

# Statistics is NOT for Dummies! Getting the Mean, the Mode, the Median... and Everything In Between!

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## Abstract

The project described in this article was initially designed to address the needs and unique learning styles of deaf and hard of hearing students in lower division General Education Math classes. At California State University Northridge (CSUN) these classes include Math Ideas (Math 131) and Introduction to Statistics (Math 140). Although the research was conducted at Cal State Northridge, our findings lead us to believe that the project is replicable in other postsecondary institutions.

## Background

The initial investigation of students' success in these lower division courses led to the findings that from Fall '96 through Fall '97, 27% to 50% of deaf and hard of hearing students received grades of D or F in one of the two lower division GE math courses. This led to the questions:

- Where is the problem?
- Are the students not capable of learning this level of mathematics?
- OR is the instructional methodology flawed in some way?
- OR do additional classroom and tutoring support make a difference?

A brief review of research in math by Dietz (1991) showed that communication as well as computation in mathematics is a critical determinant of success. In addition, students who write/discuss concerns, questions, and points of confusion become more confident in their math abili-

ties. Learning to communicate mathematically allows students to become mathematical problem-solvers.

Our analysis led us to compare the receptive modalities of hearing students and those of students who are deaf or hard of hearing. Hearing students receive information auditorily/directly; furthermore, they are able to engage in dual tasking. In other words, students are able to listen and watch simultaneously. This allows them to ask questions immediately and receive closure where gaps exist. Students who are deaf or hard of hearing, on the other hand, depend on visual reception (sign language interpreter or realtime captioner) and receive information asynchronously. Potential discrepancies between instructor and interpreter exist (e.g., "move this here"), as well as delayed opportunities to ask questions. Additionally, hard of hearing students may receive distorted information.

Table 1 below presents the summaries of performance by deaf and hard of hearing students in Math 140 for the Fall '96 through Fall '97 semesters. As can be seen in this table, 58% of deaf and hard of hearing students were successful in math classes; in other words, they passed with the grade of C or better. The research assumption is that the gap in communication and the discrepancies in information presentation are the primary factors in the low achievement (grades of D and F) for the remaining 42% of deaf and hard of hearing students in these two lower division, General Education Mathematics courses.

Table 1.

Academic Grade	Fall '96 (n=15)	Spring '97 (n=11)	Fall '97 (n=10)	Total (n=36)
A	0.00%	0.00%	0.00%	0.00%
B	6.70%	9.00%	20.00%	11.00%
C	46.70%	64.0%	30.00%	47.50%
D	13.30%	27.00%	40.00%	25.00%
F	33.30%	0.0%	10.00%	16.50%

### Project Objective

As a result of this background analysis, the objective for the project developed as follows: Specialized instructional components and teaching techniques will enable students to complete Math 140 (Introduction to Statistics) with a passing rate of 75% or better and no dropouts. The innovative element was the idea of a "Class Assistant." The Class Assistant would have a background in mathematical statistics, in the mathematical learning process, in the learning styles of students who are deaf or hard of hearing, and the sign language skills necessary for direct communication. It was determined that the Class Assistant would develop a partnership with the Course Professor and would also provide supplemental instruction through group tutoring, individual tutoring, and in-class support. The Class Assistant was not to be the Course Professor for the deaf and hard of hearing students. Additionally, the course was to be staffed with an interpreter.

The proposed impact of this experiment was that students who successfully complete this Math 140 course will have met their General Education requirements and will be better prepared for other upper division mathematics courses which might be required in the undergraduate or graduate level majors.

### Project Implementation

Personnel for the project were selected in the Spring of 1998 so as to get the course listed as being offered by the Math Department. Dr. Mark Schilling, a professor with more than fifteen years of experience in teaching Statistics and Mathematics, was asked to teach the course. Art Caplan, an interpreter and Math tutor at the National Center on Deafness, was offered the position of Class Assistant.

Why was the Statistics class selected over the Math Ideas class? Math 140 (Statistics) satisfies both the Math requirement in General Education and the Statistics requirement of several majors in the university, such as psychology and sociology. It was determined also that Math 140 would prepare students for other statistics courses required at the upper division or graduate level.

The project was undertaken during the Fall '98 semester with 28 students enrolled in Dr. Schilling's Math 140 course. Seventeen were deaf or hard of hearing students and eleven were hearing students.

### Findings

To reiterate, the project objective was that specialized instructional components and teaching techniques will enable students to complete Math 140 (Introduction to Statistics) with a passing rate of 75% or better and no dropouts. Table 2 shows the grades received by the deaf and hearing students in this Fall '98 class.

The results of the Project, as shown in Table 2, suggest that:

- There is clearly evidence of successful achievement by students who were deaf or hard of hearing;
- This project can be replicated in other math classes;
- This design is applicable to courses with smaller populations than the Fall, Math 140 course; and
- This support is relevant to any student with disabilities.

At the end of the semester students were asked for their comments and feedback. Their responses included the following statements:

"I liked the fact that most of us students were motivated to learn more about statistics. People

Table 2.

Academic Grade	all students n=28	deaf students n=17	hearing students n=11
A	7.14%	5.88%	9.10%
B	32.00%	35.30%	27.30%
C	28.60%	41.20%	9.10%
D	21.40%	11.80%	36.40%
F/U	10.70%	5.88%	18.20%
Dropped		0	
<b>Summary</b>			
Passing (A-D)	89.30%	94.00%	81.80%
Failing (F)	10.00%	5.88%	18.20%

look at me a little strange now when I say that I enjoy statistics.”

“Art was a fantastic tutor. I entered the class very unmotivated and unsure of my ability to grasp concepts. But after a few sessions with Art, I ended up loving the class. I ended up surprising myself.”

“I think that direct communication and contact are essential, especially in a math class setting.”

“I loved how the professor was very patient and the tutor, Art, was very motivated to help us. I also like that there were a lot of deaf and hard of hearing students, because we all studied together and it helped for test preparation.”

“I liked best the pace, Dr. Schilling’s availability and understanding to meet my needs.”

“I would suggest more in-class activities and more sample problems to help with preparing for tests.”

“The special tutor [allowed for] direct communication through ASL.”

“I liked best the times when I was finally able to understand the math problems.”

“Everything in the class was fine. If I were better prepared, I’d have gotten a better grade, but I am satisfied with the ‘B’ I got.”

### Summary

What follows is a summary of the statements made by the presenters at the PEPNet Conference. **Dr. Schilling:** Teaching this class was a great experience, much because of the support services pro-

vided. I don’t know how many of you noticed, but not just the lower end of the grade curve but the upper end of the grade curve showed great improvement. In previous semesters there were 11% As and Bs, while there were 40% during the semester we ran this project. In the past I’ve had deaf students, but never more than three or four at once. The large number of students in this class emphasized the fact that we were dealing with three languages: there is sign language; there’s mathematics; and there’s the primary challenge for students, all students, language. That language not only contains technical terms, but also various symbols, Greek letters, and letters with funny marks on top of them. Dealing with these three languages was quite a challenge.

One surprised me at first. I guess I was trying to be even with everyone, when a couple deaf students said, “Can we all sit on this side, please, so we can see the interpreter better?” So immediately the class was segregated, deaf students on the right, hearing students on the left. This was fine, but it was unexpected.

I give a lot of prompts when I lecture. I wait for a student to fill in an easy answer for a quick response, and you can probably guess what happened. When I would give such a prompt, immediately the hearing students would call out an answer, or possibly raise their hand, but in either case they would answer before my prompted question was even completely signed to the other half of the room. So this was a situation where I had to learn to hesitate and ignore any response until the signing was completed.

A particular issue that came up in this class was the use of computers. We used the computer lab for about ten days of the total 45 class meetings, and the computer lab presented an additional challenge. In that environment, the students have to look at the the board and the computer monitors. Throw in the need to watch the interpreter as well, and the deaf students were frustrated. Furthermore the monitors are big and tall, so students couldn't even see around them. So this was a particular problem that was difficult to control and forced me to considerably slow down my presentation.

My course is an activity based course as opposed to the traditional textbook course which requires a significant amount of reading. The text we used required more in-class activities. The reading skills of all students at Cal State Northridge are pretty weak, and this is a particularly acute problem for the deaf and hard of hearing students. So I felt that this model worked better in getting students on task with activities in class. It certainly resulted in dramatically improved performance for everyone! I would walk around and check on student work. With deaf students it is not effective to just look over their shoulders and say "Good" or "Do this a little differently," because I want to be able to do this quickly and move on. But I had to have an interpreter follow me around in order to do this. We were in a very small room, and it was hard enough to weave in and out with two people and sometimes three with Art there.

Another issue was that sometimes we had different interpreters on different days. When we had our regular interpreter, things went well. But on days when we had substitute interpreters, it was a big, big problem. In mathematics courses especially interpreters need to know the symbols. Not having the background, the substitute interpreters would have to spell out "hypothesis testing" and "confidence intervals" and all these words. The result was that they would fall behind and not quite understand what I was talking about.

The hearing students in the class adapted to the environment of having a large number, really a majority, of deaf students quite well. I think part of that was the fact that they realized that the pace of the class was somewhat limited. And they were happy to have a nice, even pace, not a rushed pace for themselves as well. So it worked quite well. But I didn't give them any overt advice, like "Hold up" or "Don't answer until everybody has a chance."

Does the project design influence the course process and outcome? I would say it does limit the pace a little bit in terms of how much can be covered. Is this a bad thing? I don't think so. I think a number of faculty have talked for some time about the fact that all of our courses cover too much material too fast. We should probably knock it down to 70% of the material, and let the time dictate what you could cover. But I was still satisfied with what we covered.

The course did not require much more planning time than is normal. The additional time involved meeting with Art and making sure that we were "on the same page." We did that on an "as needed" basis. One thing I would do in the future is to make up some sort of a glossary, a list for interpreters at the beginning of the semester, with the technical terms and the symbols, so that they know in advance that these are the things they are going to have to sign. Maybe the students can work out some sort of quick signs for specific vocabulary so interpreters don't have to spell out everything.

I think that one of the most important features of this model is to have someone who is a very capable tutor. Art was really wonderful. He's really an expert in statistics. It's a difficult subject, so having someone convey exactly just the things that I was trying to say was truly essential. I think that group tutoring and the fact that there was such a large group of deaf students who were able to meet as a group was a good model. A lot of times one student will stipulate what another student hadn't thought of or couldn't even express. So those are just some of the experiences I've had teaching this class. I really enjoyed it, and I saw it as a success.

**Mr. Caplan:** I guess I'm batting "clean up." Who understood what I just said? Batting "clean up?" This is kind of a simple sports analogy. This is a cultural point, the kind of example that comes up in classes over and over again, and causes an amazing amount of confusion for a simple statement with a simple meaning. Culture, culture of all kinds, comes up in statistics because that's the application of statistics. It's applied to culture, it's applied to politics, it's applied to everyday activity. Gaps in cultural awareness often show up in students' experiences, whether they're hearing or deaf or hard of hearing.

In keeping with my role as Class Assistant, I did go to every class meeting. I took notes, and I

watched very carefully what Dr. Schilling was presenting; I wanted to be able to emphasize the same points and use the same examples in the out-of-class sessions that I set up. I call this “supportive teaching.” I know that it is usually called “tutoring,” but it felt different than just regular tutoring sessions. I was borrowing the direct ideas from the classroom and coming up with a good deal of additional material to emphasize the same concepts. I offered about seven hours a week, sometimes up to ten or twelve depending upon which week students needed the additional support. The students would come singly, sometimes two or three, sometimes up to eight or nine typically before a test.

So, what did I notice? Would you be surprised to hear that one of the biggest problems in a statistics paragraph is not statistics vocabulary but some of the English vocabulary and culture which is mixed in with it? Take, for example, the phrase “term limit restrictions.” Does that mean there’s a restriction on the limit? Or the term? This may seem very confusing, but it is typical in the statistics book. So this type of problem would cause vocabulary questions not related to statistics at all. And much of my time in my supplemental instruction was really involved with translation: translation of culture, translation of English, and of course, translation of statistics.

In terms of tutoring strategies, I particularly like everyday examples. I used material that the students could relate to, ideas from their experiences, so there was no confusion with culture outside their experience, no confusion with any other English related problems. Just direct, simple examples to emphasize the statistics. Of course, I answered many questions about homework; that’s kind of normal for any kind of tutoring. But more than that, I brought in and made up many examples of some problems using the formulas, using the concepts from the class, specifically those concepts that Dr. Schilling was using that week. Prior to the test I brought in many sample problems and study guides, true/false questions, fill in the blank questions, calculations, and explanations of the answers. What is required in statistics is the ability to comprehend what you have observed. Students would practice writing an English sentence, explaining what they just found.

All our communication was direct sign communication. I required students to solve problems on the board. I would ask them questions to make sure they understood the point, not just show them how to solve it, but make sure they could explain it back

to me. So I really was pulling out the information more than just trying to build it in.

If you went to the Plenary Session this morning, you may have heard Harry Lang describe the characteristics of effective teaching, characteristics that fit our model. Direct communication. An interactive approach, such as when we pull out answers and the students communicate ideas back to me. Participatory learning, where students talk with each other, support each other, and answer questions in front of me and each other.

Let me say a word about interpreting in a Statistics class. When Harry Lang mentioned effective teaching, one of the important criteria he emphasized was knowledge of content for teachers. He emphasized that point. I would suggest that that’s equally important for the interpreter in the classroom. If the interpreter doesn’t know what’s going on, then the deaf students are not being served with a clear picture of a very complicated topic. It’s like the teacher is leading them through the dark forest of Statistics at night time. The interpreter only brings this to light if they can understand what’s going on.

Notes are another issue that gets easily overlooked. It’s a struggle for deaf students to take notes themselves because that means they’re looking down and up, and it is a struggle to receive all the information. Often what happens in the classroom is that another person is taking the notes, and the notes are given to the deaf students later. That is fine, except the teacher often expects that as lessons progress, definitions, formulas, explanations, and examples that are in the notes are in front of the student during that class period. And they’re often not. Several deaf students have expressed the frustration of having the information go right past them. They say that they just expect that they’ll “get it” later when they get the notes at home. So they are essentially blocked from that first opportunity to interact with the material in a meaningful way.

**Ms. Treiman:** In regard to the financial support for this project, we were able to secure funds through the Judge Julian Beck Grant that is offered at our university for innovative teaching strategies. The grant sum of \$5,000 paid for almost all of Mr. Caplan’s time in class and outside of class and accommodated one unit of released time for Dr. Schilling.

When we initially conceptualized the idea for this project, I met with the chair of the Math De-

partment. Having taught deaf and hard of hearing students, he was aware of the discrepancy issue that we were targeting as the problem, the time lag, and the different kinds of presentation (visual/symbolic as contrasted with linguistic information). After less than ten minutes of discussion, he said, "You've got my support!" He actually had to do a little more work than we did. He had to switch around professors' schedules to accommodate our needs.

### Conclusion

We began our project with the belief that the below-average achievement of deaf and hard of hearing students in statistics classes

could be significantly reversed with an approach that focused on the unique learning styles of the students. By addressing communication and information processing issues in a new way, our goal of 75% (passing the experimental course with a grade of C or better) was surpassed. Our collaborative approach, with a professor responsive to the unique needs of deaf and hard of hearing students and a class assistant employing direct communication for supplemental instruction, can be replicated in whole or in part by other institutions. This project has been one successful step toward our broader goal of providing deaf and hard of hearing students with the opportunity to achieve their true potential.