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# Web-Based Instruction Improves Teaching

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As most DSI members know, homework and exams can now be administered using Web-based software. Such software is delivered as a stand-alone package or via Blackboard or Web-CT. These software packages have been adopted by textbook publishers such as McGraw-Hill, Wiley, and Prentice-Hall. The authors have evaluated a version of this software and found it a powerful educational tool. Specifically, we have documented that Web-based software can be used for both homework and testing to improve the teaching/learning process.

The vehicle we tested is sophisticated commercial software developed by Brownstone, a subsidiary of Horizon Winba.<sup>1</sup> This particular software has been adopted by publishers to supplement their offerings in disciplines that include statistics, accounting, finance, and other quantitative fields. The version of Brownstone's software discussed here is the one distributed by Prentice-Hall under the name Prentice-Hall Grade Assist (PH Grade Assist or PHGA) and included with the Heizer Render *Operations Management* text. After extensive use by all three authors in their respective OM classes, we can make several major points regarding usefulness and student learning.<sup>2</sup>

### System Usefulness: Efficiency and Grading Integrity

From the instructor's perspective, PHGA is a highly efficient system for creation and grading of homework and exams. This software allows randomizing problems, algorithmic variation of numbers within problems, automated grading, worked-out explanations, and a variety

of administrative options. Additionally, the assignments can be generated by problems from the instructor, the text chapters, and the text test bank. The process of creating an assignment is simple: Pick a few problems from an extensive library, establish a few parameters, and click to send them to the students. Then wait for the grades to arrive. Tests are prepared in minutes and there is no time spent grading.

The system also adds integrity to the testing/grading process. Given the current pervasive academic dishonesty (McCabe et al, 2006) this can be a significant issue. PHGA curtails academic misconduct because the problems can be randomized, presented one at a time on the computer screen, and most significantly, the data values within problems may be generated algorithmically and, therefore, be unique. Accepting that it is the instructor's responsibility to avoid dishonest systems, automated and randomized algorithmic testing is an excellent way to add integrity to the system.

A system that faculty find efficient (i.e., one that requires less time making and grading tests), combined with a reduction in student collaboration (i.e., cheating), is very appealing. Given that we can also document improved learning, faculty rationalization for use of the software is an easy next step.

### Student Learning Outcomes

The system does improve learning. Nail cites earlier use of on-line quizzes in his engineering course that led to improved performance.

The total percentage of students failing the final examination dropped from approximately 25% to 7%....

The level of improvement in performance varied among the students. In general, it was approximately a letter grade higher in the final analysis. (Nail, 2006)

These conclusions are consistent with the experience of the authors, who have been using PHGA for several years. There are many ways to utilize the software package to teach and evaluate student performance. The following three successful approaches using this technology have been used to improve student learning.

First, the system can be used to administer and evaluate homework assignments. Students often subvert the purpose of the homework assignments by not doing them, by obtaining answers via fraternity files, or by simply copying the work. Additionally, the homework may be turned in wrong. And even when grading is done promptly, the feedback to the student is typically delayed by days. However, students like immediate feedback—and immediate feedback supports learning. Feedback delayed, whatever the cause, may be education denied. PHGA not only provides unique homework assignments, but immediate grading with detailed explanations.

PHGA not only provides instantaneous feedback and also permits, at the instructor's discretion, repeated efforts to work and rework problems until mastery. When used in this manner, PHGA allows a number of good things to happen: (1) the faculty does not get in the way of feedback to the student, (2) the student gets instantaneous feedback, (3) the

faculty is not burdened with grading papers, but most importantly, (4) the student learns. Table 1 below, based on research at the University of New Orleans, indicates student homework performance via this approach. Note that both graduate students and undergraduate students average about two tries to get their work correct. The result is a 15.3 percent to 34.9 percent increase in their performance.

A variation of the homework approach was reported by Mandernach (2003). This approach had students taking online weekly cumulative reviews. On average, these students used 3.17 attempts to reach mastery on the cumulative review assignment. This approach yielded final exam scores of about 75 percent vs. 66 percent for those not participating in the weekly reviews. This increase in performance is consistent with the one letter grade improvement reported by Nail as noted above and the experience of the authors.

A second way PHGA can be used is to provide pretests for upcoming classes. With this approach, students may be assigned a selection of objective questions (True/False or Multiple Choice) and introductory problems that are representative of the text material. By specifying a cut-off time and date immediately prior to the class where the material will be covered, PHGA motivates the student to prepare for class. Again, the student is provided with immediate performance feedback without intervention by faculty. This approach has been addressed historically by "pop quizzes." Pop quizzes

may have helped, but they absorb class contact time and add to the grading burden Mandernach (2006). The judicious selection of questions for pretest can increase student motivation, class discussion, and stimulate true inquiry about the material. Students like the PHGA system and they do come to class with some knowledge of the material—an exciting prospect for the instructor. The class is the richer for it.

Finally, both homework and exams can utilize PHGA. This model was evaluated via the performance of two classes at the University of New Orleans. One MBA class had assignments using PHGA while students in the MBA control group did not. They were different students, but they were selected into the same program using the same criteria. With minor differences, the assignments were the same. The PHGA group was slightly more demanding, as Queuing was an added topic. Additionally, the PHGA group had all quizzes and homework graded for accuracy via the automated system, while the control group turned in material with homework counting for 30 percent of their grade based on completion, not accuracy. These distinctions make the PHGA class slightly more rigorous. Additionally, the control group received a grade curve of over 20 points and a weighting in the final grade of 30 percent for homework graded for effort (not accurate, just complete). In spite of the greater demands placed on the PHGA group and a significant curve for the control group, the control group scored much lower (nearly 10 points) on their

<u>OM Class</u>	<u>Sample Size</u>	<u>Improvement %</u>	<u>Attempts (Average number)</u>	<u>Attempts (Range)</u>
Undergraduate	27	17.2	1.9	1-8
Graduate	50	15.3	1.7	1-14
Graduate	63	34.9	2.4	1-17

Table 1: Student homework performance via the PHGA approach (based on research at the University of New Orleans).

overall average than the PHGA group. These findings are consistent with the work of Professors Nail and Mandernach cited above.

### Students Like the System

Students like immediate feedback. These Web-based systems provide immediate grading and clear explanations. In addition to the positive classroom experience noted by the authors of the present study, we note that Mandernach (2006) found that:

all findings agree that students learn more in classes that utilize computer-based instruction than in classes that do not, computer-based instruction is more efficient than traditional instruction, and that students generally have more positive attitudes toward instruction when it incorporates computer-based material.

Additionally, there are indications from course evaluations that students using PHGA take responsibility for their grades in a manner that evaluates teaching not on the student's particular outcome, but on his or her opportunity to learn.

### Conclusion

The Brownstone/PHGA Web-based technology is ushering in a new, improved way of teaching—and learning. All indications are that these systems do improve learning. At the same time, they allow faculty to enrich the course through scholarship and improved instruction, rather than spending tedious hours preparing tests and grading.

### Endnotes

1. Authors Heizer and Render include the Brownstone (PHGA) system as a supplement to their texts (*Operations Management*, 9<sup>th</sup> edition, and *Principles of Operations Management*, 7<sup>th</sup> edition, Prentice Hall, 2008). All three authors have used the Brownstone/PHGA software as part of their Operations Management courses.
2. A recent article by Susan W. Palocsay and Scott P. Stevens, "Empirical

research: A study of the effectiveness of Web-based homework in teaching undergraduate business statistics," *Decision Sciences Journal of Innovative Education*, 6(2), July 2008) found differences in student performance in classes using several different Web-based software, but all classes used some version of a Web-based system, and results were overwhelmed by variations between instructors and experience. In this study the instructor variable was held constant.

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