IBL Education Fad

The Notices has now regaled us with more than enough of the IBL (Inquiry-Based Learning) education fad ([1], [2]) that is particularly ineffective in regard to communication of mathematics. Would-be mathematics students are coming to the university having experienced less and less direct instruction from knowledgeable teachers and well-written textbooks and are becoming weaker and weaker math students. University-level IBL is more an attempt to educate ill-prepared students without repairing easily identified deficits than an effective pedagogy for the communication of mathematics (the “Moore method” is excluded and is irrelevant to the discussion).

Using the four bullet summary of [2] in the December Notices, we look at actual outcomes:

- Restating what students said or did in more conventional or formal terms. Students are demonstrably worse in recognizing and using conventional or formal terms. Emulation of perceived experts (parents and teachers among others) is one of the most powerful forms of communication. Deliberately avoiding it is bringing along students who use unrecognizable or incorrect mathematics language. “Restating what students said or did” is an ineffective remedy that requires first unlearning unconventional invented terms along with too many misconceptions as well.
- Introducing a new but related concept, definition, representation, or procedure that extends what students did. Here we have an implied acknowledgment of how much the students have missed by not having the ideas presented in traditional, logical order with important implications and corollaries systematically included.
- Restating a student’s explanation and attributing authorship to the student or students, i.e., creating the sense that mathematics is arising out of students’ own work. Attributing authorship to the student or students to mathematics arising out of students’ own work? Compare and contrast with Newton’s famous statement, “If I have seen further, it is only by standing on the shoulders of giants.” Except for minor extensions of known results, even geniuses often miss underlying structure of new situations. Small groups of ordinary students with little to no careful guidance creating mathematics successfully? Even good students know better. Moreover, where is any of the intrinsic history of the discipline?
- Restating student ideas in ways that connect to established mathematical culture.

See the first bullet. Even when the students’ ideas are correct, the language still needs to be “cleaned up.” More often than not, the ideas themselves need to be cleaned up; they carry elements of validity with a lot of misconceptions that are badly in need of repair.

All of these problems are bad enough but they are not the worst; the worst is lack of coverage of standard mathematics content. Comparative data-based evidence is hard to come by in mathematics education but occasionally we get glimpses of reality. Although PISA is vastly inferior to TIMSS regarding international comparison of precollegiate student mathematics performance, the former has gotten much more publicity and study. One study ([3]) conducted an intensive look into the reported pedagogical approaches of schools in the PISA assessments:

“We analyzed the PISA results to understand the relative impact of each of these practices. In all five regions, when teachers took the lead, scores were generally higher, and the more inquiry-based learning, the lower the scores.”

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References


*We invite readers to submit letters to the editor at notices-letters@ams.org.
Response from Rasmussen et al.
The claim that mathematics students come to the university less prepared than the students who preceded them is a popular bemoan of mathematics faculty today as it has been in the past. The data simply do not bear this out. One reliable measure of high school students’ mathematics achievement is SAT and ACT mathematics scores. 2017 was a baseline year for the new SAT test, so comparison to test performance from previous years is not possible. ACT [1] reports that overall levels of readiness for college remain steady, but that underserved students continue to lag behind their peers. It is important to point out that the number of test takers has increased for both the ACT and SAT, meaning more students each year are considering entering college and yet scores have remained relatively stable. Regarding the study [2] investigating the pedagogical approaches of schools participating in the PISA assessment, we point out that the continuation of the cited quotation goes on to argue: “That sounds damning for inquiry-based learning at first glance, but by digging deeper into the data, a more interesting story is revealed: what works best is when the two styles work together—specifically, with teacher-directed instruction in most or almost all classes, and inquiry-based learning in some.”

This is exactly what we (e.g., [3]) have argued: that mathematics faculty should be well versed in a variety of pedagogical approaches and, more importantly, understand what it means to teach in a format other than lecture. While one might characterize inquiry-based learning as a “fad,” we argue that student-centered approaches to mathematics instruction require more detailed and clear articulation, discussion, and debate, since few mathematics faculty are prepared to teach in these ways. Our goal is to stimulate discussions about what to do when you are not lecturing in your classroom, not to advocate that there is not a place for lecturing. Further, we define Inquiry Based Learning in terms of principles, and in our article we provide tips on specific instructional strategies with the understanding that instructors have pedagogical autonomy but also may need some practical tips on what to do if they are not lecturing. Interestingly, recent national studies [4] show that students are more likely to continue studying mathematics when they are in a classroom that employs some active learning techniques. We also find that instructors do not feel prepared to carry out such strategies in their classrooms [5]. National survey responses [5] indicate that over 90% of mathematics departments denote active learning as somewhat or very important, yet less than 15% of departments reported that they felt active learning was implemented very successfully.

Finally, it behooves us to attend to recent studies demonstrating evidence of increased performance by students in STEM classes with some active learning [6] and the promise for active learning to decrease the achievement gap for underrepresented minority and first generation college students [7].

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References
Letters to the Editor

Response from Ernst et al.

We stand by our statements in our article and invite math instructors to join us in engaging in productive, fruitful discussions about IBL methods in mathematics courses. IBL is not a fad. It’s an empirically validated and highly effective method of teaching, fully endorsed by all of the major mathematical associations, including the AMS.2

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“Infant in the Real World”?
The quote by Sylvain Cappell (Notices, December 2017, p. 1330) made me feel both mildly amused and annoyed. My wish is not to be characterized as an “infant in the real world.” Over the years I’ve been fortunate to have met many colleagues from all over the world. We are responsible adults, perfectly able of cooking spaghetti (and more advanced dishes), signing a mortgage contract, and taking the kids to the pediatrician when needed. It’s time we mathematicians embrace our normality.

—Peter Hinow
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Response from Cappell

I hadn’t noticed that quote from me in the Notices. It was first published by Sylvia Nasar as a chapter heading in her biography of John Nash, A Beautiful Mind. She’d interviewed me several times in a memorably charming, but alas now long gone, Greenwich Village cafe, Pane and Cioccolato, where I’d passed many wonderful times with research collaborators. However, she (I’m sure inadvertently) made it more definitive than what I’d said, as I told math pals when her book appeared (and as anyone who knows me and my reluctance to generalize about people could guess). I didn’t actually say that “a mathematician is an infant in the real world, but...” just that “a mathematician could be a child in the real world, but...” I’ve always felt a bit unhappy about this slight error in quoting me for precisely the reason Peter Hinow states.

—Sylvain Cappell
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