

# Information Is Not Knowledge: The Information Revolution

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## 1. Introduction

In the Information Revolution commission's report to the president of the University of Michigan (UM) we read:

The university is one of civilization's most enlightened creations. It simultaneously preserves knowledge and creates new knowledge that often upsets the old. A great university must be forever off-balance, caught between the past and the future. The information revolution provides a particularly disequilibrating time for the University. The magnitude of change it brings has been likened to the discovery of fire, of writing, and of printing. Information is at the heart of learning and of knowledge. If we are in an information revolution, we are in a university revolution as well.

At best, we point in a direction that must be traveled to be discovered. Nevertheless, the challenge before us is so pressing and the stakes so high that we dare not to hold back. It is the duty of a great university to reach beyond what is known, even when that means going beyond our own well-known ways of doing business (2001).

As teachers of a first course in statistics we have to assist our students grappling with the explosion of information. We need to play a role in harnessing the immense volume of information to create real knowledge as well as teaching the digital environment itself.

## 2. Statistics 100

In Statistics 100 at the UM, with four sections of 120+ enrollment per section, there are students pursuing a wide spectrum of disciplines. Using technology in a creative way may be highly effective. We can enhance personalized learning with updated material on the Web. The universal accessibility of the Web will allow students to review the material at their own pace. There is currently little material available that provides visual demonstrations of statistical concepts, and the majority of the problems and data sets in use are generic and scientifically outdated. The use of real-world data sets and visual demonstrations is a feature that the current statistics pedagogy literature considers essential to statistical education (Snee (1993)).

Not only do we need to update our courses using computer-generated slides projected onto large screens, but to engage our students so that they become active learners. Even with large classes, we demand that the students think critically and argue for and defend their ideas.

Our challenge is to present statistically sophisticated topics in an accessible, interesting and enticing way to an audience of students lacking a firm knowledge of the vocabulary and symbolic

representation of statistics. Our goal should not be to teach these students the vocabulary and symbols of statistics since they will soon forget any foreign language not used after the final exam. Instead our goals are to open the students' minds to ideas and to help them learn innovative modes of thought that empower them to approach and conquer all sorts of issues within and beyond statistics. We wish to teach students something that they will actually use in their real lives: a way of creating original thoughts.

In 1992-1993 during the calculus reform at the UM, we adopted the graphing calculator to teach mathematics, and with the arrival of the TI 83 we understood the power of teaching statistics with this technology. The way a problem is presented is crucial. We use two overhead projectors. One projector displays the problem under consideration in large letters with no more than four lines. This allows everyone to see the problem and refer back to it. The other projector is used for discussion of the solution, related examples, etc. The graphing calculator can be displayed on this second overhead so that the entire class can discover the principal with the help of the display.

How do the students sit? We begin forming groups on the first day. The instructor attaches a number to each chair, with numbers ranging from one to the maximum number of students in the class. As students enter the room, they receive a slip of paper with a number and are instructed to sit in the seat with the corresponding number. The instructor then points out the partners (a group of two) who will be working together for the first class. The partners then introduce themselves through exercises, and they exchange phone numbers. The following day students are invited to change seats if preferred, but the majority choose to continue with the original partner. Students are encouraged to work together on homework assignments. The environment is conducive to learning as well as enjoyment. Although many students have difficulty in accepting working in groups, they are likely to adapt the team approach if they understand that this is what happens in the real world.

We always personalize our classes, regardless of class size, by walking all around the room, getting close to the students and asking them questions. As the students start to respond, we walk farther away from them so they have to speak more loudly, allowing the entire class to hear. Our students are not afraid to ask questions, and even in a large class we tell the students, "We will pose many questions, and we will invite you to make mistakes. Your mistakes will help not only you but also other students to better understand. Your confusion is good because it is a tool to help us teach." We can say, "Good, that is a good mistake. It shows us what we did not explain clearly."

We carefully structure the syllabus so that the important content of statistics that must be covered during the course is offered to the students at a pace that meets their ability to learn new ideas. As their knowledge base increases, we can move faster and in large conceptual blocks. We find situations that surprise the students, believing that paradoxes are an effective tool for teaching.

Data analysis is one of many tools available for making sound decisions. It might convey how valuable data science is for learning about the world. What we teach should be up-to-date and relevant to our students' lives and to society's needs. Statistics can mislead you. It is all a matter of becoming familiar with and understanding statistics' powers and limitations. The students will later remember the striking situations where the class made a mistake.

Students must be tested on materials while still at the beginning of the learning curve so that errors can be noted immediately and corrected before they become an erroneous part of their statistical thinking and understanding. Quizzes are comprehensive; they test all previous material with an emphasis on the most current. This approach avoids the feelings that all previous assumptions about statistics are to be forgotten and that the class starts over with each new unit.

In many universities, students evaluate all faculty members at the end of the course. We do not find this helpful since the class is finished by the time we get the data. Hence, in addition to the end-of-the-semester evaluation, we do assess the class using evaluation forms that students fill out every Friday, immediately after they finish their quiz. We get feedback each week that we use to make decisions about what happens next. We believe that students came to the university intending to succeed. Our role is not to judge, not to fail students, but to be the facilitators of their successes. We strive to make the examinations challenging since we believe students want to be challenged. As instructors we have the opportunity to prepare students to meet this level of difficulty.

### **3. Web-Based Interactive Statistics Education Tools (Wise)**

The Department of the Statistics at the UM will create, during the summer of 2001, interactive Web-based demonstrations to teach basic and advanced statistical ideas for exploration of data and will develop a portfolio of case studies from various scientific disciplines to use in classes and labs.

The convergence of various institutional initiatives in the life sciences and the information technology for the undergraduate education created the team teaching approach. Students from different departments are exposed to different ideas from their own disciplines and work in teams to solve problems otherwise unimaginable to them. The WISE product will be universally available through the Web allowing students to explore and learn at their own pace.

The University of Michigan with its excellent student body makes an ideal setting for teaching new technologies and for the faculty to research how this information revolution affects the teaching, learning and global outreach. With the proposed WISE project, the Department of Statistics at the UM hopes to integrate computer-based demonstrations and to illustrate complex ideas during class using web based demonstrations.

### **4. What We Should Teach.**

- Information is not the same as knowledge. Knowledge involves the use of information. Knowledge is both personal and communal, and the learning process has personal and social implications that information gathering per se lacks.
- Existence of information does not guarantee communication. It can lead to miscommunications.
- Students need to know that context matters and how to understand context.
- How to evaluate information and become aware of some of the cultural, economic and political implications of the information revolution, and to grasp the legal and ethical issues it raises.
- Information is not necessarily reliable, accurate or valid.
- Issues of privacy and ownership.

## 5. Remarks

Heavy personal investment in instructional technology has little or no automatic payoff in academic review. The time spent to experiment with new technologies in teaching is time taken from activities leading to tenure, promotions and merit increases. Intellectual property lacks clarity and could be an inhibitor of faculty efforts in that direction. Universities and executive committees should accept innovative teaching and pedagogical research.

## 6. Acknowledgement

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## Resume

Le propos de cet article est de traiter des avantages et des inconvénients d'un cours d'introduction aux statistiques à l'époque de la révolution de l'information. Ce que nous enseignons doit correspondre à notre temps et se rapporter à la vie de nos étudiants et aux besoins de la société. *Grâce* à un bon enseignement nos étudiants devraient prendre conscience du fait que l'information ne remplace en rien les connaissances.