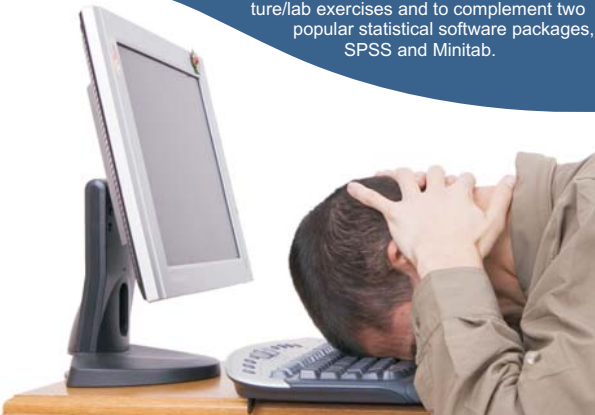


Overview & Motivation

Recent curricular reforms for teaching statistics focus on providing students with practical experiences with data and training in the use of computers to explore the fundamental concepts of inferential testing. Although computers and statistical software have freed students from the computational drudgery associated with performing many tests, students still struggle with selecting and performing the appropriate statistical analysis, interpreting the results, and understanding the connections and relationships among procedures. This Phase 1: Exploratory Project addressed these pedagogical challenges through the development, testing, and evaluation of an interactive tutorial program called StatTA. The program fosters statistical literacy by improving student competence and proficiency in practicing statistics and is designed to support inquiry-based and problem-based activities in biology. It includes interactive exercises, demonstrations, and self-test activities to help students select and perform statistical procedures, identify the connections between graphical and inferential analyses, and master the art of statistical thinking and practice. Thus, the program includes features of computer-assisted tutorials known to be effective in fostering self-directed learning, addressing a wide range of learning styles, and improving student performance and comprehension. StatTA is intended to be a supplement to traditional textbooks and lecture/lab exercises and to complement two popular statistical software packages, SPSS and Minitab.



StatTA Interface & Modules

StatTA consists of four modules linked to a central user interface (Fig 1). They include:

1. Test Selection Module (What statistical test should I use?)

The first module consists of a series of interactive pages that guide students through the process for choosing the appropriate analysis for their data and experimental design (i.e., a "decision tree"). For example, students are first asked if they are testing for associations or relationships between variables or differences among groups. If they select differences, they are then asked whether they are interested in comparing distributions, means, or variances. This procedure continues until they reach the end of the decision tree and are provided with a link to an annotated tutorial describing how to perform the selected analysis (see *Test Execution Module* below). To help students understand the connectivity among statistical procedures, final pages include navigational prompts that suggest alternative tests that may be used to analyze the same data set.

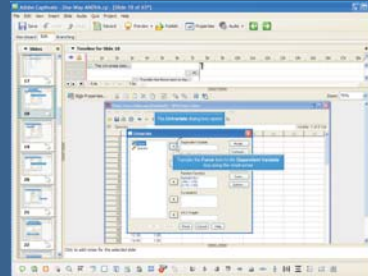
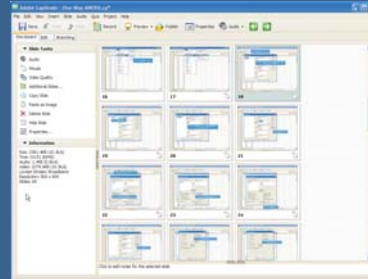


Fig 2: Sample screens of the interactive simulations and tutorials developed using Adobe Captivate.

2. Test Execution Module (How do I perform the analysis?)

To assist students with performing exploratory analyses and inferential procedures, the second module consists of a series of interactive simulations demonstrating how to use SPSS or Minitab to conduct common statistical tests. The simulations were developed using Macromedia Captivate (Fig. 2), a tutorial-generating program that records on-screen activity (e.g., mouse clicks, text input) and plays it back as executable Flash files. The simulations guide students through the steps necessary to perform statistical tests typically covered in an introductory statistics class, including t-tests, ANOVA's, regression, and correlation. The tutorials focus on how to (1) enter and format data in the data editor, (2) select the appropriate menu commands and options to run the test, and (3) interpret the output.

3. Statistics Glossary Module (What's the meaning of this term?)

The main StatTA interface (Fig. 1) includes a link to a list of common statistical terms and their definitions. The glossary is designed to help students understand and use the vocabulary typically associated with statistical analyses. The glossary is searchable using an alphanumeric index and each definition contains interactive links to definitions of related terms. Glossary terms are included as an interactive feature of the statistics tutorials. Thus, the glossary is available as both a standalone searchable database and as a hyperlinked resource that is accessible through the other modules.

4. Statistics Practical Module

The final module consist of a series of self-guided exercises designed to engage students in applying and synthesizing lecture, text, and lab material. The module is designed as a "statistics practical" in which students exercise and practice their critical thinking skills and statistical competence. Students are provided with descriptions of experiments and case studies and are asked to serve as "statistical consultants". Emphasis is placed on important test selection skills, including identifying the number and types of variables, identifying test assumptions (e.g., homogeneity of variance and normality), and defining null and alternative hypotheses.



Fig 1: StatTA main interface and menu.

Goals & Objectives

The goals of the project were to improve student critical thinking and decision making skills, to enhance their learning and understanding of statistical applications, concepts, and practices, and to increase their confidence in selecting, executing, and interpreting the results of common statistical tests. To meet these goals, the following objectives were identified and addressed:

- ✓ To develop a series of interconnected, web-based resources that include interactive tutorials and practice exercises designed to improve student competency and proficiency in practicing statistics. The tutorials target test selection skills and the application of appropriate statistical procedures to research problems;
- ✓ To field-test the program's components in a variety of educational settings, including introductory and advanced courses in biological statistics and inquiry-based laboratories in ecology;
- ✓ To evaluate the program's usability, consistency, and accuracy using feedback from expert reviewers and small groups of intended users, and
- ✓ To assess the program's effect on student learning, especially the students' ability to select and apply appropriate statistical procedures to novel research problems and to conceptualize the relationships and connections among statistical tests.



What's Next?

Evaluation of the application of the StatTA modules indicates students spend less time learning statistical software and completing computational recipes and more time learning how statisticians approach problems and interpret statistical results. Thus, instructors are able to focus on statistical thinking and interpretation rather than the steps and procedures necessary to perform a test. Results also indicate the program enhances student understanding of the scientific process and the appropriate application of statistics and experimental design.

Although StatTA was initially designed to support inquiry-based exercises in the biological sciences, students from other disciplines, including math, engineering and the behavioral sciences, can also benefit from the tutorials. Thus, we are currently evaluating its use as an alternative to traditional computer-based laboratories for courses in statistics and experimental design and as a supplement for online and distance learning courses.