Implementation of WeBWork in 104-227 and Team-Built Assignments: Pros and Cons

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January 26 and 27, 2011

Aims of this Talk

- Present effectiveness of online assignments
- Present the virtues and tremendous opportunities of WeBWork, from national level to local level
- Report on departmental WeBWork advances
- Discuss pros and cons of team-built common assignments
- Sketch the outlines of a departmental grant proposal
- Open the floor for discussion of all these topics.

Online Assignments: AMS Homework Software Survey of 1230 departments in 2010

i) assess the experiences of departments using homework software;
ii) understand the concerns of departments that were considering such software.
Current users were more positive than prospective users. Less than 5% of users discontinued use.
Primary Benefits

- Better student learning
- Can now grade homework that previously was ungraded

Primary Drawback

- Students do not show work (can be addressed)

Online Homework Platforms

Online Homework Platforms

- MyMathLab (Pearson)
- WebAssign (Cengage/Brooks-Cole)
- WileyPLUS (Wiley)
- WeBWork (National Science Foundation)

We propose WeBWork: non-profit, free, open-source, made by faculty for faculty, we have in-house support, much larger variety of problems, system not aligned with any textbook/publisher, not aligned with any teaching style

I. What is WeBWork?

What is WeBWork? The Facts.

WeBWork is an online homework system. Features:

- Individualized homework problems (different students have different numbers)
- Gives immediate feedback on student answers, allows multiple tries on a problem, has a preview function
- Requires no software beyond ordinary web browser
- Developed by faculty for faculty, open source (complete **freedom** from publishers)
- Developed at the University of Rochester by Gage, Pizer, Roth since 1994, later with NSF Funding
- National library of over 20,000 problems: college algebra through linear algebra, complex analysis, stats, probability...
- Problems can be customized according to faculty wishes
- Instructor can see student progress in real time
- Textbook independent
- Can be used for homework, gateways, diagnostics

Virtues of WeBWork

Virtues of WeBWork:

- WeBWork increases interaction and collaboration amongst students, and between students and faculty (e.g. in class, in office hours, in chat room, in email).
- Quality of discussion is much better, since students have already thought about the problem in detail, questions are more focused.
- Students are more persistent: they work on a problem until they get it right, unlike written assignments.
- Many types of problems and answers: numbers, functions, units, anti-derivatives, vectors, matrices, ...
- WeBWork encourages class attendance (to present problems, learn solutions)
- WeBWork decreases fail rates

Testimonials

Student Testimonials

- "I can fix my mistakes while the problem is fresh in my mind."
- "I don't have to wait for lecture to see if I'm doing it right."
- "It makes you want to redo it; after finding an answer, you feel accomplished, immediate feedback makes sure you have accomplished something."

Faculty Testimonials

- "But more than WeBWork itself, the people involved with it have provided the rest of the mathematical community with not only a truly impressive system, but a level of cooperation better than any I have experienced in any undertaking during my more than fifty years as a professional mathematician." Kenneth Appel, University of New Hampshire

See MAA Website for more.

Optimization of WeBWork with Interactive Sessions

Dedic, H., S. Rosenfield, I. Ivanov. *Online assessments and interactive classroom sessions: a potent prescription for ailing success rates in Social Science Calculus*, 2008. 210 pages.

Three Test Groups in Social Science Calculus (same problems!):

1. Lectures and **graded, returned** paper assignments
2. Lectures and WeBWork assignments
3. Lectures, WeBWork assignments, and **interactive sessions in computer lab** with faculty and peer support to solve WeBWork.

No difference between 2 and 1!
3 significantly outperformed 1,2 **in all measures**: knowledge, final grade, percentage of correctly solved problems, frequency of assignments handed in, likelihood of taking further math courses, more questions posed to instructor, more help sought out of class

II. State of the Union

WeBWork at the National Level

- James Glimm, Past President of AMS: "In my role as President of the AMS, I decided to initiate some action regarding collegiate level teaching, reflecting my long held views that this is of great importance to the mathematics community, not to mention to our students and to the country. In the process, I have acquired some anecdotal evidence which is very strongly supportive for WeBWorK. The key mechanism for this improvement seems to be that the students find their homework to be far more rewarding and do more of it, and, not surprisingly do learn more."
- NSF awarded MAA half a million $ to expand WeBWork and to create a permanent supportive home for WeBWorK
- Over 240 institutions use WeBWork (high schools, colleges, masters universities, large research universities...) see map.

III. WeBWork in Michigan

WeBWork in Michigan

Michigan institutions using WeBWork:

- University of Michigan, Ann Arbor
- Michigan State University
- Eastern Michigan University
- Detroit County Day School
- Interlochen Arts Academy, Interlochen
- Catholic Central High School, Manistee

UM-A^2 said: "In our experience WeBWorK has been as reliable and more flexible than the commercial product we were using before, and the WeBWorK user community has provided support as good or better than that for which we were paying a commercial vendor. We currently use WeBWorK to administer on-line homework and tests for approximately 8000 students each academic year, and to deliver placement tests for approximately 6000 students each summer." (Gavin LaRose and Mel Hochster)

IV. WeBWork and UM-Dearborn

WeBWork and UM-Dearborn

Chancellor Little: deepen academic excellence, increase enrollment, enhance student engagement, and achieve metropolitan vision.

Lunch with Chancellor Little, 11/18/2009: What can faculty do to make the university more cost-efficient?

UM-Dearborn is also discussing online learning.

Answer: WeBWork!

V. WeBWork in our Department

WeBWork in our Department

For 3 semesters, our WeBWork assignments have been built and hosted in Ann Arbor by Gavin LaRose, for free. Local support and organization was performed by Mahesh Agarwal.
Future yearly cost (total for 3 semesters): between $0 and $2000 (approximately)

Recent Departmental WeBWork Usage
Winter 2010: 16 courses, 11 faculty
Fall 2010: 14 courses, 10 faculty
Winter 2011: 22 courses, 13 faculty
MLC does the Gateway in 113, 115, and 116 with WeBWork
Gateways and Homework in one system, with usual UM-Dearborn password, is huge simplification of administration

VI. Team-Built Common Assignments

Team-Built Common Assignments, Pros

Team-Built Common Assignments have the following advantages

- Excellent problem sets, refined every semester
- Our problems would automatically be placed in WeBWork site by Gavin LaRose with incredible efficiency using batch assignment,
  faculty merely choose a due date and click on "Assign", no extra administration for instructors
- Students from any section could solve the problems at MLC/SI sessions, with the tremendous benefits documented by Dedic–Rosenfield–Ivanov
- MLC/SI become an extremely cost-efficient support system for students and faculty
- Students have more flexibility in which SI session they attend because sessions are not tied to a particular section
- Students are more likely to attend MLC/SI since they have the concrete benefit of finishing an assignment there

Team-Built Common Assignments, Pros

Further advantages of Team-Built Common Assignments:

- Team-Built Common Assignments deepen academic excellence and enhance student engagement
- WeBWork makes our students competitive on the job market because
  1. Communication and teamwork skills improve
  2. Problem solving and math knowledge improve
  3. Students learn to carefully read and analyze a passage, check-answers, and self-diagnose
  4. Students learn how to enter math into a computer: even spreadsheets require "calculator syntax"
- After students get used to WeBWork in one course and Gateway, it is easy to use in subsequent courses and Gateways

Team-Built Common Assignments, Cons

Drawbacks of Team-Built Common Assignments:

- "Calculator syntax" takes some getting used to, but addressable through: HW Set 0, student presentations at the beginning of class, MLC/SI, office hours, chat room, emails to entire class, after students learn system in one course the future courses are easier
- WeBWork does not require students to show work, but addressable through: student presentations at the beginning of class, MLC/SI, **quizzes**, written homework, exams, ...
- If students get used to WeBWork in the introductory curriculum, how will they study in more advanced courses without WeBWork? Addressable: WeBWork is only one component of an introductory course, the other components also do the job, so students do not forget how to study without online assignments.

VII. Frequently Asked Questions

Frequently Asked Questions

- **Does WeBWork require me to change my teaching style?**
  No Way!
  Every teaching style has examples and homework, so WeBWork supports every teaching style rather than restricting.
- **Would team-built common assignments dictate my teaching?**
  No way! They are constructed collaboratively, and consist of problems each person contributes. They are refined with time according to faculty input.
- **Can students cheat because they can talk?**
  Problems are individualized, we want them to talk, not cheat. Some students will always find a way to game the system, but that is a very small price to pay.

VIII. Sketch of the Departmental WeBWork Grant Proposal

Departmental WeBWork Grant Proposal

Support for the implementation of WeBWork in 104-227.

1. Training Sessions for Faculty, especially for part-time faculty in 104, 105, 113, 115
2. SI sessions for students in 104, 105, 113, (115?), (to support both students and faculty)
3. Collaborative, team-built common assignments (refinements of sets and their solutions, customization of problems, composition of new problems,...)
4. Purchase a server? Setup and maintenance of server?
5. Team work with our colleagues at Henry Ford Community College in a 115 WeBWork pilot (e.g. training sessions, support).

IX. Opportunities and Potential, Wrap-Up

Opportunities and Potential

- Enhance student engagement and deepen academic excellence in an extremely cost-effective way (0$ to 3$ per student, i.e. 0$ to $2000 overall, approximately)
- Make our graduates more competitive on the job market
- Reduce fail rates
- Collaboration in team-built assignments
- UM-Dearborn has the potential to take a leading role in the adoption of WeBWork among Masters level universities
- Faculty publications, MAA/AMS presentations, and research on WeBWork and online learning