom instruction and discussion, due to their communication challenges (Garrison, Long, & Stinson, 1994; Saur, Layne, Hurley, & Opton, 1986). DHH students in general education classes on average are able to progress and demonstrate greater academic proficiency than DHH students in other educational settings. However, these students still lag behind their hearing peers on a variety of academic measures (Antia, Jones, Luckner, Kreimeyer, & Reed, 2011; McCain & Antia, 2005; Thoutenhoofd, 2006).

In terms of class participation, DHH students were observed to participate in class less frequently than their hearing peers, and they reported difficulty participating in class (Garrison et al., 1994; Saur, Popp-Stone, & Hurley-Lawrence, 1987; Stinson, Liu, Saur, & Long, 1996). One factor in this difficulty is the rate at which information is presented in the classroom. Since interpreted communication lags behind the original communication, keeping up with the flow of conversation is challenging, and DHH students often respond to questions posed to the class later than expected, or inappropriately (Saur et al., 1986). Moreover, during classroom discussion there is rapid turn-taking and frequent interruptions, and whether a student relies only on oral speechreading or on a combination of that and sign language, it is challenging for them to follow these general classroom interactions (Stinson et al., 1996).

Ease of communication is arguably an important factor in academic success. If it is difficult to participate in the classroom (e.g., due to the speed of presentation and/or turn-taking during discussion), students may adopt a passive nonparticipatory approach, or at least may appear to be passive, which is associated with lower academic achievement (Braeges, Stinson, & Long, 1993). Long, Stinson, and Braeges (1991) found a strong positive relationship between self-reports of ease of communication, academic engagement, and academic achievement, including language, mathematics, and science, as per standard achievement scores (see also Antia, Sabers, & Stinson, 2007).

Given the ongoing unsatisfactory state of education for these students, there is a critical need to find better ways to support them (Stinson & Antia, 1999; Stinson & Kluwin, 2011; Wagner, Newman, Cameto, & Levine, 2006). One particular classroom situation where these students need more effective support that has received little attention is engaging in collaborative activities, such as working in groups. Collaborative work occurs regularly at the elementary, middle school, and secondary levels and often at the postsecondary level as well, such as in a science laboratory (Antil, Jenkins, Wayne, & Vadasy, 1998; Cohen, 2002; Lunetta, Hofstein, & Clough, 2007; Puma, Jones, Rock, & Fernandez, 1993). In addition, learning in the 21st century requires students to collaborate more and more in order to deal with the explosion of digital information (American Management Association, 2013; Anderson-Inman, 2009; Association for Career and Technical Education, National Association of State Directors of Career Technical Education Consortium, & Partnership for 21st Century Skills, 2010).

Collaboration is a strategy that has proven effective in promoting deep, meaningful learning. One example is having an intense discussion while developing a strategy to solve a problem (Cohen, Brody, & Sapon-Shevin, 2012; Esmonde, 2009; Pintrich, Marx, & Boyle, 1993; Shuell, 1996). Successful instructional approaches that include substantial student collaboration include problem-based learning (Herreid, 1994; Markowitz, DuPré, Holt, Shaw-Ree, & Wischnowski, 2006) and process-oriented guided-inquiry learning. In problem-based learning, students work through materials to develop solutions (Herreid, 1994). When these students collaborate, they usually do so in small groups with two to seven members (Cohen, 2002). In process-oriented guided-inquiry learning, students work in self-managed teams of typically three to five learners while the instructor serves as a facilitator. The learning cycle within these groups consists of exploration, concept invention, and application (Hanson, 2006; Moog & Spencer, 2008; Moore, Black, Glackin, Ruppel, & Watson, 2015).

Collaboration is challenging for DHH students, for various reasons. Although these students can use a support service (e.g., an interpreter) to access the comments of hearing class members, issues such as the processing time between when a hearing student finishes talking and when the service provider finishes conveying the message frequently limit the DHH student's participation. Unfortunately, direct commu-

nication between DHH and hearing students is often difficult and makes participation by all members of the group a challenge. For example, observation of mixed groups of DHH and hearing members indicates that, in small groups, hearing members often communicate directly with each other instead of through a service provider (Stinson & Liu, 1999). This makes it difficult for the DHH member because they usually cannot understand all of the spoken communication, while the hearing members may not be able to understand the DHH member's speech and usually do not know the sign language DHH students often use to communicate. Furthermore, an interpreter is often not immediately available (Stinson & Liu, 1999). Therefore, it is important for educators to find better ways to support communication and learning when students with disabilities and other students collaborate.

Marchetti, Foster, Long, and Stinson (2012) have been exploring ways to increase the interaction and participation of groups that include DHH and hearing students in introductory statistics courses, such as requiring the use of whiteboards by small groups while solving statistics problems. They also tried using tablet computers, and thus compared a low-tech and a high-tech solution to promoting communication in the classroom between students with diverse abilities. Both solutions (whiteboards and tablets) ameliorated some of the communication challenges. Both hearing and DHH students said they liked using the whiteboards: "I was able to see others work and understand the concept better related to the topic" (p. 55) and "Using the whiteboard made working in the group a much more open experience, and people were more driven to pay attention and be involved with work" (p. 55).

Learning styles also impact classroom communication and collaboration (Lang, Stinson, Kavanagh, Liu, & Basile, 1999; Lynn, Connelly, Ross, & Schley, 2015). Strictly speaking, "learning styles" are students' preferences (rather than abilities per se) about the type of assignments a course requires, how information is presented, how they think about and process information, and how they prefer to relate to others (Grasha, 1990). The Grasha-Reichmann Student Learning Style Scales (Grasha, 1982; 1996; Riechmann & Grasha, 2010) is a 60-item survey about students' preferences regarding their motivation to think and learn (independent versus dependent), their interactions with peers and instructors (collaborative versus competitive), and their engagement with classroom activities and experiences (avoidant versus participant). Lang et al. (1999) and Lynn et al. (2015) compared postsecondary DHH students' learning styles to those of hearing students. There is some evidence to suggest that students with a participative learning style (e.g., "I am interested in learning things in this course" versus "I study only enough to pass") fare better on measures of using class resources, interest in the course, and course grade (Lang et al., 1999). While learning styles were not the focus of the present study, these different styles of approaching the task of learning in class and in groups could arguably be a factor here. Given the impact communication challenges have on actual participation, DHH students could benefit from increased communicative and participative options.

Components of online and/or blended learning can extend options for interaction about course materials and topics. When comparing students in blended learning courses (i.e., that include both online and in-class components) who are DHH, hearing, and English language learners, Long, Vignare, Rappold, and Mallory (2007) found that DHH students in particular perceived that both the quality and quantity of their interactions with their peers and instructors were greatly improved by including an online component. By including online discussion boards and other online tools, the DHH students had another option for interacting with the course materials, their professor, and other students: using online text. This mitigated some of their classroom communication challenges: They could communicate directly (rather than via an interpreter, for example), and they had time to compose their contributions (rather than being "on the spot" in a classroom). In some important ways, this helped level the playing field in terms of ease of communication between DHH and hearing students.

This study examined collaboration in groups with DHH and hearing members from two perspectives: postsecondary education and teacher training. By working with students enrolled in a special education teacher-training program (i.e., future teachers of DHH students, in either a DHH school or program, or in a regular education program; although arguably this kind of pedagogy would benefit a wide range of students), we hoped to help them become skilled at using effective collaborative learning tools and techniques. We were specifically interested in adding synchronous communication to the classroom using print/text modalities as a medium of instruction in order to increase communication options and opportunities. We added three "lab assignments" to the syllabus, which required students to use in-person conversation, text conversation, and online collaborative documents to research a topic and develop a presentation.

Method

Participants

The participants included 55 students registered in two sections of a course in a DHH education teacher preparation program (for Year 1, 19 students were enrolled; for Year 2, 20 were enrolled in one section, 16 in another). The course, titled Psychology and Sociology of Deaf Students, examined psychological, sociological, and cultural issues in the context of the development of DHH students enrolled in kindergarten through 12th grade. Course objectives included examining the relationship between psychological and sociological theories and practices; generating appropriate applications of theory to practice, including applications regarding learning, cognitive development, and school socialization; identifying and analyzing educational issues and approaches that foster appropriate cognitive, affective, and behavioral development of DHH children; and understanding methodological issues that arise when doing research with DHH people.

Materials and Procedures

Assignments for the course included in-class quizzes on readings, K-12 classroom observations across a variety of DHH educational settings, a written observation report, a series of online assignments (interview summary, article review, presentation outline), class presentations, and three computer lab-based "mini projects," which are the focus of this article. Each collaborative group had three to five students and required them to do a focused assignment using web resources, online collaboration (in print and in person), and a brief presentation to the class at the end of the lab session. While there are many ways to design cooperative learning within a classroom (see Slavin, 2010), we adopted a group investigation approach to develop inquiry, group discussion, shared planning, and shared presentation skills.

Google tools (Google Documents, Google Chat—a text-based chat system in Gmail[1]) were the communication and collaboration forms selected for these assignments. Free Google accounts were available (most students already had one before these lab sessions started), and students for the most part were comfortable with the platform. When we first conducted these lab sessions, video chat was cumbersome on a wireless connection and Google Hangouts did not yet exist. Students were introduced to the collaborative document and text chat features, and they were required to use at least text chatting (Google Chat) and collaborative document construction (Google Documents). Groups could also use ASL signing and/or spoken English as they chose.

The collaborative groups included a mix of DHH and hearing students. Group members changed for each of the three lab assignments. Overall, 46% of the students were DHH (thus, 54% were hearing). About half of the DHH students preferred signing without voice, and about half preferred relying at least in part on the spoken channel. About half of the hearing students were fluent in ASL and about half were newer learners. While hearing status and communication preferences were not controlled within each group, students in each group had a variety of communication preferences and usually a variety of hearing statuses.

Lab sessions. The three lab sessions included the following details, directions, and sample sizes.

Lab 1: Deaf culture lesson. Students were asked to integrate materials and resources on Deaf culture. Each group was assigned a different topical area: famous deaf people, ASL poetry/theater, and deaf artists. Several websites for each topic were distributed to students. Students had to review the topic areas, identify resources to use in teaching, and present curricular ideas and resources with the entire class. This study examined Google Documents for six groups from Year 1 and five groups from Year 2 (an additional group from Year 1 declined informed consent; following IRB protocol we did not ask why). This study analyzed Google Chats from three groups for Year 1 and four groups for Year 2.

Lab 2: Learning, cognition, and teaching web resources. Students were divided into four groups. Each group was given a specific topic about learning, cognition, and teaching, along with a specific website (the four websites were: www.inspiration.com, http://www.strategytools.org, http://readwritethink.org, and http://learnweb.harvard.edu/ALPS; the latter website is no longer active). Each group was charged with reviewing the website, exploring the potential applications to the classroom, and sharing their analysis and review with the class. These websites were selected because they illustrated how principles of cognitive development and learning apply to instructional materials that are used to teach students, and because they provided tools for facilitating active visual learning. These sites are relevant to working with DHH students because they all involve visual approaches to learning, such as mapping ideas, and these students often respond positively to visual instructional materials (Power & Leigh, 2011). This study examined Google Documents for five groups from Year 1 and five groups from Year 2 (an additional group from Year 1 declined informed consent). This study analyzed Google Chats from five groups for Year 1 and four groups for Year 2.

Lab 3: Suggestions for parent resources. Four groups of students tackled a list of seven websites (http://deafchildren.org, http//www.gallaudet.edu/clerc-center/our-resources/for-families.html, http://www.ncbegin.org/, http://www.handsandvoices.org, http://www.nichcy.org/FamiliesAndCommunity/Pages/Default.aspx, http://www.pacer.org/publications/taAlliance.asp, http://infoguides.rit.edu/dsa), and developed a set of topics they deemed of interest to parents of DHH children along with suggestions for these parents. These sites were selected because they contained information that was relevant to issues that teachers of the deaf seemed likely to discuss with parents of DHH children, such as communication methods for DHH children and developing an individualized education program. This study included Google Documents for five groups from Year 1 and seven groups from Year 2 (an additional group from Year 1 declined informed consent). This study analyzed Google Chats from nine groups for Year 1 and two groups for Year 2.

Eight chat sessions that lasted less than five minutes were excluded from the analysis, as they were "mis-starts" and consisted of only a couple of lines, where multiple students in a group had initiated a chat session that was abandoned.

Data Collection

The Google Chat and Google Document sample sizes varied somewhat across the two study years and across the three labs in each year. The primary reason for this was because student groups sometimes started more than one chat session. This usually was due to multiple chats occurring between pairs of students within the groups. The authors made the analytic decision to include all chat sessions in the analyses, since the analytic goals were to see how students used these tools and how much text they created using Google Chat tools. Similarly, student groups occasionally produced more than one Google Document. When this happened, it was because students created one document that included notes for what they wanted to include in the presentation, and a second document was the presentation itself. In these cases, the documents were considered jointly while coding and counted as a "presentation."

For each lab session, students were asked to explore websites on their own for approximately 20 minutes, then to meet as a group and brainstorm ideas, combine information into a presentation document, and present to the entire class. They were encouraged to converse using ASL and/or spoken English, Google Chat, and to use Google Documents to work collaboratively on the presentation document. They were allowed to work with any Google Document format that they liked—word processing, presentation, etc.—thus documents came in different forms and had different formatting and content across all the groups.

All Google Chat sessions were saved by the instructor (by adding an instructor to each chat session, a full copy of the session is saved in Google's mail system), who also saved all Google Documents.

Analyses

This research examined the text-based chat conversations and the shared documents produced by the students.

Google Chat analyses. Text chat sessions were analyzed for how much time students used the utility, how many conversational exchanges were made, the "density" of their sessions (proportion of exchanges divided by time using the utility), and what students discussed during these sessions. Three to four chat sessions occurred during each lab session (depending on how many groups we had designed for each lab: four groups in the first lab session for each section, three groups during the second lab session for each section, and four groups during the third lab session for each section). An example of what they looked like in progress appears in Figure 1 (a screen shot of the faculty member's screen, with four chat groups occurring during the lab session).

Google Document analyses. Google Documents has a variety of options: text, spreadsheets, presentations, forms, and drawing documents. Students co-constructed a document, chose the format, and added elements themselves (text, videos, web links, etc.). For the three lab sessions, these co-constructed documents were analyzed for the following features:

- Whether students included content independent of the assigned websites
- Whether they integrated the different parts of their document
- The format they used
- Length of the documents
- Whether or not they included graphics, web links, and/or videos/video links

One group's co-constructed document is reproduced in Figure 2.

In all cases, descriptive analyses were chosen as appropriate for this study. We also conducted inferential analyses of the amount of talk included in the chat sessions across the two years and the three labs. The data include 27 chat sessions and 33 co-constructed documents.

Results

Chat Sessions

The students and groups varied greatly on how much they used Google Chat. Across the three lab sessions and the two years, some groups used it copiously and some very little. A summary of descriptive statistics across both years and all three labs is included in Table 1.

Length and density of chat sessions. Chat sessions were measured for their length in two ways: the number of minutes students spent in the session and how many chat lines they produced. At one extreme, two groups used the chat function for only 5 to 10 minutes with approximately 10 interchanges (i.e., lines of chat). At the other extreme, four groups used it for over an hour (max: 1 hour 24 minutes) with 93 to 169 interchanges.

Students used the chat sessions for longer periods of time in Year 2 (mean: 55 minutes) than they did in Year 1 (mean: 43 minutes). However, they produced more lines of chat in Year 1 (67 on average) than in Year 2 (43 lines on average). Some groups used the Google Chat utility for quite a while, some only for a few minutes.

A better measure of how much interaction occurred during the chat sessions is to take the proportion of lines per minute across each session, a measure of the density of text in their sessions. The average density was 1.72 lines per minute in Year 1 and 0.8 in Year 2. Table 2 summarizes results across the two years of data collection and across the three labs conducted each year.

A two-way ANOVA with an interaction term was used to compare the means of the three labs across the two years in terms of density of talk in the chat sessions. Density was defined as the proportion of lines per chat session divided by the total number of minutes spent on the chat session. For example, one group spent 64 minutes using a chat session and wrote 169 lines of chat. This group's "density" was 2.64—or a little over two and a half lines of chat per minute during the session. The ANOVA showed no difference in density across the three lab sessions: Student groups wrote about as much per minute during the chat sessions in each of the three labs (F=.02, df=2, 24, p<.98). The average density in the lab sessions was 1.29 for Lab 1, 1.33 for Lab 2, and 1.36 for Lab 3. There was a main effect of Year (F=7.33, df=1,25, p <.02). The Year 1 density averaged 1.65 lines per minute during the chat session, and the Year 2 density averaged 0.8 lines per minute. We conclude that there was little difference in chat interactions between the three lab sessions, but there was a difference between Year 1 and Year 2, with Year 1 students using the tool more. The interaction effect between Lab and Year was not significant (F=3.07, df=1,25, p <.09): The Year 1 students consistently used the chat tools more than the Year 2 students in each of the three labs.

Content of talk in chat sessions. The content of the text-based chats among students included conversation about assignment mechanics and about them sorting out their own "process," "meaty" conversation about content of the assignment, and sharing of links, videos, etc. The exchanges included a predictable variety: Some students were more "participatory" than others, some were less comfortable with the technology, and some were less "verbal" in the text chat mode. Table 3 includes examples of each type of chat interactions.

Collaborative Document Construction

The Google Documents results also included quite varied outcomes: Some students produced in-depth summaries and some were more "cursory." In and of itself, a cursory presentation document is not a problem, as the documents were supporting material for a class presentation; the document can be cursory as long as the presentation is sufficiently detailed.

The collaborative construction of a single document (with four-five simultaneous co-authors) seemed to be a useful process. The document texts included:

- Presentation notes (sequence of topics, bullet points on necessary facts and ideas)
- Summaries of assigned websites
- Information about additional material (beyond the assigned websites)
- Web links during presentation
- Video links during presentation

The documents demonstrated a variety of "quality" elements. We looked at whether students included content independent of the assigned website, whether they integrated different parts of their document, what format they used, the length of the documents, and whether or not they included graphics.

Overall, about half of the students included substantive content independent of the assigned websites (across the 33 documents, 17 included "above and beyond" information, five incorporated some additional substantive content but not completely). Similarly, about two-thirds of the documents had integrated information across the sections (14 documents had fully integrated information and nine had partially integrated information). Formatting choices varied across the groups: Eight groups chose to use narrative text and 25 used outline/bullet formats. The documents averaged

approximately four pages (range: one-half page to 14 pages/slides, standard deviation: 3.8 pages/slides). Finally, we looked at whether students incorporated graphics, videos/video links, or web links into their presentation documents: 12 included graphics (pictures, sketches, etc.), five included videos or video links, and 29 included links to other webpages.

Discussion

Our goals for these lab sessions were threefold: to provide students with additional opportunities and modalities for written self-expression, to provide an opportunity for collaboration while using Internet resources, and to encourage the development of ideas through discussion. The lab assignments met all three goals. The data analysis showed that, while students used these additional communication and collaboration tools to differing degrees, the modalities themselves (Google Chat and Google Documents) effectively fostered communication and collaboration in written formats among the students.

This itself is an important classroom outcome. The authors have several decades of experience between them of working with diverse groups of DHH, hearing, and other identified special needs postsecondary learners. Effective classroom communication is frequently a challenge, as some students are better signers than talkers, some are better at writing than signing, and there are the inevitable interpersonal differences, where some students are more comfortable talking in a class group format and some are more introverted.

Our prior attempts at smoothing out these communication challenges have involved setting up online course discussion boards, both faculty managed and student initiated, to give students an additional written outlet and to accommodate those who are less comfortable or able to communicate in class (Schley & Stinson, 2011). These helped to some degree but did not foster simultaneous synchronous collaboration.

While the data show differences between groups in their use of the chat and documents functions (with some groups using either to a greater or lesser degree), both tools clearly were effective in fostering simultaneous synchronous collaboration using oral/manual talk, written chat, and collaborative document construction. In short, with the help of the online collaboration tools, students were able to collaborate and complete their work in a manner that fulfilled the assignment requirements.

Implications for Postsecondary Disability Services Providers

For those representing disability issues on higher education campuses, these results suggest the need to advocate for the incorporation in college classrooms of multiple modes of communicative interaction (e.g., text chat and online collaborative tools, in addition to oral interaction and other modes of providing access for students with disabilities, such as note-taking and ASL/English interpreting). This instructional design detail dovetails nicely with principles of Universal Design for Learning (Izzo & Bauer, 2013; Jackson, 2005; Moon, Utschig, Todd, & Bozzorg, 2011). From an instructional design perspective, this addition is relatively simple. Campus representatives who work with faculty to improve the educational access of DHH students and students with other communication challenges can add this approach to their repertoire of effective teaching strategies.

Implications for Teaching

Implications for teaching include the pros and cons of using the technology-based collaboration tools. The pros are that the assignments capitalized on multimedia use of websites and presentations. Internet and technology resources are an increasingly rich area for teachers to incorporate in their classrooms, and we designed these assignments to give students practice at using these resources critically and analytically.

Cons include the fairly "heavy" technological requirements of this kind of classroom endeavor. The technology used in our classes required every student to have a laptop, as well as a classroom projection system and a stable, high-speed Internet connection. Technical support during the sessions is also crucial: There are numerous system breakdowns, which would be difficult for a faculty member to manage while also managing the students and the classroom session. However, certain collaborative technologies, such as Google Documents, are becoming increasingly familiar to students so less technology support may be needed in the future.

Implications for Further Research

Future research would benefit from collecting video data on these types of activities. What we could not analyze during these sessions was the extent and quality of students' oral/manual talk during the lab assignments. We assume that those who chatted less in the online format probably had higher levels of oral/manual communication that enabled them to prepare for their group's presentation at the end of the lab session, but we do not know if that is true. Additionally,

looking at their interactions across both oral/manual and text-based chat modalities would be of great value to the field of classroom collaboration research.

For this study, students were identified as DHH or hearing in a class registration list, and the students in groups knew whether a member was DHH or hearing. It seems that this approach may also be useful with other students who have difficulty communicating in groups, such as those with a learning disability or English language learners. It would be desirable to conduct future research with groups whose members have diverse communication characteristics other than being DHH or hearing. As mentioned above, this approach to collaborative group work increased students' communication options. While we have not evaluated whether the approach "works" for students with different temperaments (e.g., introverted versus extroverted), we suspect that such efforts level the communication playing field in a classroom of diverse learners. The tools certainly encourage complex thinking: The authors, who design and require these activities in the courses they teach, judged the "products" as being generally thorough, complete, and nicely done[2]. And, finally, this type of assignment represented and encouraged active rather than passive learning.

In sum, this approach proved to be an effective way of encouraging online and in-person synchronous collaboration with a diverse group of postgraduate learners. While further research is necessary, it was a promising classroom exercise and we will continue to include such methods in our future teaching.

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Footnotes

[1] Face-time video chat functions can be incorporated into Google's Chat function, but we did not use this feature during these lab sessions.

[2] While not analyzed or summarized in this paper, grades for these collaborative assignments were consistently high across both years of the course. At the time, grades at this college consisted of letter grades only, without +/- gradations. There was not enough variation in grades to include it in the analyses.

Table 1

Descriptive Statistics: Google Chat Summary Data

	Year 1 (*n*=17)				Year 2 (*n*=10)			
Measure	*Mean*	*SD*	*Min*	*Max*	*Mean*	*SD*	*Min*	*Max*
Time	42.6	26.6	6	84	54.7	19.6	34	94
Lines	67.3	46.7	3	169	43.3	41.9	4	144
Density	1.72	0.9	0.3	3.18	0.80	0.70	0.11	2.08

Table 2

Descriptive Statistics for Google Chat Data by Lab Groups: Density of Chat Sessions (# lines/# minutes), N=27

	Year 1		Year 2		Overall	
Lab	Mean	SD	Mean	SD	Mean	SD
Lab 1	2.03	1.55	.73	.37	1.29	1.16
Lab 2	1.53	.61	1.09	1.03	1.33	.79
Lab 3	1.59	.73	.37	.36	1.36	.83
Overall	1.65	.83	.80	.70	1.34	.88

Table 3

Google Chat Analysis Examples

Type	Example
Assignment Mechanics	**student1:** do we pick one website and indepth analze it or do we all pick different ones? analyze* it'd be nice if i could spell **student2:** i think we choose one in the end spelling blah
Assignment Process	**student3:** I say we each pick one and explore that way we can get more information that way the last page says combine information into a page with a list of topics two suggestions and one exaple of a website **student2:** right so lets look s and pick oe one **student4:** I can do Familieswith Deaf Children Resources **student3:** sounds good
"Meaty" Conversation	**student1:** i like mine it has a bunch of handouts for parents and a lot of them are translated into spanish or other possible home languages it seems like something realistic that i'd actually use **student2:** OOOOH how about technology for the home **student3:** my is mostly legal information so that kids the support needed in school. there is stuff about IDEA it has different organizations that they can join and schools that are affiliated with the website **student3:** here is a great thing if we can do younger. it is a program of how to read to deaf children student4: im gonna check out te hands and voices site
Sharing Links/Videos	**student4:** i found a site about deaf role models http://handsandvoices.org/articles/perfect/V12-1relevant.htm student3 http://www.ncbegin.org/index.php?option=com_content&view=article&id=100&Itemid=55 that link is to ASL but you can search around the home page has a lot of other topics

Note. All text is presented as it occurred during the Chat sessions (spelling errors were not corrected).

Figure 1. Screenshot of Google Chat Sessions in Progress.

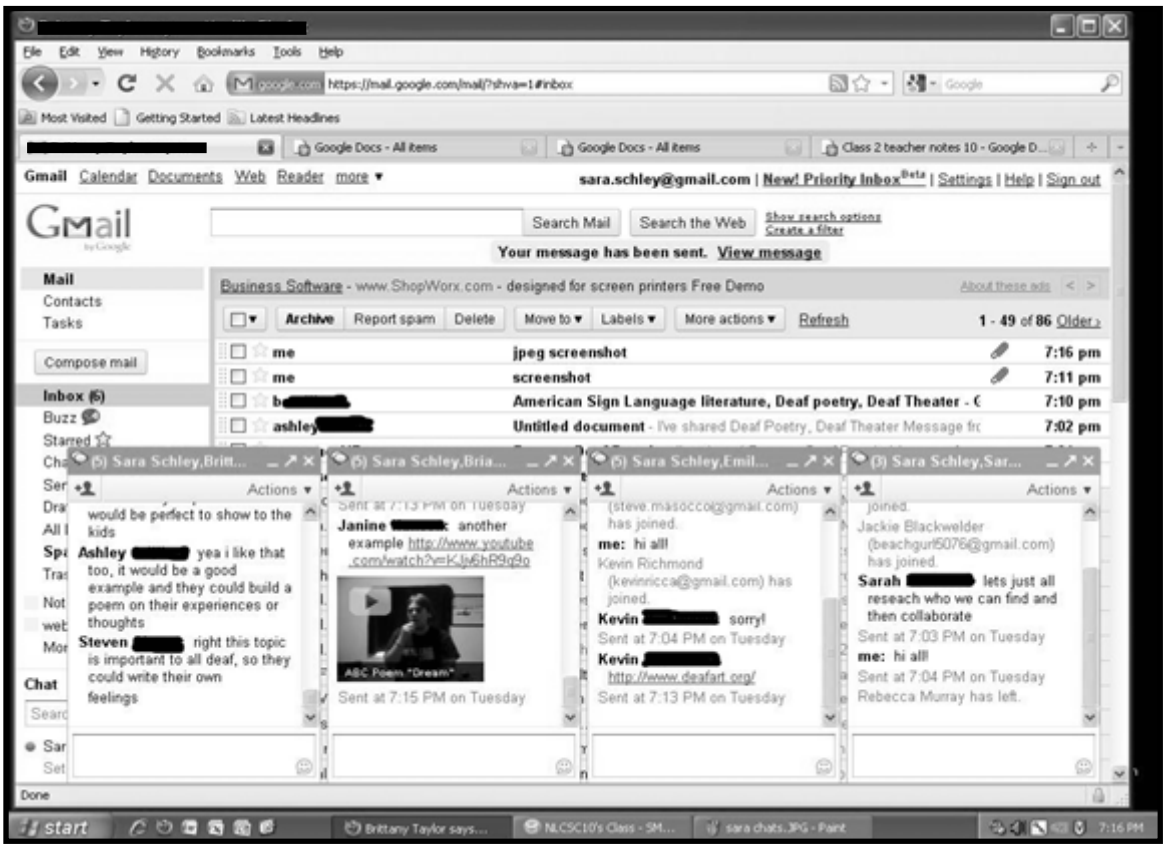

Figure 1. The figure displays a Gmail account window, with four chat windows next to each other along the bottom half of the screen. Each chat window has individual chat lines from 2-3 students, including text chat, web links, and a screen shot of a small embedded You Tube video.

Figure 2. Screenshot of Google Chat Sessions in Progress

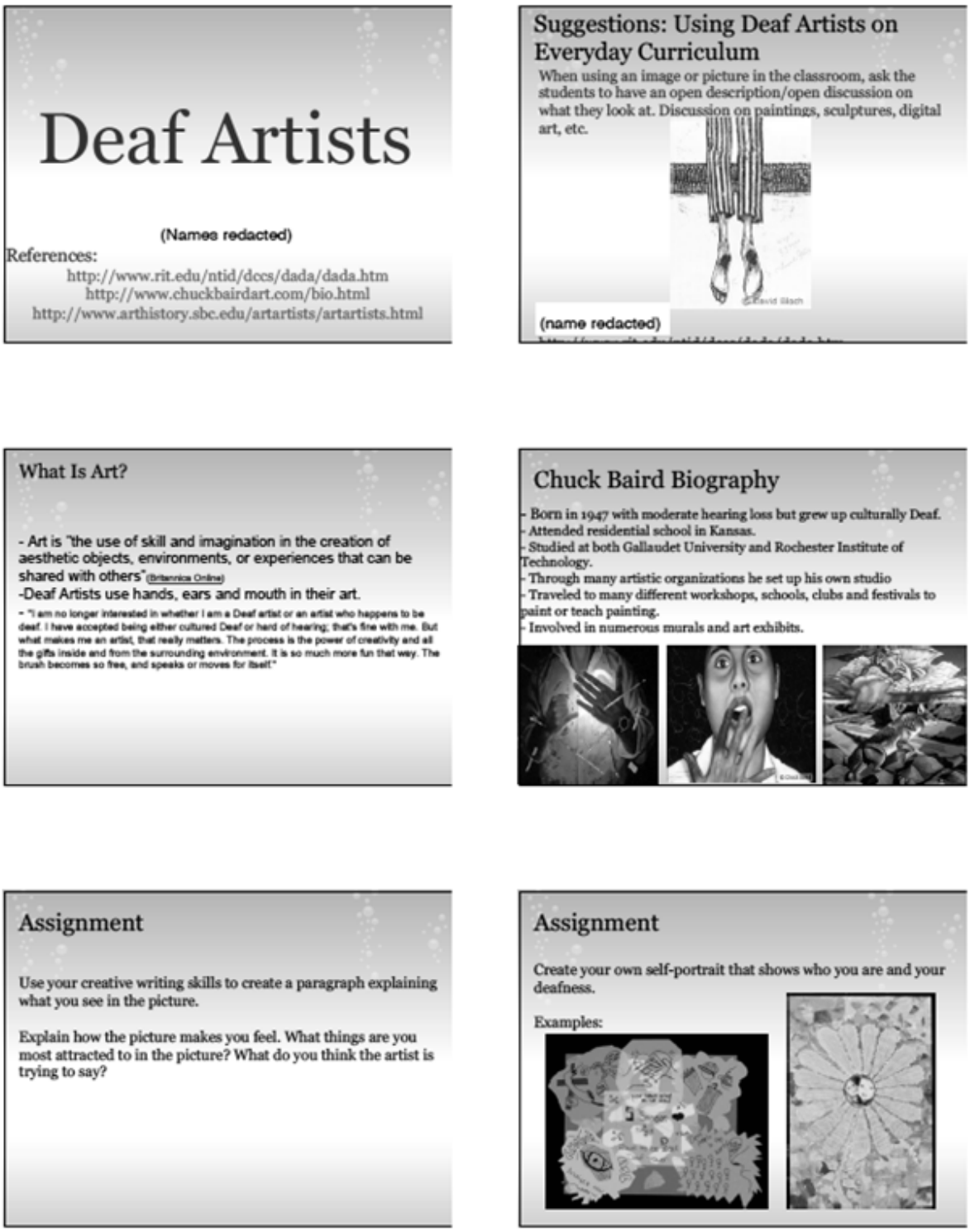

Figure 2. The first slide is a title slide, "Deaf Artists," with three references to web pages of deaf artists. Slide 2 briefly summarizes "Suggestions for Artists in Everyday Curriculum" (for K-12 classroom teachers). Slide 3 summarizes what art is for Deaf artists: "The use and skill and imagination in the creation of aesthetic objects, environments, or experiences that can be shared with others." Slide 4 gives biographical information of Chuck Baird, a prominent deaf artist. Slide 5 summarizes a classroom assignment ("Use creative writing skills to describe what you see in a Chuck Baird picture"). Slide 6 summarizes another possible assignment ("Create your own self-portrait that shows who you are and your deafness").