

Implementation Of And Student Behavior Under A Flexible Homework System

Steve Stonebraker (stonebraker.5@osu.edu)

Lei Bao (bao.15@osu.edu)

Ohio State University

Supported in part by NSF grants #REC-0087788 and #REC-0126070

Why “Flexible”?

- Students make their own decisions about homework.
 - (With some restrictions.)
- The freedoms we provide allow students to:
 - spend their time more efficiently.
 - ‘design’ their own assignments.
 - tailor the challenge level to their abilities.
 - take responsibility for their own education.
 - feel like a grownup!

Features of “Flexible Homework”

- Students may *choose* from a pool of problems.
- Problems are split into two groups:
 - Group I – Complete solutions are posted to course website several days *before* due date. Solutions can be used however students wish, short of turning in a printout for a grade.
 - Group II – Solutions are available only after the due date.
 - At least half of the problems submitted for an assignment must be from Group II.
- Assigned problems are labeled by difficulty:
 - A = Hard, B = Medium, C = Easy. Students who can solve all the “A” problems should be able to earn an “A” in the course! If they only solve “C” problems, a “C” is more likely.

Solutions and Grading

- The solutions must be very detailed!
 - Thorough, conversational, walkthrough-type solutions.
 - More words than math.
 - Address alternate methods and common stumbling blocks.
 - Point out connections to other physics ideas or everyday experience.
- HW grading can be fairly lax, but not nonexistent. Make sure students don't skip the HW entirely.
 - Small, but not trivial, portion of final grade
 - Graded on “completeness”/effort, not correctness.

How We Assign Flexible HW

- Students turn in 10 problems from a list of 15-20.
 - At least five must be from GII.
- List is split evenly into GI and GII.
 - Groups should be similar in terms of topics, difficulties.
 - If at all possible, provide parallel problems.
- Difficulties:
 - “A” level problems are for challenging the students.
 - “B” problems are ‘regular’ problems the most students should be able to handle.
 - “C” are for warm-ups or getting a handle on new formulae.

Course Trials

- Several OSU classes starting in Spring 2002.
 - Honors, non-honors.
 - Calculus-based, algebra-based.
 - Reformed lecture, traditional lecture.
 - All large enrollment intro classes. (150-250 students split into two or three lecture sections.)
 - Also, three small classes at a branch campus.
- Our data come from required web-based surveys / reports given 7-10 times during these courses:
 - Calc-based mechanics, traditional lecture. (AU 2002)
 - Honors calc-based mechanics, reformed lecture. (AU 2003)

Student Behavior

- Do they just choose the easy problems?
 - They lean towards them, but only a little. From AU 03:

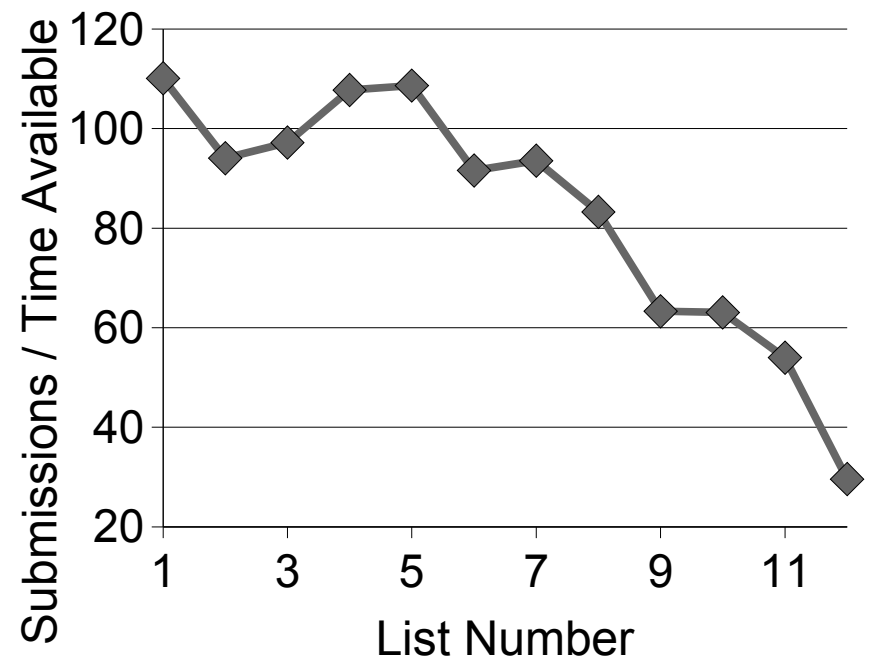
Difficulty	Tot. Submitted	Times Avail	Subm/Avail
A	4582	64	71.6
B	8862	92	96.3
C	4643	46	100.9

- Mean assigned problem difficulty: 3.089 (St.Err. = .05)*
 - Mean submitted problem difficulty: 2.997 (St.Err. = .05)
- Do they just copy the solutions?
 - Sometimes, but not usually.
 - They're well aware that copying won't teach them.

* Standard Error = (Standard Deviation)/(Sqrt[N])

How do students choose problems?

- Tend slightly towards easier ones.
- AU 2003 students marginally preferred textbook problems (Halliday/Resnick/Walker) to Context Rich (U of MN) or Active Learning Problem Sheet (“ALPS”, Van Heuvelen / Etkina) problems.
- More likely to choose problems early on the list. This seems to be the strongest effect! Almost twice as many students chose #1 as #10.



Students' Reactions

- They like it! (Duh.)
 - Attitudes about homework are almost uniformly positive.
 - In AU 2002, 85% of respondents ranked problems with provided solutions (i.e. Group I) as being more effective in their learning process than problems without (i.e. Group II).
 - In AU 2003, students ranked the relative helpfulness of homework, lectures, recitations, and labs when it comes to “learning of physics, performance on the exam, etc.”:

Most Helpful	%
HW	41
Lec.	34
Rec.	24
Lab	1

Student Performance Under FlexHW

- Liking it doesn't mean it's good for them.
 - After all, students like traditional lectures!
- Getting a “control” class is hard, but comparing yearly Mechanics Baseline Tests in a reformed-lecture course:

Year	N	HW	Raw MBT	St. Err.
2001	207	trad	16.96	0.25
2002	157	flex	18.85	0.30
2003	233	flex	18.22	0.23

- In terms of student performance, Flex HW appears to be – at worst – the same as regular homework.

The N Students were split among three lecture sections. Staff continuity from year to year:

2001 Van Heuvelen, Van Heuvelen, Harper

2002 Van Heuvelen, Heckler, Adelson

2003 Heckler, Reay, Hammel

Achievement Levels

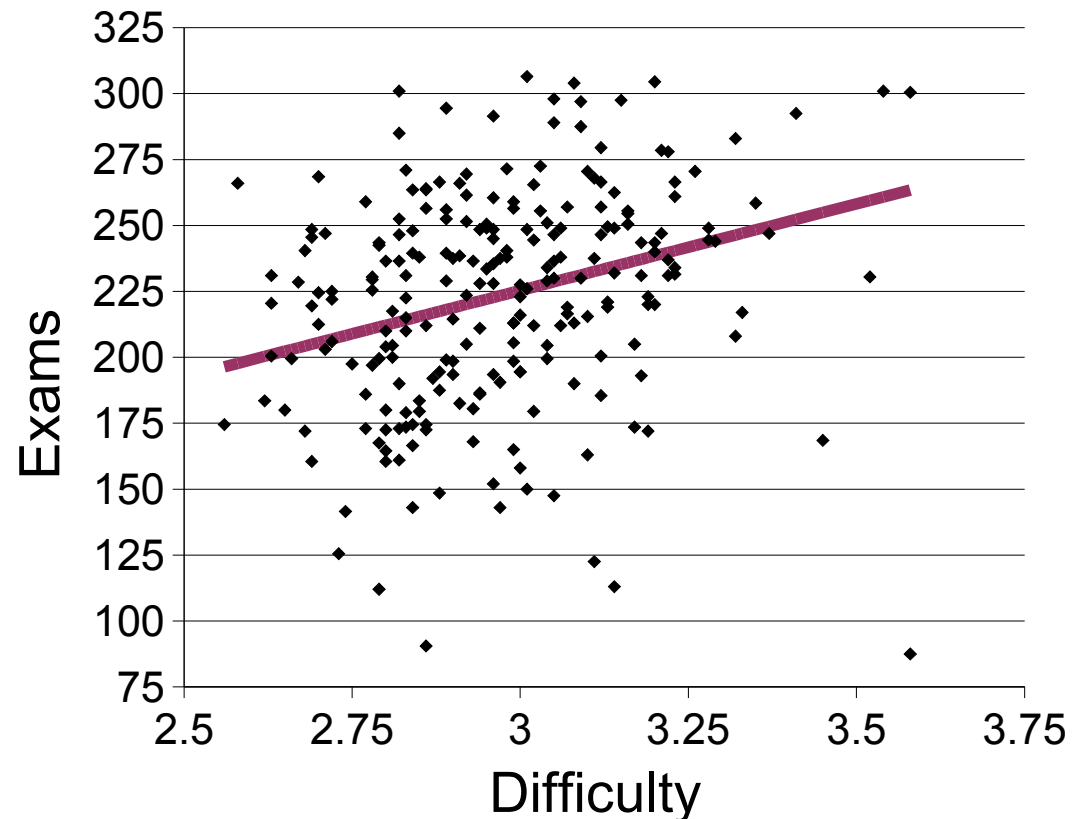
- In general, better students are spending slightly *less* time reading solutions, and reading fewer of them.
- We asked AU 03 students how often they read ‘extra’ solutions. Broken down by the total of their exam scores for the quarter (out of 350):

How often?	Ex > 250	Ex < 250
Never	34.1	19.7
A little	56.8	58.3
A lot	9.1	22.0

- One trend goes the other way:
 - correlation of exam/MBT scores with submitted HW difficulty

Achievement and HW Difficulty

- Correlations:
 - HW difficulty and exam: $r = 0.302$, $p = .00000296$
 - HW difficulty and MBT: $r = 0.228$, $p = .000483$
- What's the causality?
 - Strong students challenge themselves with harder problems?
 - Working through harder problems makes stronger students?



Our arbitrary number scale for difficulties is like letter grades: A=4, B=3, C=2.

Summary

- Flexible HW *can* be better for the teaching staff:
 - Cursory grading is sufficient, reducing the workload.
 - The solutions – if done well – take a long time to write, but they can be reused from year to year to save time. Also, they are actually *worth* reusing.
- Flexible HW *is* better for the students:
 - Our students learn at least as much as with regular HW.
 - They strongly *prefer* the Flexible HW system. It makes them happier students.

Future Research

- Find the direction of causality in the difficulty / grades relationship.
- Deeper analysis of which problems students choose and why. What features are alluring to them?
- Effects of different types of provided solution. How complete should they be? How long is too long?
- Wider adoption FlexHW system and/or variants?
 - If you are interested in trying something like this out with your class, please contact us! We can give you advice, share ideas, etc.. Write to the author: stonebraker.5@osu.edu

Title

- Point 1
 - Sub-point A
- Point 2
- Point 3