Investigating and Mitigating Students’ Illusions of Competence

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Illusions of competence

“The fool doth think he is wise, but the wise man knows himself to be a fool.”

As You Like It, Act V: Sc 1, line 34

i.e. the most confident in their level of expertise and skill are not necessarily those who should be...
The *Dunning-Kruger Effect* is a cognitive deficit that plagues the unskilled.

- The poorest performers are the least aware of their own incompetence.

  "the miscalibration of the incompetent stems from an error about the self, whereas the miscalibration of the highly competent stems from an error about others"

- This effect has been replicated among various situations.


We undertook a large-scale study of this phenomenon in General Chemistry.

• Studies of the Dunning-Kruger effect involving authentic classrooms are few and those involving STEM classrooms are fewer.

• We collected data from nine General Chemistry I and four Chemical Principles for Engineers classrooms.

  traditional lecture/lab course formats
  exams required written problem solving and short-answer responses

  General Chemistry I: 65% female students and 35% male students, predominately biological (60%) and health sciences (30%) majors

  Chemical Principles for Engineers: 15% female students and 85% male students
We can measure *illusory competence* in two ways.

**on midterm exams:**

How well do you think you performed on this exam compared to other students in the course?

*I think I performed better than ______ percent of students in the course.*

Error bars are 95% confidence intervals.

Data are from the *Chemical Principles for Engineers* course.
We can measure *illusory competence* in two ways.

**on midterm exams:**

This exam has a total of 100 possible points. How many points do you think you will receive on this exam? I think I will receive _______ points on this exam.

![Graph showing actual exam score and predicted exam score with error bars. Error bars are 95% confidence intervals. Data are from the *Chemical Principles for Engineers* course.](image)
How does the phenomenon vary from classroom to classroom?

What is the effect of sex on this phenomenon?

![Graph showing the effect of sex on academic performance in General Chemistry I course.]

To what extent do students’ self-perceptions change over the course of the semester?

• We want the unskilled to adopt different learning strategies, study skills, or seek out help.

• Why not just directly TELL the incompetent that they are incompetent?

Typical course feedback does this (to an extent). Does it work?

To what extent do students' self-perceptions change over the course of the semester?


Data are from the *General Chemistry I* course.
"poor performers do not learn from feedback suggesting a need to improve"

Pause for thought.

In what ways do these data manifest themselves in your classrooms or in your interactions with students?

In what ways do you think differently about your students of lower skill in light of these data?
"poor performers do not learn from feedback suggesting a need to improve"

How can we intervene on behalf of the low performers so they may engage meaningfully in course feedback?

Let’s add another dimension to the *formative assessment loop.*


We created an activity that scaffolded student engagement with course exam feedback.

In the *Chemical Principles for Engineers* course, students were given the option to self-assess their midterm exam performance according to a set of instructor prescribed guidelines.

*What did you do wrong? Why was it wrong? What kind of response do you think would get more credit? How can you change your studying?*

Task feedback was provided by instructor; process feedback emerged as students completed the activity.

*Students could “earn back” up to 33% of the unearned exam points.*


The activity had a consistent effect on student miscalibration (as measured by percentile rankings).

120 students completed a self-assessment, 327 did not.

error bars are 95% confidence intervals
The activity had a consistent effect on student miscalibration (as measured by percentile rankings).

Note: we see the same trend when we monitor miscalibration using raw exam score predictions.
The activity had a consistent effect on student performance as well.

120 students completed a self-assessment, 327 did not.

*error bars are 95% confidence intervals*
The activity had a consistent effect on student performance as well.
Barb Reisner (James Madison University) used Gradescope to implement this self-assessment activity.

• About one third who did this activity stopped by to talk to me about chemistry. The students asked interesting questions about inorganic ideas and these questions weren’t just about the test!

• Apparently, inorganic chemistry was a topic for lunch discussion for several days while they were doing the activity. (I always feel good when my class makes the lunch discussion!)

• Lots of the students worked in groups to explain the chemistry to each other. They spent lots of time on task and felt like they understood the chemistry better. By talking about this exam again, they had another opportunity to review.

https://www.gradescope.com/
https://www.ionicviper.org/blog-entry/learning-ionic-community
Barb Reisner (James Madison University) used Gradescope to implement this self-assessment activity.

• Because students had to do more explanation in the activity, I was able to learn about some persistent misconceptions.

• I thought that students would get a lot more correct when they could use nearly any resource to revise their understanding. On average, students earned just over 50% of their points back. Although there isn’t a strong correlation, stronger students tended to earn back a larger percentage of their points.

• I was a bit surprised at some of the basic things that they just don’t know. I realize that there are some very persistent misconceptions that I was not able to help students get past.

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https://www.ionicviper.org/blog-entry/learning-ionic-community
A twist on the activity for more advanced students…

In smaller upper-level courses, I photocopy exams as soon as they are taken and pass back student work without task feedback.

Students must look at their own work critically and discover their errors; they pass in their self-assessments when I pass back graded exams.

This activity tends to stimulate a good deal of dialogue between students as well as with the instructor.
Pause for thought.

How can you increase student engagement in the feedback you provide in your courses?
Thanks for attention and cooperation!

Any last questions or concerns?