Where are the two-year college faculty?

A response to "The Past, Present, and Future of the IBL Community in Mathematics"

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In this brief note, we react to some issues raised by Laursen, Haberler, and Hayward (2016) in their essay "The Past, Present, and Future of the IBL Community in Mathematics." In particular, we highlight the need to reach out to our two-year college faculty colleagues.

Laursen's foundational work on IBL has demonstrated that this teaching approach helps in "leveling the playing field" to ensure equal access to high quality mathematics in undergraduate mathematics classrooms (Kogan & Laursen, 2014; Laursen, Hassi, Kogan, & Weston, 2014). But as their essay points out, the prevalence of IBL teaching is hardly widespread (Laursen, et al., 2016). One particularly salient barrier they point out, namely the connection to the name "Moore," resonates strongly with our personal experiences in the IBL community. For example, a few years back, as we prepared a presentation for the R. L. Moore Legacy conference, the graduate student who would be presenting the study said to us that he did not want to be in a space that honored someone who would have not accepted him as member of the mathematical community. The student is African American. As Laursen et al.'s (2016) essay starts to explore, this troublesome association alone is hardly the only barrier to equitable access to IBL teaching nationwide. We propose that two-year mathematics college faculty are overlooked by the IBL community, which is an additional, *significant* barrier to equitable student access to IBL teaching.

Our Institutional Setting: A Bubble

In our immediate experience, IBL instruction thrives. But our institutional setting is hardly typical. We are both faculty members at University of Michigan, involved with IBL teaching in two different capacities: as an instructor (White) and as a math education researcher (Mesa). The University of Michigan mathematics department is a rich environment for observing IBL teaching, as the penetration of IBL teaching is deep. IBL-type teaching has existed among individual faculty members (notably Paul Halmos) since the 1960s, and as part of the department's Calculus reform, since the 1990s. At present more than 16 different courses are explicitly taught using IBL teaching, including Linear Algebra, and all the math courses for future teachers. Departmental supports for IBL teaching include course reductions, co-teaching, mentoring for new postdoctoral fellows, monthly lunches, summer workshops, and one-on-one feedback on teaching based on observations and focus groups with all students experiencing IBL in any given semester.

Mesa's systematic observation of IBL classes at the mathematics department at the University of Michigan since 2005 supports Laursen's findings that IBL teaching "levels the playing field." But the lack of ethnic and racial diversity in University of Michigan's mathematics classrooms is highly visible in these observations. This is certainly an artifact of the institutional make-up and reflects a well-known lack of diversity in the mathematical discipline. Our institutional setting is a "bubble" and extending IBL teaching solely to similar institutions—institutions with robust departmental and institutional financial supports, institutions with predominantly high-income students—does not achieve the goal of scaling up access to IBL teaching and learning in an effective way.

In what kinds of institutions is IBL teaching currently reaching this kind of high penetration? Precise data on this question may not exist, but we note that the "IBL Centers" funded by the EAF include Harvard, University of Chicago, University of Michigan, University of California Santa Barbara, and University of Texas at Austin. And at large-scale gatherings of IBL community we have noticed major representation of faculty from liberal arts colleges. Over the years that we have both been involved in the IBL community we have repeatedly noticed minimal inclusion or participation from two-year college faculty. Their absence is quite troubling if our goal as a community is equitable access to IBL instruction.

The Importance of Two-Year Colleges

It is hardly news that two-year colleges (TYCs) today play a key role in helping students pursue a college degree. Current figures indicate that community colleges enroll 45% of all undergraduates in the US. TYCs play a particularly important role in the education of groups traditionally underrepresented in mathematics. The 2016 figures from the American Association of Community Colleges (2016) indicate that community colleges enroll 62% of all Native American undergraduates, 57% of all Hispanic undergraduates, 52% of all Black/African-American undergraduates, 46% of American Indian, and 37% of Hawaiian, Pacific Islander undergraduates. Moreover, according to a recently released report of the National Science Board (2016) based on an NSF 2008-09 survey, important proportions of students receiving a bachelor's or a graduate degree in STEM fields between 2006 and 2007 have attended two-year colleges: 39% of physical sciences graduates, 43% of computer/mathematical sciences graduates, 40% of engineering graduates, and 29% of biological sciences. These figures make the invisibility of the community college sector in the mainstream discussion of issues of access to mathematical sciences—including access to IBL instruction—even more troubling.

Mathematics Instruction at Two-Year Colleges

Mesa's research into instruction in mathematics at two-year colleges reveals high interaction between students and teachers. The small class sizes (often no more than 30 seats per classroom) led by faculty who want students to experience success in mathematics result in higher levels of interaction than what is observed in mathematics classes taught at universities, although not as high as what is observed in IBL classes (Mesa, 2010; Mesa, Celis, & Lande, 2014; Mesa & Chang, 2010). At the same time the need to help students experience success leads some faculty to propose activities that may not be too challenging, because faculty worry that giving tasks that students do not know how to do will affirm the message that they can't do math. We know from literature that it is precisely challenging work which helps students develop an increased sense of mathematical competency (Silver & Stein, 1996); giving students challenging work, tasks that they do not know how to do, can generate significant gains in understanding mathematics and mathematical work. This kind of work is done every day in IBL classrooms. We further note that two strategies highlighted in the NCSM/TODOS (2016) position statement are particularly prevalent in IBL teaching:

- Cultivate and sustain a positive mathematics identity and affect in students as doers of mathematics (Aguirre, Mayfield Ingram, & Martin, 2013)
- Increase use of complex instruction and other participation structures that maximizes mathematical discourse and student contributions while minimizing status issues in the classroom (Featherstone et al., 2011; Horn, 2012; Turner & Celedón-Pattichis, 2011)

The CBMS 2010 report (Blair, Kirkman, & Maxwell, 2013) indicates that there are about 62,500 college instructors in the United States. Of these, 55% teach at a TYC. These are the faculty who

are teaching the most diverse sector of our undergraduate population and thus, reaching out to our TYC colleagues is a first step in increasing student exposure to IBL classrooms.

Suggestions Moving Forward

We propose concrete suggestions for bringing TYC faculty into the IBL community, which we envision might increase student participation in and experiences with IBL teaching.

First, faculty at four-year institutions and at research universities need to educate themselves about the wealth of resources that the TYCs have to offer. After all, most faculty at TYCs choose this institutional setting because of its emphasis on teaching. And even though the name "IBL" may not be widely used within the TYC community, this does not mean that various forms of IBL are not practiced already. IBL instruction may have many expressions, and while the term IBL is ever more prevalent in undergraduate mathematics education, the practices associated with IBL may be present even when a specific label is not given.

The major professional organization for TYC mathematics faculty, the American Mathematics Association of Two Year Colleges (AMATYC), is a thriving and active community in which many ideas about instruction get tested, changed, and disseminated. Annual conferences bring over 300 participants from many corners of the country. Efforts to reach out to TYC faculty could involve closer concerted efforts to connect the SIGMAA on IBL and AMATYC on IBL instruction. Specifically, the SIGMAA on IBL should:

- Reach out to AMATYC leadership, for example by learning about their committees, their major activities, and programs, such as Project ACCCESS, which is a program modeled after the MAA's Project NExT, and has been instrumental in reforming instruction at the TYC level.

- Present at state-level and national AMATYC meetings, by sending proposals for the annual conference (deadline is February 1st) or by offering webinars to faculty
- Support AMATYC members to join and participate in the SIGMAA on IBL without having to additionally become members of the MAA.

The SIGMAA on IBL as well as the SIGMAA on RUME could better serve the TYC community regarding research and dissemination on IBL. First, the current research on the efficacy of IBL does not extend to the TYC setting—this gap must be filled. Further, much thought and research has been put into faculty development programs for faculty (Hayward, 2015) but these include very few TYC faculty and don't acknowledge unique challenges of the TYC setting. Finally, articles on IBL could be written in collaboration with TYC faculty and disseminated in the *MathAMATYC Educator*, the journal of the association.

National IBL meetings such as the IBL conference and workshops at MAA Mathfest and the Joint Math Meetings need to do a better job in reaching out to our TYC colleagues. Sessions "by TYC faculty for TYC faculty" could start the two-way conversation that is so lacking about what our TYC colleagues already do. We must identify current successful IBL practitioners among TYC faculty who can be part of the national IBL leadership in the SIGMAA on IBL and in AIBL.

The Academy for Inquiry-Based Learning and its NSF-funded PRODUCT grant should make an effort to invite and support TYC faculty to its summer workshops and develop a community of TYC IBL faculty nationwide.

The MAA's Project NExT should create a minimum number of TYC new faculty fellowships that don't require institutional financial support of $4000. Further, the program should be better advertised to AMATYC, TYC departments, faculty, and future faculty.

We agree that the barriers to more widespread IBL instruction mentioned in "The Past, Present, and Future of the IBL Community in Mathematics," including the Moore name, need to be discussed by the wider IBL community. We hope we've added some additional fodder to this centrally important discussion of educational access.

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