
**AC 2012-4540: PERSPECTIVES OF TEACHING A DEAF STUDENT IN
THE MATERIAL AND ENERGY BALANCES COURSE**

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Perspectives of Teaching a Deaf Student in the Material and Energy Balances Course

Abstract

This paper discusses the experience of a Deaf student and their professor in a material and energy balances course. This non-traditional combination was challenging for a few reasons. First, from a professor's perspective, it was initially distracting to have two interpreters by your side in the front of the classroom. Second, from an interpreter's perspective, it was difficult to come up with the appropriate sign for technical terms that they are not familiar with. Finally, from the Deaf student's perspective, the amount of information conveyed was less than that compared to the other students because of the lag time with the interpreters.

To address this, the professor provided the interpreters a copy of the course notes at the beginning of every lecture. One interpreter will sign the first topic in parallel with the professor, while the second preps for the second topic. They switch roles during the transition. This on/off system has significantly improved communication to the student.

Despite this improvement, professors who have a Deaf student must be aware of several issues. First, the lag time generates missed opportunities to answer questions that the professor verbally asks the class. Second, learning appears to be better with lectures delivered in Powerpoint versus the traditional chalk and blackboard. This may be due to the fact that all of the information is presented simultaneously, versus bits when writing on the chalkboard. Finally, professors should practice appropriate courtesy. They should address and speak to the Deaf student directly while listening to the voice of the interpreters, rather than engaging with the interpreters directly.

Feedback from the Deaf student's classmates revealed that most of them have not experienced the presence of an interpreter in a classroom, and it was initially distracting during the beginning of the semester. However, most of the students became accustomed to the setup over time. Additionally, interactions with the Deaf student were not particularly difficult, indicating the ease of mixing Deaf and traditional students in an academic setting. Finally, students perceive that the Deaf student has a disadvantage in learning the same material, and would be aided with more written material provided by the professor.

Introduction

The goal of engineering education research is to improve how professors convey the principles within the various disciplines of engineering to their students, with the goal of preparing them for the practical, real-world experiences they will encounter in their professional life. Though much of the field includes anecdotes and teaching strategies that educators have tried and "worked", not as much has been done to examine special populations, in particular Deaf engineering students. Most of the research in this area focuses on the interface between the Deaf student and educator. One study examines the effect of using sign language interpreting, real-time text, and both [1]. Here, the authors conclude that providing real-time text produced significantly higher performance from Deaf students, and that the combination did not produce any greater benefit. Another paper asserts the need for signs that communicate technical jargon [2]. The authors make a case that interpreters who have a knowledge of content, provide better instruction compared to those who are not familiar with a subject. Additionally, the selection of signs in communicating technical jargon is important in effectively translating the idea. Finally, a study examining direct instruction (i.e. where the educator is signing) vs. mediated instruction (i.e. where an interpreter is present) showed no difference in effectively conveying the information to the Deaf student [3]. However, one disturbing fact from this study is that Deaf students leave a course with less knowledge compared to their hearing peers.

Programs have been created to encourage Deaf students who are interested in engineering to matriculate in traditional institutions. Most options for these students occur in institutions specifically geared for teaching the Deaf. One program at Purdue University pairs Deaf students with mentors from engineering or science (who are also Deaf), so that they can pass vital information on pitfalls and hurdles they themselves encountered while going through the program [4]. This program also provides mechanisms to help the Deaf students learn concurrent with traditional students. They were provided stenographers, speech-to-text translation equipment, and access to interpreters.

Another program that accommodates Deaf engineering students is the National Technical Institute for the Deaf at the Rochester Institute of Technology [5]. It is purported to be the only technical college for Deaf and Hard of Hearing students, and has performed research on best practices in this topic [6]. However, despite being part of a traditional institution, the institute remains separate from traditional students pursuing engineering degrees.

Methods

The sophomore-level materials balance course was taught during the Fall of 2011 with an initial class size of 42. The students met three times a week, at 55 minutes per period. For assessment, there were daily quizzes, two exams, and a comprehensive final exam. There was no team project assigned this year.

One of these students in the course was deaf, and had never taken any chemical engineering courses. To accommodate this student, a pair of interpreters would rotate during the class to translate the professor's spoken word using American Sign Language (ASL). The purpose of having two interpreters is to allow one to sign the lecture in real time, while the other prepares for the upcoming section by studying the professor's notes. It was agreed at the beginning of the semester that this strategy (i.e. two vs one interpreter) would be best because they do not have any training in chemical engineering, and there would be a large burden if a single interpreter would have to translate technical terms in real-time. The professor taught the course in the standard manner and tempo using both chalkboard and Power Point slides. More specifically, the professor would teach the concept, work through a problem with the students, and then resolve any points of confusion. Essentially, the only change was the dissemination of lecture notes to the interpreters so that they may prepare for any technical terms that will be discussed.

Professor Perspectives

This is the first experience the professor had with teaching a Deaf student in class. Before the semester began, the professor, student, and interpreters discussed the best possible execution, and ultimately came up with the two interpreter strategy described earlier. The initial hurdle occurred during the first lecture, where it was very distracting to have another person in the front of the class. Aside from losing some board space, professors are used to being the center of attention, and it became very apparent early on that students were sometimes looking in the direction of the interpreter. However, some prompting over time gradually trained the students to divert attention to the lecture at hand.

The other major hurdle is learning the etiquette of interacting with a Deaf person. When asking or answering a question, it was a natural tendency to look in the direction of the interpreter because that is where the voice was coming from. However, the proper etiquette is to look directly at the Deaf student, and listen to the interpreter in the background. This took some time to become acclimated, but was able to properly interact after several lectures.

Student Perspectives

At the conclusion of the semester, students were asked to voluntarily fill out a survey pertaining to their experiences with the Deaf student in class. Of the 36 remaining students, 24 submitted responses (Table 1). The first question asks of their proficiency

with American Sign Language (ASL). Most identified themselves as "not proficient" (20 students, 83%), while some were "somewhat proficient" (3 students, 13%), and one "proficient" (1 student, 4%). Thus, we can conclude that most of the students in the sample have had minimal interaction with Deaf people. To contribute to this assertion, the second question asks if this experience was the first time there was an interpreter in any of their classes. Most replied "yes" (23 students, 96%), while only one had experienced this already (1 student, 4%). While generating the questions in the survey, it was speculated that this was going to be the outcome (i.e. that most student would have minimal experience with a Deaf student). Thus, the effect of the new environment (i.e. interpreters translating during class time) on the students was of interest. The third question asks if the presence of an interpreter was distracting in the beginning of the semester. Not surprisingly, most found the new environment distracting (16 students, 67%), while few thought it was fine (8 students, 33%). As a follow up, the survey asks if those who found it distracting in the beginning also found it distracting in the end of the semester. Of this group, most found it no longer distracting by the end of the semester (14 students, 88%), indicating that students got used to the interpreters in the front of the room as the course progressed.

The next set of questions probed students attitudes and interactions with the Deaf student. The survey asked if they interacted with the Deaf student outside of class. Slightly less than half responded that they did (11 students, 46%). Of these students, the survey asked if they found it difficult to interact (i.e. communicate with the Deaf student). All but one said that it was not difficult (10 students, 91%). Finally, students were asked if this experience has encouraged them to learn American Sign Language (ASL). Approximately half of the students (13 students, 54%) replied that they wish to learn it.

The final set of question asked students to switch roles (i.e. pretend they were the Deaf student), with the goal of closing the gap between teaching both traditional and Deaf students. The survey asked that if they were the Deaf person in class, would they have a more difficult time in learning the material compared to other students. Here, most students replied that they would have a more difficult time (15 students, 63%), which implies the traditional students perceive that a Deaf student would have a disadvantage in learning the same material. The follow-up free response question asks that if this was the case, what would they like to have done differently. Most of the responses asked to have a printout of the notes and powerpoint ahead of time. Another response asked to have dedicated office hours. Surprisingly, one response stated that they would not change anything for "fear of slowing the class down."

Interpreter Perspectives

This section is focused on two female interpreters sharing their experiences about working in this environment. They were interviewed, and asked to explain various aspects of their experience.

Starting with the easiest aspect of the job, it certainly was working with the student who was prepared, dedicated, and comfortable with using interpreters. It definitely eased their concerns at the challenging material they were interpreting, knowing that if the student didn't understand something, she would ask the interpreters to repeat the information. "Knowing that Shiran would make sure she was 100% responsible for the information put me at ease, knowing we were working as a very effective three way team, her, myself and my team interpreter (and the professors, too!)"

The most difficult aspect of the job was walking into a semester already in progress where no training or preparation was given to the professors. This was the first time the institution has experienced working with the interpreters, thus creating a great learning curve on everyone's part. The interpreters needed to remember how to "break in" new hearing consumers who were unfamiliar with a Deaf student as well as how to even use an interpreter effectively. The interpreters stated that remembering how to talk about their work with those who are unfamiliar with "their lingo" and explain their needs to the professors without seeming demanding or overbearing was a challenge, at first.

However, at a linguistic and cognitive level, the material they were interpreting was also rather challenging for them, as most interpreters have a strong liberal arts background, they are not familiar with the content, making it that much more challenging to interpret. "As a teacher, myself, I always tell my interpreting students that you cannot interpret that which you don't understand; therefore, not understanding all the equations and terms made the interpreting work very challenging."

"Not having a specific interpreter coordinator and working with professors who were all new to working with us was different. Content-wise, I have never interpreted for a chemical engineering student, though I have worked in upper level mathematics classes and somewhat similar topics - it was never quite such intensive content. So content wise, this was relatively new to me - and working with (what we call) "uninitiated" professors made it different."

The interpreters shared their thoughts about what the professor could have done to make the job easier. A class outline or notes for the day can help the interpreters follow the lecture. It often also provides proper spelling of terms the interpreters may not be familiar with. Drawings are also very helpful. Allowing the interpreters to assist the student in choosing seating for the most optimum visual placement will help everyone. Being able to reference on paper what is being written on the board makes their job much easier.

The only other thing that would have made their job slightly easier was having a bigger space to work within (not in the professor's control, really). They were often relegated to a tiny corner to work in, making it difficult to refer to the visual information being written on the board. When necessary, they would stand and move around the front of the room to point and refer to what had been written on the board, but often they then felt they were a nuisance to the professor, walking around each other quite often.

As the semester went on, the professors realized that the interpreters were not the distraction they feared. They relaxed a bit and let the process flow. The interpreters started to become familiar with some of the terminology. If allowed, the team of professor, student, and interpreters could find a groove and function almost unnoticed. Some of the professors asked questions about how to make the process work better. They also had generic questions from time to time about translation and deafness in general.

Perspective of the Deaf Student

It's a wonderful opportunity to be able to reflect on how it feels to be a Deaf student in a regular "normal" classroom with a professor, fellow classmates and interpreters. It is my first time to be in a classroom environment like this as my undergraduate degree is from a university for the Deaf. This new experience highlighted numerous obstacles, but at the same time, it has been a very valuable learning experience.

I rely on interpreters every moment throughout the class in order to have full access to information taught by the professor. The interpreter hears the professor and then translates those spoken words to ASL, which is not necessarily English word order. There is a certain amount of pressure on the interpreters, because they must faithfully and accurately relay the context, nuances, and concepts delivered by the professor. They must do this translating, while continually taking in the next information spoken by the professor. Whenever I have a question or a comment, I use ASL to communicate the thought and the interpreter speaks for me to the class. That is what I did on a daily basis.

The structure and set up of the class is a key component to an accessible environment. In a typical class, I sit in the front and my peers sit to my side and rear. The professor is in the front lecturing and one interpreter at a time stands in the front with him as shown in Figure 1. When the professor uses the blackboard to point out parts of the lecture, the accessibility and understanding is much better. In a setup such as this, when a student behind me raises their hand to speak, I am the only student facing the front (watching the interpreter). If I look back at the student who is talking, the interpreter has to wait for me to look ahead at her again. This causes a delay in receiving the information. If I am in a smaller class where students are expected to interact, we often sit in a semi-circle so everyone can see each other. If a student wants to speak, the interpreter often moves to stand near that student. This is great because I can then allow my eyes to move back and forth between the interpreter and the student speaking. Any type of active-learning is always an additional help. When the professor poses a problem and then works with the class to generate feedback to solve it, understanding for a Deaf student is enhanced.

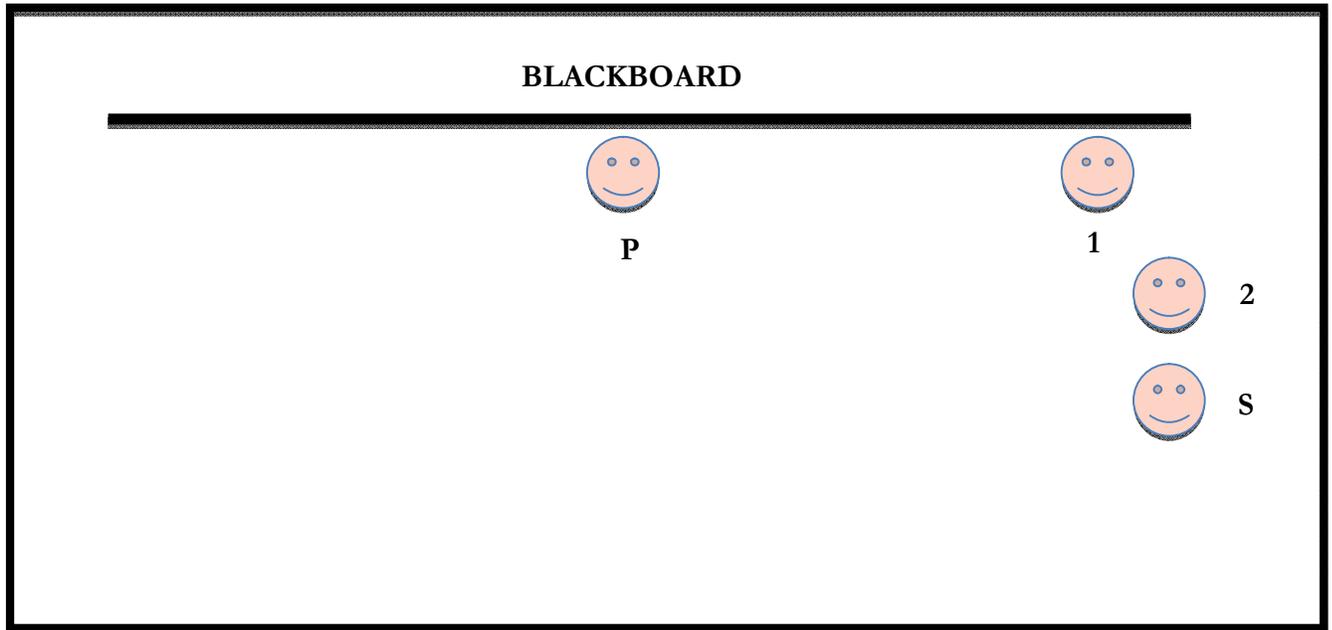


Figure 1 ó Basic classroom setup. As the professor (P) lectures, one interpreter (1) translates to the deaf student (S). Meanwhile, a second interpreter (2) is preparing for the next topic, as well as assist the deaf student.

Although I can write and read exceptionally well, it is still not easy for me to learn the way traditional students learn in the classroom. There are inherent issues in this model of communication, even though it is the best accommodation available. For example, a huge problem is the lag time which occurs during a lecture. Since I need to rely on interpreters, it takes many additional seconds for the material delivered from the professor to reach me. It has to travel from the speaker (professor or student) to the interpreter who translates from spoken English to American Sign Language (ASL). So that means, although I get all the information, I get it few seconds after the other students in the class. This can lead to some embarrassing situations. For example, sometimes I want to ask a question, but by the time I've gotten the information, then sign the question, which the interpreter then voices for me, the professor has usually moved on to the next item. I am left to feel like I am pulling the class back to something that was already discussed and is completed. This type of scenario happens all the time when I want to answer a question. By the time I raise my hand to answer the question, it's already been answered by another student. I get frustrated sometimes, but that is what I have to accept as a Deaf student. Sometimes I worry that it will impact a grade that relies on a percentage of classroom participation.

With the understanding that interpreters are the most essential key for a Deaf person to learn in school, it would be optimal to have the same interpreters for every class without changing them throughout the semester. Interpreters get familiar with the material and, in a way, learn while I am learning. The concepts and information is very foreign to a new interpreter so there is a bit of a handicap. The new interpreter might need some

support in learning the technical signs for chemical engineering terms. These are not signs that are used every day, and some concepts do not have signs at all. The interpreter and I often have to create appropriate sign for ongoing accessible communication. An interpreter, who stays with me the full semester, ends up being much more prepared for translating the material.

Like other students, I write my own notes from the professor's lectures from either the PowerPoint presentation or the black board. There is one critical difference between the other students and me. While taking notes, a student has to look down to write in his/her notebook. The moment I look down to write, I am missing vital information. Hearing students can look down and write and still receive the information. I cannot do that. So, it can get quite exhausting since I depend on my eyes the entire time. I realized during this first semester, that I did, in fact, miss information. I came home and tried to re-teach myself from the text. I believe I learned a lesson and I will request a note taker for every class from this point forward. Sometimes a note taker is simply another student who makes a copy of his notes and gives it to me every day. Even this would make my learning more pleasurable and easier.

As previously mentioned, it is unfortunately true that sometimes I have to do extra work in order to receive the same information as the other students. Even though the certified interpreters do a great job, there are still bumps in the system. The interpreters are not machines and it's impossible for perfection. After class, sometimes I ask the interpreter to accompany me to meet with the teacher. There are times I feel I have to ask the professor a clarification question, or ask students for help. I, very often, have to read and dissect a chapter to understand, more clearly, what was taught in class that day.

Although having the accommodations we have discussed is somewhat critical, I have found that as time goes on and through each semester, familiarity is a friend to the communication process. Learning the nuances of how a professor communicates, their facial expressions, blackboard writing style, etc. all help in understanding beyond where an interpreter can take me. Technology also has a place in the communication process for a Deaf individual. Devices such as the itouch/ipad/iphone all have applications that can transfer spoken language to written text. It's not perfect, but in a meeting with a professor where an interpreter is not present, this might be a viable second option along with simply typing back and forth on a shared computer.

All in all, it's not really bad to be a Deaf student in the regular class. With an ASL interpreter and an occasional note taker, everything will work out great. The key to the success of all of this is a learning institution with professors, chairs and deans who have open minds and are committed to advanced education opportunities for all individuals. Something must be going right, because I'm as excited as ever about learning chemical engineering!

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Table 1 - Survey on Students' Perspective of a Deaf Classmate (n = 24, except where noted)

	Proficient	Somewhat Proficient	Not Proficient
#1 ó What is your proficiency of American Sign Language (ASL)	1 (4%)	3 (13%)	20 (83%)

	Yes	No
#2 ó Is this the first time you took a class with an interpreter present?	23 (96%)	1 (4%)
#3 ó IN THE BEGINNING OF THE SEMESTER, I found myself more distracted in this class, compared to a class where no interpreter is present.	16 (67%)	8 (33%)
#4 ó If you answered "Yes" to Question #3, I found that I was used to the interpreters a few weeks into the semester, and was no longer distracted (n = 16)	14 (88%)	2 (12%)
#5 ó I interacted with the Deaf student outside of class	11 (46%)	13 (54%)
#6 ó If you answered "Yes" to Question #5, I found it difficult to interact with the Deaf student (n = 11)	10 (91%)	1 (9%)
#7 ó This experience has encouraged me to learn American Sign Language (ASL)	13 (54%)	11 (46%)
#8 ó If I was the Deaf person in class, I feel that I would have a more difficult time in learning the material compared to the other students.	15 (63%)	9 (37%)