

**Project RITE 2007 Final Report**  
**Testing the Efficacy of DAWG, a Suite of Online Active-Learning Modules for Enhancing**  
**Student Learning of Statistical Analysis**  
**Arnold Saxton, Robert Augé, and John Cummins**

## **Background**

The [Stats Design & Analysis Web Guide](#) (DAWG) was initiated in 2004 based in part on a [Teaching With Technology](#) award from UT's Innovative Technology Center. DAWG will be a series of online active-learning modules to supplement graduate level statistics courses. Its objectives are to guide users in selecting appropriate statistical designs and in using the SAS statistical package (SAS Institute, Inc., Cary, NC) to correctly analyze experimental data using particular designs. The first design module, [Completely Randomized Design, Single Factor](#) (CRD), has been completed and tested here at UT in a limited way. This project had the objective of a more complete student evaluation, using graduate statistics classes across the country. Questions of interest are:

- Are the modules helpful to students?
- Are the modules easy to navigate? How long did one module take?
- Do the modules aid in using SAS without spending a lot of time learning SAS?
- Can the modules be made to be more effective? Are they missing any steps?
- Do the modules improve overall student understanding of statistics?
- Do the modules have a positive impact on students in the classroom? In what ways?
- Are the modules an effective use of internet technology (IT)?
- Are the modules an enjoyable activity?

## **Methods**

A survey instrument was developed, and used for student evaluation at the University of Tennessee in January 2007. This instrument had the students take an example dataset, and implement the instructions in the CRD module on that dataset. Evaluation of each step in the module was requested. No problems with the survey instrument were discovered, so the same instrument was used at two other universities. These were two out of four that were contacted, and one conducted the evaluation around mid-semester, while the other was conducted at the end of the semester. This timing had the benefit of evaluating student response after different amounts of experience with statistical methodology and SAS. In all cases students were given course credit to encourage a meaningful evaluation. Final sample sizes were 45, 24 and 26, ordered by time of evaluation.

## **Results and Discussion**

### *How long did the module take?*

Average reported hours spent on the CRD module were 1.97 for Tennessee, and around 1.1 for the other universities. This difference ( $P < 0.01$ ) is easily explainable by Tennessee students attempting to follow the module with very little exposure to SAS. As our target audience is the novice student or researcher, the evidence suggests improvements are needed to make the module easier to utilize. One hour is a realistic time to read and follow directions in the module. Two hours suggests difficulties were encountered in translating the module into actual practice.

### *Can the modules be made to be more effective? Are they missing any steps? Are the modules easy to navigate?*

The survey instrument evaluated each of 15 steps (17 pages) in the CRD module. Students were asked to rate each step, from 1="Step was clear" to 4="Step was so confusing I could not proceed". Average scores for all universities were similar ( $P = 0.227$ ), with means ranging from 1.1 to 1.2. When scores were broken down by step, Step 8 was clearly ( $P < 0.05$ ) worse than the others, with a mean of 1.5, and only 60% of the scores being a 1 (Figure 1). Written comments from the students identified this step as very confusing, and numerous suggestions were made. Step 2 was also somewhat separated from the others, with a score of 1.3. There were no interactions between university and individual step evaluation, so prior experience did not appear to play a role in the confusion caused by these two steps. No other steps had average scores above 1.2, so in general the students found the module very clear and easy to navigate.

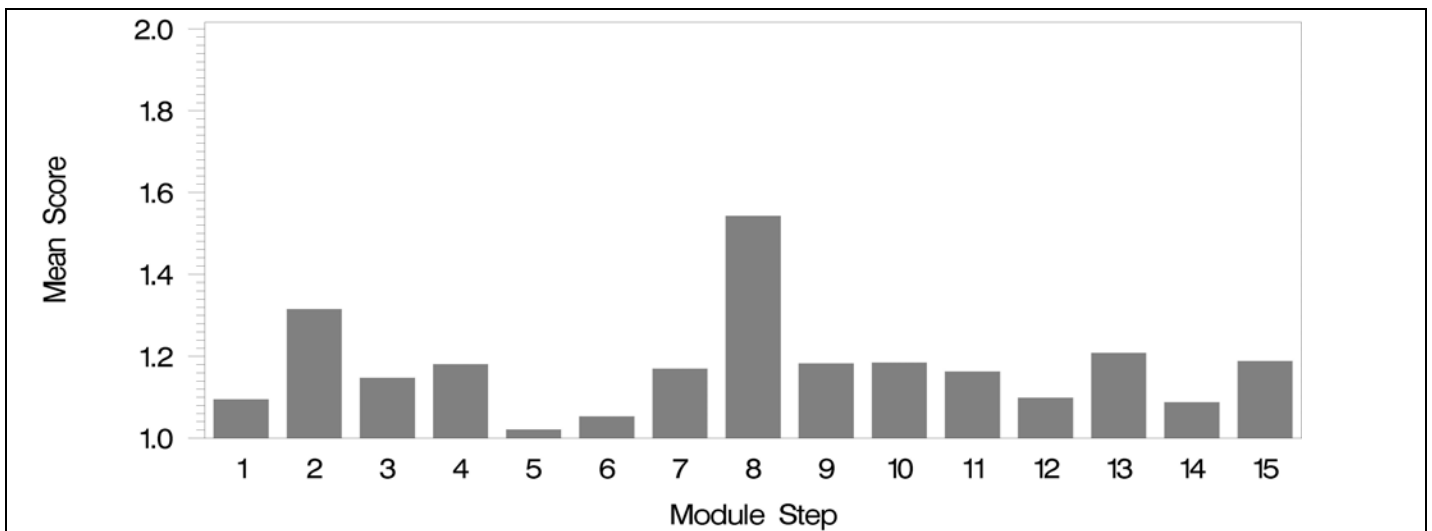


Figure 1. Mean evaluation scores on a 1 to 4 scale, with 1 being "very clear".

Students were asked if they preferred the 17 page format, or thought more pages with less information per page would be better. Our concern is that some pages/steps of the module are equivalent to a book page of text, and may appear to be overwhelming to the inexperienced. Percent in favor of the 17 page module format ranged from 73 to 79% across the three locations, unaffected ( $P=0.873$ ) by differences in prior student training. It appears that the "bookish" layout, as compared to a less "information-dense" approach, was not a major concern. Even those that thought the 17 pages should be expanded generally suggested splitting no more than 5 of the longer steps. A common remark was that it was more important to limit the number of steps and pages, rather than to make each page shorter.

*Are the modules an enjoyable activity? Are the modules helpful to students? Do the modules aid in using SAS without spending a lot of time learning SAS?*

The survey instrument specifically asked the latter question, as the module presents an approach to using SAS software without requiring the student to learn hundreds of computer language commands. The overwhelming response was "very successful". The overall approach we have taken in the DAWG modules appears to be very helpful, removing the necessity to learn the intricacies of statistical analysis software, and instead focus on scientific meaning of the results. While very few of the students said they enjoyed the exercise (statistics has that effect on most), still many made comments about how the module was helpful. Favorable comments were made about the Hints and Glossary sections of the module, designed to help with the language and common problems.

*Do the modules improve overall student understanding of statistics? Do the modules have a positive impact on students in the classroom? In what ways? Are the modules an effective use of internet technology (IT)?*

These questions were not directly assessed by the survey instrument, but student comments suggest a positive answer for all. For example, a student who evaluated the module at the end of the semester said they wished they had seen this material earlier, as it would have helped them in class. Others commented about wanting other modules to be made available.

## Conclusions

Overall the CRD module was found to be very effective at helping students and researchers conduct a statistical analysis of experimental data. The survey was also very effective at identifying necessary improvements. In particular, step 8 needs a drastic change, and overall comments suggested a more graphics, visual approach would be beneficial. A summary comment from one of the instructors was that students "were happy to have participated in the activity, believed the DAWG resource to be quite valuable, and were excited about its future development." So this project has successfully identified areas to improve, and we are encouraged to continue development of this statistics resource. The modules appear to very useful, and appear to achieve our goal of making statistical training readily available, and relatively easy to use.