

Don't Lecture Me: Tutorial-based Curricula for Advanced High School Physics

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Background

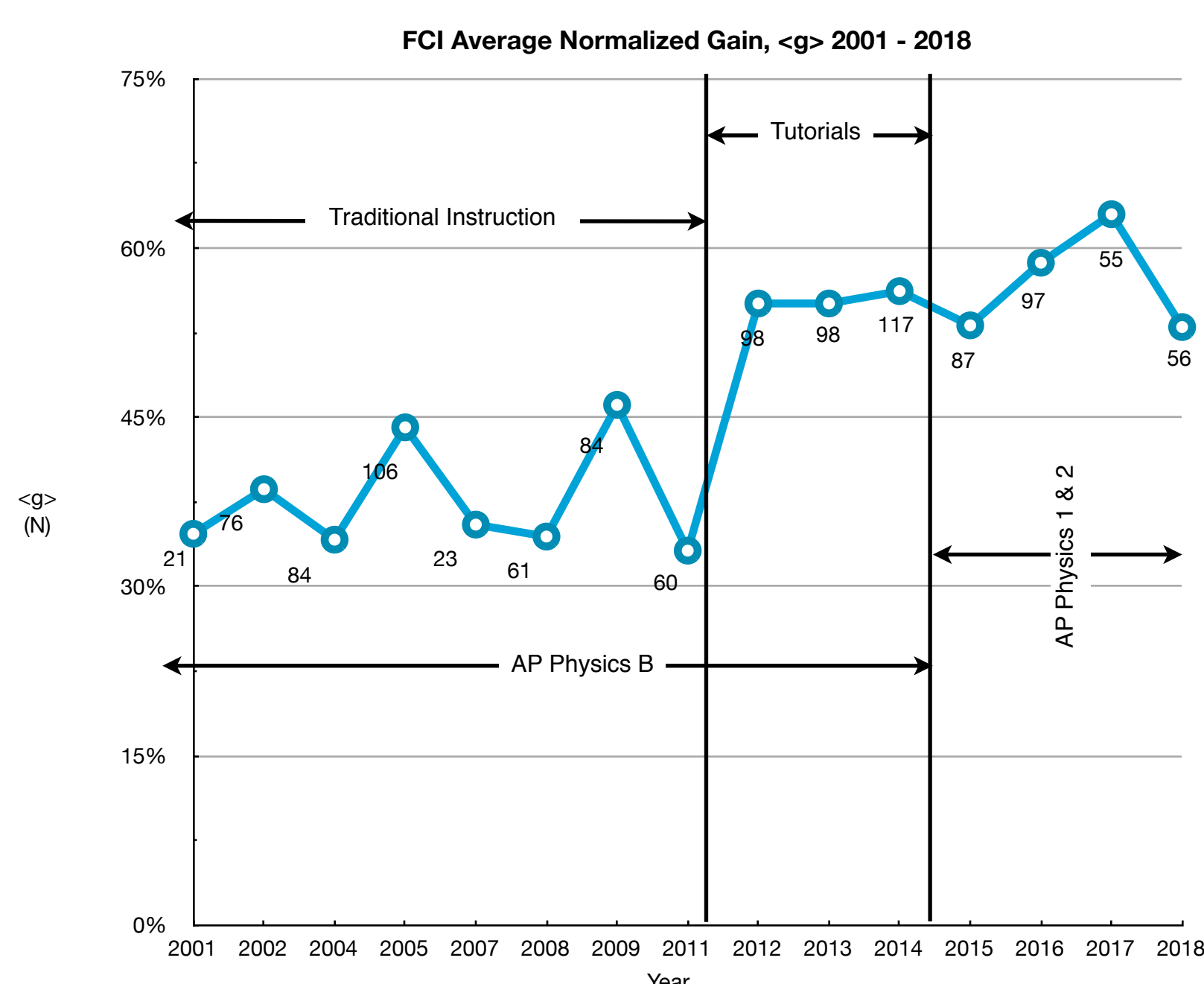
Punahou School in Honolulu is the largest private K-12 school in the country, with a total enrollment of 3,750 and a high school enrollment of 1,750. Punahou offers courses for every AP Physics exam, as well as Honors and Regular Physics. Enrollment averages over 100 for AP Physics 1 & 2, and over 30 for AP Physics C.

In stages over 10 years, Michael Gearen of Punahou worked in conjunction with The University of Washington Physics Education Group (McDermott, Shaffer) to develop tutorial-based curricula for AP Physics B (now AP Physics 1 & 2) and AP Physics C Mechanics and E & M, based in large part on their publication *Tutorials in Introductory Physics*. *Tutorials* has influenced physics curriculum development for decades, mostly at the college level. The materials were first exclusively used as complete course curricula in 2012 by Gearen, Clarke, Coke and others, and have undergone minor revisions since first implementation.

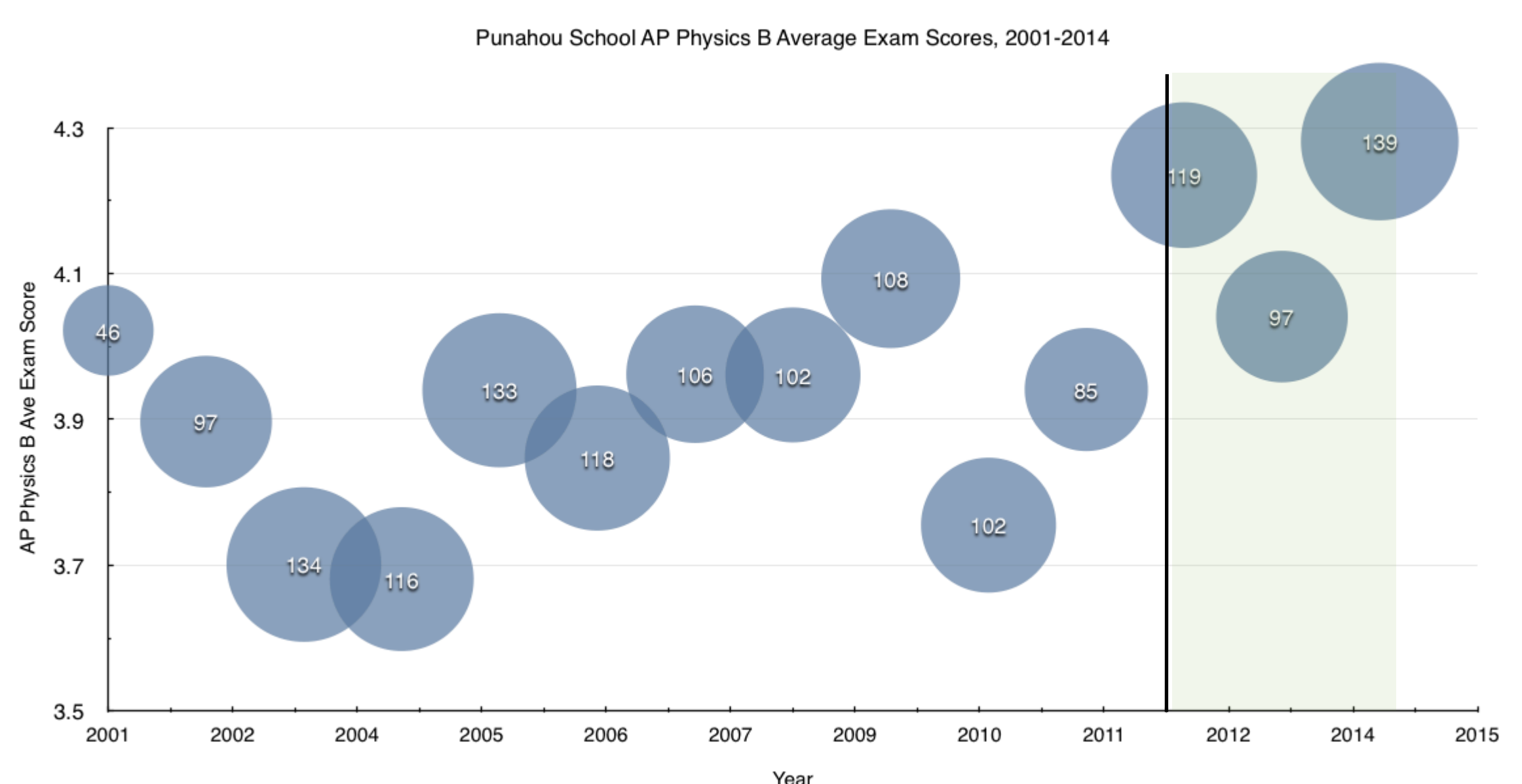
In class meetings, students work in groups of 3-4 with little direct instruction. Teachers facilitate discussion, probe student thinking, and help groups keep up with the accelerated pace. The curricula integrate both gathering/analyzing experimental data and concept development/problem solving using tutorials, with demonstrably positive results.

Student Learning and Exam Performance Pre and Post Implementation

Among the metrics used in determining learning impact were pre and post Force Concept Inventory (FCI) performance; after implementation in 2012, significant increases in gains were measured on FCI. Performance on the AP Physics B exam and the AP Physics C Mechanics and E & M exams showed significant improvement, and performance on the new AP Physics 1 and 2 exams are well above national averages.



Class normalized gains <g> on pre- and post Force Concept Inventory performance in AP Physics B and AP Physics 1 and 2. Greatest gains occur post-implementation.



AP B Exam Performance, 2001-2014: 1st (2014), 2nd (2012), and 4th (2013) highest score averages over 14 year period.

Student Feedback Pro and Con

- I'm more of a lecture and apply kind of learner, so trying to figure things out on my own is very **frustrating**.
- I believe that certain ideas need to be taught in a traditional lecture style. Ideas and concepts that are key to the lesson should be taught lecture style in order to avoid any initial **confusion**.
- Asking [teachers] didn't help because they would hint at things to try to get you to answer it on your own, but the point is that you really just don't get the concept and so you don't ever **get your answer**. Sometimes I just needed someone to say this is this and that is that.
- I think this class would be better if all of the concepts and equations were **given to us** and we just had to solve problems using the given.
- Small group is great to actually **learn to think** instead of just letting the teacher do all the thinking.
- It allows students to come up with individual questions and also gives them time to work with other students and **brainstorm**. The teachers are also able to help more people during the class.
- I think that group discussion does work better, since you're required to **think and explore for yourself**.
- I noticed that lectures take much less time, but interactive group environments help me **remember things much better**. I think that the process of experimenting, talking, and making mistakes is more productive, even though it takes more time.