Creating a virtual academic community for STEM students

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Abstract

Purpose – The purpose of this paper is to describe synchronous, remote tutoring for the Deaf STEM Community Alliance's virtual academic community (VAC). The alliance addresses critical barriers for students who are deaf or hard of hearing (D/HH) in postsecondary science, technology, engineering, and mathematics (STEM) majors.

Design/methodology/approach – A mixed-method approach (qualitative content analysis and descriptive statistics) documents project activities.

Findings – Google + Hangouts was used for remote tutoring. Participants completed 57 tutoring sessions. Participants found tutoring beneficial, especially for its convenience. Technical assistance and feedback systems were created to support participants. Grade point averages (GPA) and retention remained stable.

Research limitations/implications – Research on this project continues. Small sample size is a limitation of the study. Ongoing research investigates how remote technology and social media impact learning for students who are D/HH.

Practical implications – Scholarship on social media for educational purposes is minimal. While specifics of particular social media platforms vary, recruitment, technical assistance, and establishing feedback mechanisms are common issues for VACs. Outcomes from this study will be used to improve this VAC and create documentation for replication.

Social implications – The Deaf STEM Community Alliance provides supportive resources to underrepresented students in STEM majors. Improved GPA and retention in STEM majors will generate more individuals qualified for STEM careers. Research on VACs creates opportunities to understand how technology and networked communities change knowledge and learning.

Originality/value – The Deaf STEM Community Alliance is a unique project for postsecondary students in STEM fields who are D/HH. The information is valuable to educators interested in using social media for instruction.

Keywords Remote tutoring, Synchronous tutoring, Social media, Deaf people, Deaf or hard of hearing students, Postsecondary STEM education

Paper type Case study

Introduction

Hearing loss may be invisible to the general public, but it poses significant barriers to preparing for science, technology, engineering, and mathematics (STEM) careers.

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Like other students with disabilities (SWDs), the needs of students who are deaf or hard of hearing (D/HH) are often overlooked (National Academy of Sciences, National Academy of Engineering and Institute of Medicine, 2007; President's Council of Advisors on Science and Technology (PCAST), 2010). Educational marginalization creates a "participation gap" for students who are D/HH because their modes of communication and learning styles are different from their hearing peers (Jenkins *et al.*, 2006; Komesaroff, 2005).

Specialists in postsecondary education for students who are D/HH identify several critical barriers for these STEM students including: student preparation, socialization issues, and media access (Foster, 2009; Walter, 2009). The Deaf STEM Community Alliance (2012) was created to address these issues. The alliance involves students and professionals from Rochester Institute of Technology/National Technical Institute for the Deaf (RIT/NTID) (Rochester, NY), Camden County College (Blackwood, NJ), and Cornell University (Ithaca, NY). This case study describes synchronous, remote tutoring activities from the first year of the alliance project with students from RIT/NTID. Research questions guiding this paper are:

(1) What elements are involved in establishing a synchronous remote tutoring system for D/HH students?

(2) What are the impacts of such a tutoring program?

The first year findings raise issues concerning digital learning and the challenges of adopting an online learning environment.

Project rationale

Student preparation

Many researchers concur that students who are D/HH receive limited exposure to quality STEM education in elementary and secondary school (Foster, 2009; Kelly *et al.*, 2003; Marschark *et al.*, 2001; Walter, 2009). Elementary and secondary education for students who are D/HH often emphasizes speech, literacy, and language skills but much less attention to STEM. Walter (2010) also notes that on average, D/HH students perform more poorly than their hearing peers on standardized assessments for reading comprehension, science, social studies, and math. Weak skills and inadequate exposure contribute to poor preparation for the rigorous demands of STEM education at the postsecondary level. Consequently, academic tutors provide support for skill building and postsecondary success (Cawthon *et al.*, 2009; Orlando *et al.*, 1997; Lang, 2002).

Educators of D/HH students and D/HH students themselves often embrace new technologies (Lang and Steely, 2003), but there is a paucity of scholarship relating to remote tutoring with D/HH students (Baker, 2010; Bryant, 2011). In a recent study at RIT/NTID, one tutor offered students in-person tutoring as well as remote (online) tutoring for her writing course. Of her 22 students, 14 participated in tutoring – five in in-person tutoring and nine via remote tutoring. The tutor noted that without the online tutoring option, she would typically have about five of the 22 students receiving in-person tutoring (Bryant, 2011). Bryant's study suggests that students may not always take advantage of traditional tutoring services, but may be more receptive to tutoring alternatives.

Socialization issues

Lack of community and a need for role models are two socialization issues confronting D/HH students in STEM. Similar to other SWDs, many D/HH students in STEM programs feel rejected and isolated, frequently being the only deaf person in class (Gottlieb and Leyser, 1981; Johnson, 1997). They want to connect with their hearing peers and with other D/HH students in STEM programs throughout the world (Clymer *et al.*, 2008).

Computer-mediated communication connects people separated by time and space who might not otherwise meet. Although proximity is critical to developing peer and mentor support in most settings (Stainback *et al.*, 1992), the internet provides a medium with the potential to build and sustain human relationships over great distances, especially for SWDs (Burgstahler, 1997; Scatliff and Meier, 2012; Whitley-Grassi and Hoefler, 2012).

D/HH students may have difficulty envisioning a STEM career without role models (Foster, 2009; Marschark *et al.*, 2001; Walter, 2009). Walter (2010) found that overall, 17.9 percent of persons who are hearing are employed in STEM occupations vs 15.5 percent of workers who are D/HH and the types of STEM jobs in which persons who are hearing and D/HH are employed differ. Higher percentages of hearing persons work in computer and medical fields, while higher percentages of persons who are D/HH work in construction, mechanical, and agricultural areas. Without exposure and significant interaction with D/HH professionals who have successfully completed postsecondary STEM programs and entered STEM professions, students' aspirations will be negatively affected. These role models could serve as excellent mentors.

Accessible media

A common complaint expressed by Foster's (2009) and Walter's (2009) focus groups was that STEM courses often incorporate uncaptioned media. Uncaptioned videos are inaccessible to D/HH students, and in-class interpreters or captionists find it difficult to interpret or caption quickly enough to capture information presented in the videos (see also Erath and Larkin, 2004; Fichten *et al.*, 2009; Hyde *et al.*, 2009; National Center on Disability and Access to Education, 2011; Teachers' Domain, 2009). Furthermore, Lang and Steely (2003) suggest that web-based content needs to address such factors as reading ability, student engagement, and visual reinforcement of content to be appropriate for D/HH learners.

Personalized learning

It is widely acknowledged that students have diverse learning needs (Manzo, 2010). This is especially true for students who are D/HH because of students' varying communication needs (Stinson *et al.*, 1996). Educators and students frequently turn to digital resources for personalized learning opportunities, including digital libraries, remote tutoring, and remote collaboration opportunities (Manzo, 2010). According to Wolf (2010), essential elements of personalized learning include: flexible, anytime/everywhere learning; redefinition and expansion of the role of a teacher; and student-driven learning. The Deaf STEM Community Alliance addresses these issues of personalized learning by providing D/HH students individualized, electronic resources responsive to their particular needs.

Internet support, cyberinfrastructures, and communities of practice (CoP)

Internet opportunities for learning, support, and professional development continue to grow. Internet use decreases feelings of isolation (Burgstahler, 1997; Johnson, 1997), provides distance learning opportunities and professional development resources

(Johnson, 1997; Slike *et al.*, 2008), and offers mentoring opportunities for students who are D/HH or other SWD and their educators and service providers (Burgstahler, 2008).

The National Science Foundation (NSF), US Department of Education, and others have made substantial investments to create resources supporting STEM learning. Because the resources are housed in many different domains, including free-standing software packages, YouTube videos, web sites for various projects, etc. they are not always easy to locate (NSF Task Force on Cyberlearning, 2008; National Educational Technology Plan Working Group, 2010; Zhang, 2009). Cyberinfrastructures consolidate diverse resources, ensuring the preservation of these resources for the future (National Educational Technology Plan Working Group, 2010; NSF Task Force on Cyberlearning, 2008).

Cyberinfrastructures impact knowledge and information sharing. Individuals use of technology in education has transformed their relationship with access and dissemination of knowledge (Siemens, 2006). One way in which cyberinfrastructure can be utilized is to create CoPs (Gannon-Leary and Fontainha, 2007; Lave and Wenger, 1991; Wenger *et al.*, 2002). CoPs have emerged in which groups of individuals unite online to share their knowledge and to generate new understanding within their realm of common interest.

Theoretical background

This project demonstrates an applied example of constructivist learning theories (Adams, 2006; Caws, 2012; Siemens, 2006; Svendsen, 2012; Truong and Zanzucchi, 2012; Wankel and Blessinger, 2012). In this construct, learning is characterized as a dialectical exchange between learner and teacher. Each actor brings prior knowledge and experience to the encounter, and through mutual communication and information exchange, each generates newly created knowledge from the experience (Siemens, 2006; Svendsen, 2012).

Description of the project

The Deaf STEM Community Alliance is creating a cyberinfrastructure/CoP to support postsecondary students who are D/HH. The cyberinfrastructure provides a platform for the delivery of:

- remote tutoring and mentoring support services;
- remote interpreting and captioning access services; and
- an accessible STEM "library" with resources such as accessible captioned media, connections to professional organizations, deaf-friendly STEM resources such as American Sign Language STEM dictionaries, and professional resources.

This cyberinfrastructure addresses critical barriers facing STEM students who are D/HH by providing greater access to the resources developed by NTID and others and by extending opportunities for sharing information, talents, and supports. Through mutual sharing of information and knowledge, the alliance constitutes a CoP to enhance STEM learning.

The goal of the Deaf STEM Community Alliance is to establish a model for a virtual academic community (VAC) to increase graduation rates of D/HH STEM majors in postsecondary education in the long term. Two objectives support the goal: first, documenting and disseminating a description of the process of creating the VAC in order to create a scalable model that can be replicated to fit the needs of other SWD in STEM majors; and second, increasing the grade point averages (GPA) and retention rates of D/HH students in STEM majors. The project addresses the needs of preparation, socialization, accessible media, and personalized learning within the construct of a cyberinfrastructure/CoP.

Methods

Participants

Students. In Winter, Spring, and Fall quarters, 2012, 12 STEM students from RIT/NTID who are D/HH received synchronous, remote tutoring. Five of the students were female, seven were male. Ten were Caucasian, one was African-American, and one was multi-racial.

Tutors. The tutors ranged in age between 34 and 72. Seven RIT/NTID faculty members provided the tutoring, including four tutors who are themselves D/HH. One tutor was female, and the rest were male. Five of the tutors were Caucasian, one was Asian, and one did not declare a race. Tutoring was provided in STEM courses including: biochemistry, calculus, circuit theory, computer science, differential equations, endocrinology, engineering, patents and trade secrets, and physics.

Materials

Hardware. Tutor/student pairs used standard desktop or laptop computers such as Macs, PCs, and Chromebooks with webcams that were either external to or built into the computer.

Software. Google + Hangouts (Google, 2012) was used as the web conferencing platform. Google + Hangouts is a Google application (app) that became available in the summer of 2011. Several other web conferencing packages were tested including Adobe Connect (Adobe Systems Inc, 2012), Fuze Meeting (FuzeBox, 2012), Skype (Skype, 2012), and WebEx (Cisco, 2012) before Google + Hangouts was selected. Considerations for the appropriate platform included accessibility, administration options, collaboration and variety of features, cost, user interface (UI) ease, operating system compatibility, and user analytics tools.

The Google + Hangouts app was chosen because many of its features could be used together during a tutoring session as well as the reasonable cost of the app (free). Commercial online tutoring programs often have a virtual whiteboard and chat features, but these features alone are insufficient for students who are D/HH. Google + Hangouts incorporates options for D/HH accessibility and video chat, text chat, document sharing, screen sharing, a virtual whiteboard, and access to YouTube. Google + Hangouts can involve up to nine participants simultaneously, so there is flexibility to use Google + Hangouts for group tutoring situations or to add an interpreter. It was anticipated that the Google + Hangouts app would be accepted by students because e-mail accounts for RIT students are Gmail accounts, and all Google apps are connected to Gmail accounts.

Procedure

Recruitment. STEM department chairs were asked to identify potential tutors from among the faculty who provide face-to-face tutoring as part of their normal workload. Nominated faculty members received personal e-mail invitations to participate. Faculty who agreed to participate were asked to invite one or two students whom they thought would be willing to try online tutoring.

Orientation. Tutors and students were consented and trained to use Google + Hangouts during one, 60-90 minutes session for each tutor/student pair. During the first two quarters of year one, the consent and orientation session for participants was in-person and included a project team researcher, the VAC manager, the tutor, and the student(s). This session was conducted in person to create a protocol that will be used with remote tutors and students at other campus sites in future years. In the Fall 2012 quarter, orientation sessions were conducted either in person or online, depending on the participant's location. Students used their school Gmail accounts for the Google + app. Tutors were assigned a specific Gmail account for the project so that they could separate their personal Gmail and other Google app usage from the project activities (e.g. LastNameVACTutor@gmail.com).

Tutoring activity. Tutors and their students participated in synchronous tutoring sessions remotely – i.e. not together in the faculty members' offices. For initial sessions, students used computers in a campus learning center, while the tutors were in their offices. As tutor/tutee pairs became more comfortable with the technology, they ventured to other locations, such as the library, dorm room, or home. The VAC manager provided technical assistance during the tutoring sessions and through e-mail. Tutors and students required various levels of assistance depending on their technical expertise and comfort level with the Google apps. Plate 1 illustrates a tutoring session.

Data collection. All participants completed online surveys pertaining to background and demographic information at the start of the project and at the end of Spring quarter 2012.

In Fall 2012, two brief online questionnaires were initiated pertaining to: technical issues, and the impact on tutoring or learning. The questionnaires include multiple

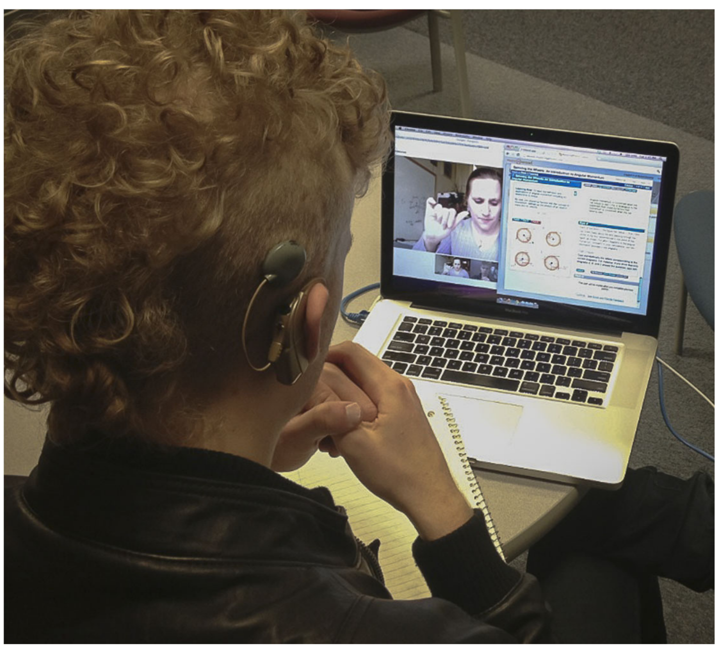

Plate 1.
Student participating in a synchronous, remote tutoring session

choice, Likert-type, and open-ended questions. The technical issues questionnaire includes approximately 30 questions relating to the conditions of the tutoring session and the equipment used. Responses to the technical issues questionnaires were followed-up with e-mail if respondents reported technical problems. The impacts on tutoring/learning questionnaires included approximately ten questions each, and focussed predominantly on the types of tools used for the session (e.g. Google Docs, YouTube, calculators, etc.) and the benefits and challenges of remote tutoring. Tutors and students received one or the other type of questionnaire on alternate weeks throughout the quarter. Respondents were only obligated to respond to a survey if they actively engaged in a tutoring session. The first question on each survey was, "did you have a tutoring session this week?" If respondents answered "no," then the automated survey was immediately directed to the end of the survey, and no further questions were asked. Survey results below represent those tutors and students who actually participated in a tutoring session.

Analysis

Data collected during these initial trials is summarized quantitatively as well as with excerpts from qualitative responses to questionnaire items.

Results

Activities

The academic marking periods were ten-week quarters. Since the start of tutoring activities near the end of Winter quarter, 2011-2012, 57 synchronous remote tutoring sessions occurred. Tutoring sessions lasted, on average, 55 minutes, the range between 15 and 75 minutes. Tutoring sessions occurred one to three times per week, depending on student needs.

In the early weeks of each quarter, few sessions occurred, but the frequency increased as the quarter continued. Students and tutors were informally surveyed about why tutoring was delayed. According to both students and faculty, many students are reluctant to begin tutoring in the Fall quarter because they do not feel they need it – until after they see their first exam results (around week four). In addition, tutors are asked to recruit students and it takes a few weeks at the beginning of each academic period to establish rapport and determine who would be motivated to participate in the activity.

Feedback from participants

Technical issues: student perspectives. Eight student responses were recorded for the technical issues questionnaire. All of the students participated in the tutoring sessions from their residence (e.g. dorm, apartment, or home). Based on feedback from the questionnaires, the video quality was acceptable for all respondents. One student reported that due to the fact that the connection was through WiFi instead of an Ethernet connection, the video was choppy and so the pair used the typed chat to communicate. Several students reported using audio as well – most reported good quality audio, while one student commented on the presence of feedback from the tutor's computers. Five students rated their tutoring sessions as either "excellent" ($n = 4$) or "above average" ($n = 1$) (scale: 1 = extremely poor to 5 = excellent). Three students did not respond to this question. Students offered varying responses for these ratings including:

- permanence of the text: the ability to save everything that was said for future reference;

- skill of the tutor: good tutor;
- convenience of remote tutoring: I was able to get some work done and questions answered with my tutor in my own apartment; and
- satisfaction with the process: getting the job done. Learning!!

Technical issues: tutor perspectives. Eight tutor responses were received for the technical issues questionnaire. Tutoring sessions occurred in faculty offices and at home. Most sessions used video, and the video quality was acceptable for their sessions, although some tutors raised issues concerning video quality. In one case, the student was using a WiFi connection; in another case, the student was positioned too close to the camera, so the American Sign Language was somewhat difficult to read. None of the tutors reported using audio during their sessions. Tutors rated the sessions (on a scale from 1 to 5, 1 = extremely poor to 5 = excellent) as "above average" ($n = 4$), "average" ($n = 1$), or "below average" ($n = 2$). The lower ratings were associated with poor video quality. In addition to the ratings, tutors commented on the convenience of tutoring remotely plus the flexibility of using a variety of applications within the Hangouts environment:

> I found it convenient to chat and to use the Google Docs to try and communicate with the video. Also it was great to be able to be able to tutor from home!

Impact on learning: student perspectives. Four student questionnaires were received on the topic of the impact on learning, rating on a scale from 1 to 5, 1 = extremely poor to 5 = excellent. Students rated their sessions as "excellent" ($n = 3$) or "above average" ($n = 1$). In response to the question, "how does remote tutoring help you with your studies?" students addressed the issue of convenience:

> When I don't have the time or methods to go to see a tutor, it is much easier to do it remotely and only work for a short time.
> I am able to receive tutoring without having to walk across campus to my tutor's office. It is really convenient for me.

In addition, respondents felt that remote tutoring compared favorably to in-person tutoring, each responding that the remote tutoring was the same as an in-person session.

Finally, students' only suggestion for improvement of the system was smoother functionality of the Hangouts functions.

Impact on teaching and learning: tutor perspectives. Eight tutors responded to the impact on teaching and learning questionnaire on a scale from 1 to 5, 1 = extremely poor to 5 = excellent. Tutors rated their sessions "above average" ($n = 2$), "average" ($n = 3$), and "below average" ($n = 1$). Rationale for the ratings included efficient use of time, challenges with turn-taking within the hangout, and challenges with spatial awareness and a comparable comparison with prior sessions. Despite some low ratings, tutors acknowledged benefits of the remote tutoring with regard to scheduling and convenience for students:

> It definitely makes scheduling hours more flexible.
> It makes it easier to meet with students who have a limited time window (esp. since my office it so far from their classes).

Challenges

During the first two quarters, the biggest challenge faced involved frequent changes to the UI and functionality of the Google + Hangout app. The application was new and seemed to change, without warning, almost weekly. Therefore, creating training materials for new tutors and students was frustrating because the information needed frequent revision. In addition, the changes meant additional time was required for technical assistance. Another challenge that was experienced was unstable video quality.

Strategies

Despite the challenges, tutors and students were successful with their tutoring. During the Spring quarter, several guidelines were established to address the challenges experienced. For example, all participants were recommended to use the Chrome browser to access the Google + Hangout. Participants were also encouraged to use a wired, Ethernet connection instead of relying on WiFi. In addition, the online questionnaires addressing technical issues helped to pinpoint issues that occurred during tutoring sessions. Research team members reviewed questionnaires weekly and provided necessary feedback to tutors and students through e-mail.

Impact on educational progress

GPA. Prior to receiving remote tutoring, the mean GPA of participants was 3.26 (SD = 0.340). At the conclusion of the Spring 2012 quarter, the GPA was unchanged, at 3.26 (SD = 0.344). The mean course grade (A = 4.0, B = 3.0, etc.) for student participants was 3.13 (SD = 0.99). The grade distribution for student participants was A ($n = 4$); B ($n = 1$); C ($n = 3$). GPA for the Fall 2012 quarter is not yet available.

Progress toward degree. The participants are at various stages in their progress toward their degrees. Of the eight participants in the initial cohort (Winter/Spring 2012), seven are continuing in their studies, and one student graduated. Information is forthcoming related to the cohort that began in the Fall quarter.

Discussion

Within the first year of its inception, the Deaf STEM Community Alliance began providing synchronous, remote tutoring for postsecondary students who are D/HH in STEM fields. To the best of our knowledge, this is a novel activity for postsecondary STEM students who are D/HH. Students without disabilities have ready access to a variety of online or remote tutoring systems (Wankel and Blessinger, 2012), but the unique needs of D/HH students present challenges. The Google + Hangouts app offered tutors and students a variety of options for communication through video and chat streams as well as ways to share content collaboratively.

Limitations

Preliminary data from the project suggest that students and tutors are embracing the remote tutoring system. However, it is still too soon to know whether the remote tutoring will be enough of an adjunct to other campus resources to impact GPA, retention, and graduation rates. As the project progresses, additional data will be available to test the impact of the program.

Conclusions

Digital learning

Many studies of online learning that incorporate social media apply constructivist learning theories to explain the learning process (e.g. Wankel and Blessinger, 2012).

Siemens (2006) suggests that traditional learning theories such as behaviorism, cognitive learning, and even constructivism are inadequate for describing the types of learning that take place within the complexity of social networks and digital learning environments. He proposes a new theory, connectivism, which draws features from chaos, network, complexity, and self-organization theories. This theory reconsiders sources of learning and the greater flexibility of roles for learners and teachers. Examples of connectivism can be witnessed in the interplay between tutors and students through their mutual exchanges in learning to use the Google apps as well as in their simultaneous uses of other online resources during tutoring sessions.

The Deaf STEM Community Alliance named its online learning, mentoring, and STEM resource environment a "VAC." Turkle (2011) suggests that the online world is distinct from the physical world, creating what Jurgenson (2012) refers to as "digital dualism." While our data are limited, comments from participants suggest that students are not experiencing remote tutoring as "virtual" or somehow a different type of tutoring experience. Instead, they have described their remote tutoring sessions to be the same as their in-person sessions. For these students, at least, there seems to be no digital dualism. Similarly, Bryant (2011) found that her D/HH students receiving tutoring for a writing course also perceived their remote sessions to be similar to in-person sessions.

Embracing innovations

One of the biggest challenges of this project is to persuade students and faculty to participate in remote tutoring. Bryant (2011) refers to these challenges as "transitioning." She suggests that changing roles is particularly challenging for the tutors, because the tutors need to be the technology experts as well as the teachers of the course material. Svendsen (2012) suggests that e-learning stretches educators' roles in new directions, which may or may not be comfortable for the educator, including finding new ways to motivate students and serving as an educator outside of the standard classroom setting. Students also redefine themselves in the context of e-learning, developing new technical skills (Caws, 2012), and realigning their beliefs about the application of social media for new purposes (Rubrico, 2012; Simoes and Gouveia, 2012; Truong and Zanzucchi, 2012). In this project, the tutors and students did not express much distress about their altered roles, but they relied on each other for technical expertise, which more closely aligns with Siemens' (2006) model of shared knowledge and role redefinition (Wenger *et al.*, 2002).

Tutoring for postsecondary students who STEM majors and who are D/HH has always been conducted in-person. It is difficult to change long-held behaviors, especially when individuals do not recognize that change is needed (Rogers, 2003). In addition, while students in our study used Gmail as their school e-mail client, some research suggests that it is a challenge for students to adopt social media apps for academic work (Rubrico, 2012; Simoes and Gouveia, 2012). Previous research by Elliot *et al.* (2003) describes the adoption of a speech-to-text (captioning) technology by students who are D/HH and their instructors. Using concepts from the theory of diffusion of innovation (Rogers, 2003) faculty were viewed as much more likely to embrace the new technology when they could grasp the benefits of the innovation for themselves as well as for their students. The current study suggests a similar trend, reflected in tutor and student comments. Despite technological glitches, students rate their sessions with high marks, primarily because of the convenience of remote tutoring. Faculty tutors are more critical of their tutoring sessions, but they too, acknowledge the convenience of remote tutoring.

Baker (2010) describes four pilot studies involving K-12 students who are D/HH enrolled in after school remote tutoring programs. Each pilot study used different videoconferencing technologies. The primary challenge faced in each trial related to video quality, and satisfaction with the trials reflected those challenges. Bryant (2011) also describes challenges with video quality as a major source of frustration for remote tutoring students. However, Bryant also remarks that using the webcam and video technology was considered to be a very valuable element for remote tutoring with D/HH students, compared to using text-only formats such as e-mail or text chat dialogue. Bryant suggests that a variety of communication tools should be available to insure success when conducting remote tutoring with D/HH students. While the Google+ video quality is more robust than many systems, its quality varies depending on user bandwidth, Ethernet vs WiFi connection, etc. The current project has, on the whole, experienced better video quality, although it is not perfect. Users generally experience better quality when they follow recommended guidelines such as using the Chrome browser, connecting to the internet through Ethernet (vs WiFi), and using good lighting. It is anticipated that as video technology improves, students and tutors will experience even greater satisfaction with their sessions.

In the first year of the Deaf STEM Community Alliance, remote tutoring for postsecondary students in STEM who are D/HH became a reality. As the project continues, more will be learned about the application of technology and its impact on learning in STEM. Additionally, lessons learned by this community of practice will have application for other virtual learning environments who have their own reasons for uniting in the online world.

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