

## A MATHEMATICS TEACHING EVENT THAT CHANGED MY BELIEF

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### ***The Event***

In 1993, I was teaching a course in introductory statistics to a class of 46 undergraduate business students. It had been my practice to use open book exams so that students could focus on understanding the material free from the anxiety of memorizing formulae. For this particular class, the results from an open book mid-term exam returned a mean score of 51%. This surprised me because it did not fit with my impression of the general level of ability of the class. So, after some thought, I decided to allow a second exam to substitute for the first one, but this one would be closed book. However, I still wanted to avoid a focus on memorizing so I decided to allow the students a "cheat sheet"— a single letter-sized page of their own notes. The results were much better, with a class average grade of 71% being attained.

One observation interested me in particular. In one group of six students, one female student had made a cheat sheet and had given copies to the other five. Her score was 56% for the first exam and 97% for the second one. The grades of her five companions, three female and two male, remained virtually unchanged in the 50 – 60 range for both exams. This caused me to ponder and ended up altering my beliefs about open book exams for mathematics.

### ***Rationale for Choosing This Story***

This event forced me to reflect on my beliefs and alter them in regard to teaching mathematics. Except in mathematics, I have always set open book exams because this allowed me to set substantive questions that require thinking and reasoning to answer. Very little in life depends on mere memorizing, and it seemed to me that anxiety about memorization actually interferes with learning. This is not to say that I believe every elementary thing ought to be looked up. After all, it is hard to follow a story if every word has to be looked up in a dictionary. However, I believe that if something is truly understood then memorization is unnecessary because details can always be reasoned out. This belief follows from my own experience and is still fundamental to me.

I also believe that forcing students to memorize puts emphasis on the wrong aspects of education and undue importance on getting marks. Accordingly, by eliminating the need to memorize, so I reasoned, students would be free to concentrate on understanding the subject matter. Certain concepts would still become familiar through repeated use. This seemed to me a more intelligent and natural way of knowing something, and more valuable than any memorization forced through closed book exams. This has been borne out in all subject areas, except mathematics. After the event described above, I changed my stance on open book exams for mathematics.

### ***Analysis***

At the time, this event caught me by surprise. After talking with the students, I found that, despite my advance warnings to the contrary, many had mistakenly assumed that "open book" meant that it would be easy to complete the exam because they could look things up in the text as needed. As a result, they had spent their time memorizing for other courses whose instructors were

using closed book exams.

This forced me to examine my belief in open book exams. After some thought, as noted above, I decided to allow a second closed book exam, but with a cheat sheet because I still wanted to avoid an emphasis on memorizing. In light of the surprising improvement in the mark of the student who had made up a cheat sheet, combined with the unchanged performance of her friends who copied the cheat sheet, I concluded that it was the *process of making the cheat sheet* that mattered because, in order to select items to record, it was first necessary to weigh their importance, *which meant thinking about them and understanding their significance!* This was exactly the attitude that I was originally trying to inculcate through the open book approach.

Ever since, I have allowed students to bring into a mathematics exam a single letter-sized sheet of paper with anything they like on both sides of it, as long as it is handwritten to make sure they go through the process. My experience is that those who do this rarely need to refer to the cheat sheet itself because they had to understand the subject matter in order to prepare the cheat sheet.

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