

# **An Intermediate Approach to the Use of Technology in Teaching: An Active, Case-Based, Web-Based Approach in Teaching Introductory Statistics**

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In academia, as in other subsets of human activity, there has been an ambivalence regarding the use of technology. Perhaps technology has had more resistance from academia than from other quarters. I say this without rancor and without judgment, but rather as a measure of personal experience.

My teaching experience began in the late 80's-when the triumvirate of chalk, ink and paper ruled the classroom. I prepared materials with ink and paper, and taught with chalk. But I had two peculiarities: My use of colored chalk (which amused students and infuriated custodians); and my use of self-prepared, proprietary manuscripts (published via photocopier under the dubious title AlverNotes™).

Beyond the material details of these early days, my teaching methodology, like many others, began with lecture. In recitation sessions this led to less-lethal versions of lectures administered by senior faculty. It was also in this setting that the value of case studies and active learning/teaching models became apparent. But I was still firmly rooted in the lecture tradition—case studies and active learning were adjuncts to lecture.

My transition to full-time teaching in an (primarily) undergraduate, liberal arts environment led to a gradual increase in my use of case studies and active learning—I began to view these elements as the center of my teaching, and lecture took a subsidiary role. My undergraduate audience simply responded better to case studies and active learning than to lecture, and so my use of active, case-based learning increased. But while my pedagogy evolved away from the lecture mode, my technology stayed the same—the old triumvirate of chalk, paper and ink.

My technological conversion came after my return to graduate school and a shift to full-time consulting. This conversion was pragmatic—working and consulting in Statistics was (and is) a computer-driven process. When I returned to teaching, I replaced the old triumvirate with new technology. This is where my teaching is now.

My current model is a compromise: it incorporates elements from traditional and active-learning pedagogies, and employs an intermediate level of technology, as well as real-time classroom work. It is a real-time course, taught exclusively with web-based media (hypermedia). It exclusively employs student group based solutions of in-class case studies. The basic tenets of my teaching are: (a) active learning can match (or beat) lecture; (b) student-driven course materials can enhance learning (c) instructor-driven small student groups can enhance learning; (d) course performance is best measured via individual assessment. The basic features of my instruction are: (a) the course is delivered in real-time, in a classroom; (b) course concepts are delivered in discrete groups of case studies; (c) each case study is instructor initiated; (d) student groups work through each case study; (e) the instructor debriefs each case study, and a solution is posted for each case study; (f) student group work drives the class-work, but individual assessment is used for performance measures; (g) all course materials are supported on a website. In-class work is documented on this website in a timely manner.

## **What is intermediate about this approach?**

The technology required for this model is minimal—an Internet Service Provider, a browser, and an office application suite will put you in business, and will not require the intensive intervention of IT professionals. This model does not involve remote learning—a classroom and real-time instructor-student interaction is still employed. While active learning and group-work is integral to the learning process, the core of performance measures remains individual assessment.

## **How do I employ this method in my courses?**

I happen to teach Statistics. My approach breaks the course down into three parts: probability, design issues and descriptive statistics, and statistical inference. Clusters of related case studies support each part. Probability theory is taught as the underlying the

topics in probability, and are ideal for teaching a mathematics-phobic, non-calculus student base. In a non-mathematically oriented student audience, it helps greatly to teach probability from an empirical point of view, with emphasis on actual experiments and sampling employed rather than solely using mathematics.

The students themselves, during class-time, produce the samples that are studied. The theories presented in the case studies are directly validated by the students' actual samples. The net result is that students view probabilistic concepts in a real, empirical way. An added benefit to this approach is that the students better appreciate the stochastic nature of random samples—this appreciation is hard to come by unless actual sampling processes are employed and examined.

Case-based learning is especially suited for the teaching of Statistics. In the more usual approaches, statistics courses present single techniques, demonstrate them on a single data set, and then follow-up is carried out or via assigned problems. But the process is simple: Presentation of Technique → Demonstration of Technique → Problems Worked or Assigned. This process is apt to focus more heavily on calculation (as opposed to comprehension, presentation, and interpretation).

It is very easy to adapt this process to case-based learning. Each case study carries out, in detail, a technique using a data set. In my approach, I put as much emphasis on writing and interpretation. Calculation, writing, and interpretation are given relatively equal status in the execution of the case. For my student base, this is appropriate.

It is easy to customize the content of the course using case-based learning. A cluster of related case studies supports each key topic. Moreover, the guided solutions to the case studies can be structured in a way that emphasizes the commonality of the approaches used in the solutions.

#### **Additional Notes about the Model**

It is easy to modify a course that is taught under this model. Since the course is based on a collection of case study clusters, modifying course content is simply a matter of editing, adding or removing case study clusters.

This model also makes it very easy to incorporate a variety of sources into the course. In my case, the material on design issues is entirely separate from

material that is usually addressed in a standard statistics text. When appropriate, careful linkage of case studies to source material is necessary.

This approach can be employed with a textbook as primary source, as a course relying entirely on hypermedia, or on a combination of both.

#### **Some Limitations of this Model**

Many students are not familiar with active learning approaches, or with student groups—the early days of a course may involve some student discomfort. Regular and timely posting of case study summaries will help these students cope. Moreover, the lack of grading based on group work will also ease students' reservations about groups and group work.

A few students may have issues with the use of the technology required for this approach. At a minimum, students require access and some acuity with an Internet browser, as well as a word processor. Advance warning as part of the course documentation should head off any problems in this area.

Some students may rely too heavily on the posted case study summaries and other members of their in-class group. I simply warn my class about the importance of active participation and regular attendance through course documentation.

#### **Some Additional Benefits of this Model**

Courses taught under this model are self-documenting—by supporting the course on the website, a course archive is maintained as part of the model.

This model heavily enables student learning. The case-based learning keeps the students engaged during class, and the posted summaries and website materials allow students to do more learning and less note taking during class. Required technical writing styles are taught, in context, by example.

Once a course is fully developed using this model, it is much easier to administer from term to term. Routine term-to-term updates require minimal effort. Moreover, the modular nature of the course materials allows significant revision of the course to be achieved with minimal effort.

#### **How this Model May be applied to a Course**

First, determine how far you want to apply the model—determine the balance of lecture and case-based learning to be employed. Next, divide and sequence

material to be case-based into a series of discrete concepts. The cases need to be restricted to at most a few key concepts. Then learning can build as students work through the cases.

Once you've determined the extent and content of your cases, you'll need to develop your hypermedia. Hypermedia describes the media that is supported on the web. You'll want to develop a page, or have one developed for you, that presents your cases and supporting material. Perhaps the simplest format for such a web page is to simply post a course calendar, with each class day linked to your cases, supporting materials and solutions. You'll need a hypertext file for each item. For an example of such a page, refer to [www.mindspring.com/~cjalverson](http://www.mindspring.com/~cjalverson).

If you're using this model in a real-time course, you'll have to have access to your page in the classroom, and your students must be web active. Whether you present these requirements up front, or ease your students into them is a matter of taste. I recommend that these items be dealt with up front, as the course begins. If time permits, spend half a class session walking your students through your page. As a group, however, students are usually reasonably familiar with web usage, though perhaps not in an academic setting.

At a minimum, your page will contain the case studies, the materials required to support them, and solutions as work progresses. More elaborate pages could contain syllabi, policies, supporting references, synopses of lectures, sample tests, study guides, and the like. Whatever the content and scope of your page, a basic requirement is that you keep the files updated and current.