

## **Gateway Skills Review and Assessment – a Homebrewed Interactive Program Richard Penn, Montgomery College**

### **Abstract:**

"Gateways" are tests in which students are required to demonstrate mastery, not merely proficiency, in key skills. We show how gateways are utilized throughout the math curriculum at Montgomery College. We then describe a web-based program that the author wrote to allow students to practice, and ultimately be assessed, on these skills.

In many math classes there are certain basic skills that students must completely master in order to have a reasonable chance of success in that class. "Gateway tests", or simply "gateways", are assessments of such skills, and are designed with 2 objectives in mind:

- 1) A passing grade should demonstrate true mastery of the gateway skill; and
- 2) Failure to pass should be a substantial impediment to passing the course, so the tests should be passable - and hopefully passed! -by every student.

A testing system which meets these somewhat contradictory objectives has been used for the past several years in a community college setting, in courses ranging from developmental algebra through the calculus sequence. While the details of the system have evolved over time, the underlying philosophy has remained similar to the one to which the author was introduced as a graduate student at the University of Michigan, and he happily gives credit for the inspiration to the UM Math Department.

### **Implementation**

A gateway typically consists of 6-8 questions, depending on the specific skill being assessed. The tests are graded on a Pass/Fail basis, with at most one error permitted in order to pass. Students who fail to meet this standard are given guidance as to what they need to study, and are then permitted to attempt alternate versions of the gateway without penalty. A student may earn full credit by passing any version prior to the deadline, generally 2 weeks after the initial attempt, regardless of the number of attempts required.

The number of gateways given in a course varies, but a standard arrangement is one in which key prerequisite skills are tested early in the semester, and during the semester one or two additional gateways are given on the new skill(s) most deserving of this level of emphasis. In calculus 1, for example, the author gives a gateway on the prerequisite algebra in the first week, and one on techniques of differentiation later in the term. Each counts as 5% of the final grade, but, as is carefully explained to the students, the author has never once has a student fail either of these and go on to earn even a 'C' for the course. For paper-and-pencil gateways, the first attempt is given in class, with repeat attempts completed in office hours. Typically, 1/3 of the class would pass on the 1<sup>st</sup> attempt, and the majority of the rest would pass on the 2<sup>nd</sup> attempt. When gateways are given online, the number of attempts is not tracked so no comparable statistic is available.

## **Incorporating Technology**

In the spring of 2005 the author took a 1 semester sabbatical during which he developed a gateway program. Readers of this paper are encouraged to experiment with the program, which is accessible at <http://www.montgomerycollege.edu/~rpenn/Main.htm>, and e-mail any feedback to the author. While the program is still a work in progress, it was successfully piloted in its present form during the 2005-2006 academic year.

The program has 18 modules, each of which dynamically generates problems of a specific form. The skills tested are generally algebraic or calculus based, although some test skills as basic as fractional arithmetic. While different modules have different features, all provide instant feedback as to whether the student's answers are correct or not, and offer hints and/or solutions when a student gets a problem wrong. Most also have recap sheets which show the problems given, the student's initial answers, and the correct solution; students print this sheet and bring it to class to earn credit when the gateways are due.

This past year the author used the online gateway test in intermediate algebra and calculus 1 classes. For the calculus class in particular, the convenience of the program made it feasible to give assignments on a wider range of algebraic skills than was practical previously. Students were assigned several algebraic modules, on topics such as finding the equation of a line given a point and the slope, factoring quadratics, and solving linear and quadratic equations. This enabled weaknesses in several students to be identified and addressed before the semester was too far advanced. Later in the semester, two graph-based gateways were assigned— one in which the student needed to identify limits, and one in which the student need to find the value of the 1<sup>st</sup> derivative, and sign of the 2<sup>nd</sup> derivative, of a graphed function at a given point. Finally, students were given a more traditional "Evaluate the derivative of ... "-gateway, testing the product, quotient, and chain rules. For this last gateway only students were required to pass the test using pencil and paper; any student who needed to retake the gateway, however, was required first to earn an "admission ticket" by passing an online version of the test.

There are legitimate concerns about the integrity of the results whenever assessments are done online. So long as the gateway tests are not weighted too greatly in the computation of the final grade, however, it is likely self-defeating for a student to cheat, as the skills tested are specifically those with greatest relevance to many of the more interesting (and often more challenging) problems later in the semester. For a similar reason, the authenticity of the results on prerequisite gateways is not a major concern, as a student who utilizes outside help to pass a test of prerequisite material is unlikely to pass the class even with the help of a few illegitimately earned points. Finally, these concerns may be alleviated by incorporating a pencil and paper element, either as part of the gateway or in a subsequent test, as the author did with derivatives.

Students tend to be very grateful that they can earn full credit on a significant portion of their final grade, even if they require several attempts to do so. Furthermore, since the technology was introduced, many students have commented that they appreciate the ability to practice in a test-like setting and receive instant feedback. From a teaching perspective, the time demand in using the gateways is minimal, and the results are encouraging, as over 75% of the students passed the

derivatives gateway on their first attempt this year.

1) Find the derivative of  $\frac{e^x}{x^2 + 2x + 2}$

$\frac{(x^2 + 2x + 2)(e^x) - e^x(2x + 2)}{(x^2 + 2x + 2)^2}$

$\frac{(x^2 + 2x + 2)(e^x) - e^x(2x + 2)}{(x^2 + 2x + 2)^2}$  is correct - well done!

2:52:28 pm  
5/25/2006

Screen shot from a derivative gateway