

Better Than Expected: Using Tailored Communication to Optimize Learning

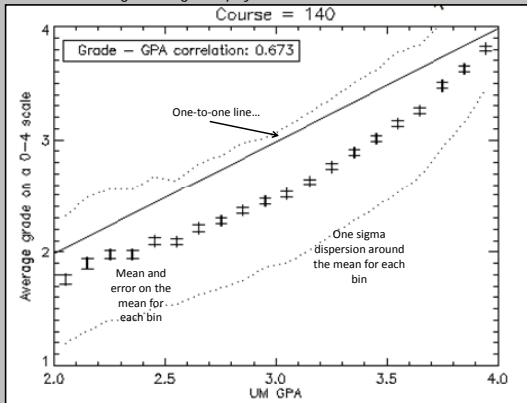
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Who does better-than-expected?

In 2008, we began a learning analytics project aimed at understanding student performance in large introductory physics courses. The 'Better-Than-Expected' (BTE) project gathered information describing the progress of 48,579 UM students through these courses over a period of 14 years. In this dataset we combined detailed information about the student on arrival in the class (including standardized test scores, high school and prior UM GPA, socioeconomic status, gender, etc.) with a full portrait of their progress through the course (including homework grades, classroom participation, exam scores, and final grade).

These data allowed us to quantify the correlation between student preparation, background, and initial performance on course outcomes – to construct predictive models of student success. We find that final grades can be predicted from information about an entering student quite well, with a dispersion of half a letter grade. The simplest predictor is incoming UM GPA.

Example results from the UM "Better than Expected" project for Physics 140, the first semester course for engineering and physical science students.



Mean grades (as points with error on the mean) and one σ dispersion (as lines) as a function of UM GPA at the time the course begins. These are challenging courses, with mean grades lower than typical GPAs.

How to reach every student?

Once we know where each student is coming from, what they're doing right now, and where they're likely headed, we can do something about it - we can provide the advice and support each student needs. But the problem of scale remains. In courses which enroll many hundreds, having the information is not enough, we must have the capacity to act on it. We have used support from the Next Generation Learning Challenge to build the E²Coach system, launched in January 2012.

E²Coach is a learning analytics driven intervention engine, designed and built to support all students. At its core is the power of computer tailored communication; the ability to design unique content for an individual based on data known about them. E²Coach is built on the Michigan Tailoring System (MTS), a mature open-source software package developed and supported by the UM Center for Health Communications Research. It allows us to give every student a website containing complex feedback, encouragement, and advice which is aware of their background, current standing, and concerns, sensitive to their ambitions and identity, and responsive to their progress as the term goes on. Because these messages, designed by a team of experts, are computer generated, they are as easily delivered to a class of 700 as they would be to a class of 20.

Gathering Advice for E²Coach

Collecting expertise:

1. **Introductory students:** The Center for Research on Teaching and Learning (CRTL) conducted interviews with 19 previous students who did better- and worse-than-expected
2. **Advanced undergraduates:** CRTL surveyed 78 Science Learning Center (SLC) physics study group leaders
3. **Faculty:** Interviewed 9 introductory physics teaching faculty members
4. **Literature:** Examined inter-disciplinary research including Physics Education, Psychology, Behavior Change Theory, etc.

Programmed logic within the MTS framework

What does E²Coach offer?

Tailored feedback and advice

Performance status updated as the course progresses

Testimonials that match the student's identity

Tiara, a pre-med student who earned an exemplary grade when she took Physics 135, says: "PRACTICE! I can't stress that enough. Physics is a very application-oriented course. You can't just memorize facts and hope to get by."

Values Affirmation Exercises

"My family and close friends are most important to me. They are my backbone and support me through everything I try. Second, because I want to become a doctor, I value learning and gaining knowledge. In order to be successful in school and in everyday life it is important that you're well-educated. Finally, I value a sense of humor because it's a big part of who I am today. It's important for me not to take things too seriously despite all of the stresses of school."

...and more...

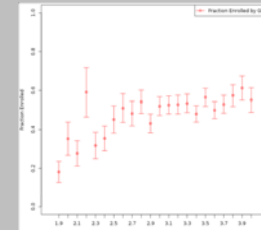
Implementation in W'12

- E²Coach was used by 950 students during the winter 2012 semester!
- Available in the life science sequence (Physics 135/235) and the engineering/physical science sequence (Physics 140/240)
- 7 communications delivered throughout the semester
- Survey given at the beginning of the semester; students may opt-out
- Data collected includes:
 - General Information (e.g. name, UM cumulative GPA, college)
 - Future Plans (e.g. concentration, post-graduate plans)
 - Science/Math Background (e.g. high school physics, college math)
 - Plans for this semester (e.g. expected hours of study, Physics Help Room use)
 - Attitudes (e.g. physics is innate, confidence)

E²Coach Status

E²Coach Opt-In Enrollment in Winter 2012: by Engineering, by Gender, by Course, and by GPA

Students with weaker GPAs enrolled in E²Coach less often



- More females students chose to enroll
- More students in first-semester courses have chosen to enroll, especially Physics 135

		Physics 140	Physics 240	Physics 135	Physics 235	All Courses
Both Genders	Total	292	145	1	0	438
	Percent	53.0%	47.4%	N/A	N/A	50.9%
Engineering	Total	501	306	7	1	805
	Percent	53.0%	47.4%	N/A	N/A	50.9%
Male	Total	416	245	7	1	664
	Percent	47.1%	41.0%	N/A	N/A	45.0%
Female	Total	85	61	0	0	146
	Percent	71.1%	61.4%	N/A	N/A	70.9%
Both Genders	Total	92	43	187	174	496
	Percent	95.8%	53.8%	68.9%	63.2%	52.1%
Non-Engineering	Total	112	59	134	200	505
	Percent	42.0%	47.9%	66.4%	58.5%	41.0%
Male	Total	45	15	206	111	277
	Percent	69	21	154	203	447
Female	Total	67	44	81	83	217
	Percent	65.2%	71.4%	68.8%	55.7%	62.4%

We will move to an automatic enrollment system in Fall 2012, integrating E²Coach into the rest of the course structure, including the gradebook

Student feedback, usage information, and initial measures of impact

Student feedback:

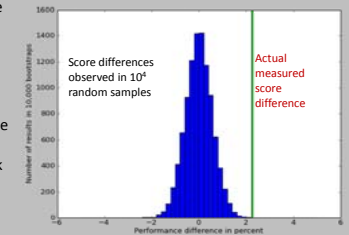
"I make a point to read through every advice topic that is given to me as soon as I notice they're up and I always check the status section to see about where I'm predicted to be."

"I felt some of the most helpful things I got from ECoach was that you should work and rework problems and make sure you really understand...and that you should make sure you are relaxed going into the exam so that you can perform your best."

"Usually working hard on your own yields good results, but it makes things easier and usually improves your results when you have people giving you pointers on how to study, how to succeed in the course, things to look out for, and such."

Performance impact:

This first trial term ended one week ago. For initial performance tests we have compared final scores for students enrolled in E²Coach to those not enrolled. Enrolled students across all courses had a 2.3% higher final score. While not a large effect, it is highly statistically significant. We are now examining this performance difference as a function of E²Coach usage patterns.



Next Steps

In this initial implementation we required students to opt-in to the system. The data above show that many of the students we most want to reach have not taken advantage of what E²Coach has to offer. We have come to realize that while developing message content is important, so is building a system that engages the students with the material.

We are planning on requiring E²Coach participation for the Fall '12 semester for all physics students. We are also considering expansion to other STEM courses which serve diverse populations. In the long run, we believe E²Coach can play a more general role in personalizing the interactions between students and the University.