

## BENEFITS OF CREATING AND SOLVING TESTS WITH SCIENTIFIC NOTEBOOK

**Marko Šifrar**

Srednja elektro in strojna šola Kranj, Slovenia

marko.sifrar@guest.arnes.si

### **Abstract**

*I use Scientific Notebook's Exam Builder to tremendous benefit. The program picks question variations and random variable values and produces solutions according to the rules I define. This way I can concentrate more on the concepts of exam questions instead of a particular exam. It is easy to create multiple choice questions because Scientific Notebook calculates both correct and wrong choices. If multiple choice question test is taken online it is graded automatically, which saves me some time.*

### **Why Scientific Notebook?**

There are many computer packages that perform remarkable computations, symbolic manipulations, and much more. I chose Scientific Notebook for a number of reasons that I find important for teaching science, and I will briefly introduce them to you.

Preparation of texts that include mathematical formulas and graphs is very easy with Scientific Notebook. There are handy toolbar icons and keyboard shortcuts for the most common mathematical objects. Documents and formulas are LaTeX formatted, which means readable form and small files. Once the formula is written, it can be easily evaluated by clicking appropriate operation on the toolbars. Either of two computer algebra systems (Maple and MuPAD) that are integrated in Scientific Notebook perform computations and graphing. There is no need for us to know any CAS' syntax.

Prepared documents can be printed or placed for online reading. This way we get electronic book that students can read or even listen to, and also



perform calculations, add graphs, solve problems, etc. An electronic book is listed in the references. Such electronic books are very attractive for students.

### **Creating tests and testing**

Creating and solving tests with Scientific Notebook combines most of the above features. First we need to create source file with questions and their solutions from which Scientific Notebook's Exam Builder will randomly extract questions for the exam, and compute solutions to the questions and save them in a separate file. Exam can be either printed or online. Online multiple choice test is graded automatically by program. It saves our time for grading tests, and gives immediate result to tested students.

Since writing formulas is easy, solutions to the problems, answers to the multiple response questions, or answers to the multiple choice questions can be quickly defined. So I prepare multiple choice questions more often, whenever I believe that basics or some fragments of knowledge should be tested. When creating answers for multiple choice questions, I include typical students' errors that I found in the free response questions during past years. This way students must have some basic knowledge, or at least be quite certain about it. After students gain some confidence with basics, I prepare tests with complex problems.

I define many variations of similar problems, so the students get different, but quite equally demanding questions. Numerical questions can be defined as variables from defined intervals. Exam Builder picks values randomly and computes solutions, or answers with chosen values. Exam Builder also permutes answers to multiple choice questions. So even with a fairly poor source file, each student gets at least slightly different exam. New questions or variants with solutions can be added to the source file any time.



Source files need not to be used for testing only. They can be used as tutorials for students' training, especially if we supply them with more explanatory solutions. We deliver them on a floppy disk or online. Online tutorials can also be linked to electronic books or our lectures placed on WWW or FTP server.

It is obvious that learning becomes more attractive with electronic tutorials. Well designed hypelinks can save some time searching for explanations, or provide information while student is very interested in obtaining it. Some students give up (too) soon. Powerful built-in CAS gives students chance to explore and experiment with mathematical concepts.

There are also benefits for teachers. In the beginning it may not look so. Writing lectures or presentations takes about same time as in any other editor, but creating exam source files with defined solutions or answers takes more effort. However, that effort seems minute to me, since I know that I will no longer have to copy/paste questions for the students that retake exams, recalculate solutions to the problems with changed values, grade multiple choice questions, etc. I much rather create new questions, prepare lectures and read than do tedious chores mentioned above.

I believe that Scientific Notebook is a great tool for teaching mathematics, from which both, teachers and students benefit a lot. I am, however, aware that the extent and the way of using it can make a big difference toward successful teaching.

## References

- Hardy, D.W., and Walker, C.L. (1997) *Doing Calculus with Scientific Notebook*, Brooks/Cole Publishing Company, California.
- Lewin, J. (1997), *Precalculus with Scientific Notebook*, Kendall/Hunt Publishing Co., electronic publication at [http://science.kennesaw.edu/~jlewin/precalculus/lewin\\_sn.tex](http://science.kennesaw.edu/~jlewin/precalculus/lewin_sn.tex)
- Majewski, M. (1999) *Experiences in Teaching Mathematics With Scientific Notebook*, 8th Southeast Asian Conference on Mathematics Education, Manila.