What is Inquiry-Based Learning?

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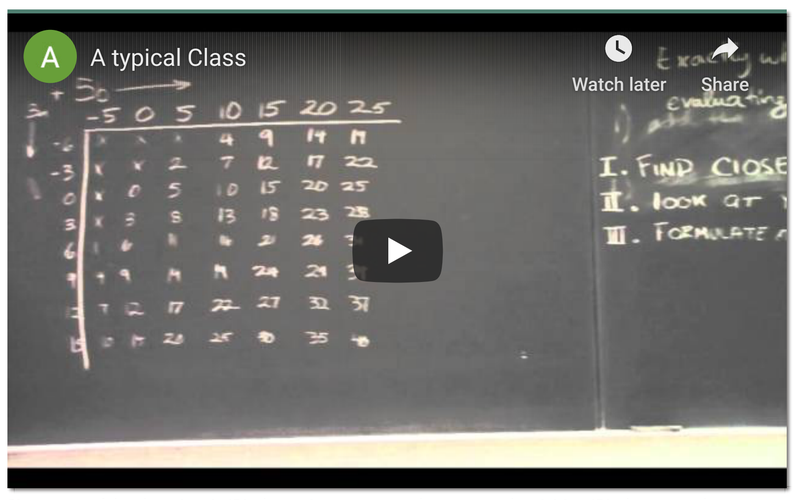
Inquiry-Based Learning (IBL) is an approach to teaching and learning in which the classroom environment is characterized by the student being the active participant while the teacher's role is decentralized. This pedagogy builds on guided discovery, a descendant of the ancient Socratic approach to teaching. [5], [10], [1], [9], [6], [7], and [4]

Following Laursen and others ([8] and [2]) we identify IBL in post-secondary education with classroom practices that have the following characteristics:

- The main work of the course, both within and outside of class, is problem solving.
- The majority of class time is spent on student-centered activities.
- The course is driven by a carefully built sequence of investigations that guide rediscovery.
- The teacher's role is decentralized, acting as a coach instead of a knowledge dispenser.
- Students are empowered by playing active roles - determining how class time is spent, initiating communication, and taking responsibility for learning.
- Students use reflection as well as active communication, both verbal and written, to assimilate new modes of thought, new learning strategies, and new mathematical schema.

We created a short document with Good Starter Activities that you can use to get a sense of the type of inquiry questions we use in our classes. You're welcome to try out these activities with your students. Please email us to receive teacher materials and student work for some of these activities.

For additional discussion and video about good starter activities please see our blog First Day of the Semester: Good Activities.



Since most of the class time in IBL classes is spent on student centered activities, IBL classrooms have very different structures than traditional classes. In an IBL classroom, the students are the most active mathematical participants in the room, which makes it much harder for students to just passively sit and drift through the course. Whether the students are working in groups on mathematical investigations or critiquing solutions that are presented by other students, the students are the ones asking questions, making conjectures, and proving mathematical statements instead of the teacher.

The benefits of IBL have been supported by research. In their 2011 study [8] about IBL, Laursen et al drew the following conclusions:

1. Students in the study reported deeper learning due to having to figure the mathematics out for themselves; in fact, these learning gains were statistically significantly correlated to the fraction of time spent on student centered activities and anti-correlated to the faction of time listening to instructors talk. Deep engagement with the material was so often mentioned by the students that the authors called it one of the "twin pillars" of IBL, along with collaboration. The authors noted that the deep engagement went hand-in-hand with collaboration because it motivated the students to work outside of class in order to be prepared for the group work in class and that the group work in class helped them gain a deeper understanding and appreciation for the mathematics. [8, Chapter 7]
2. Students in IBL courses self-report higher gains in persistence than students in non-IBL courses. [8, Chapter 3] The gain in persistence means that students are not giving up as quickly and are able to stay engaged with the mathematics.
3. Students also reported gains in thinking and problem solving skills that they believed would benefit them in other areas. They also reported gains in persistence, independence, enjoyment, and confidence. [8, Chapters 3 and 4]
4. IBL courses provided better support for the lower achieving students while not harming the higher achieving students. [8, Chapter 7]

While the Laursen study only looked at mathematics majors and pre-service teachers, there is no reason to believe that these results would not not hold for students in MLA courses. Indeed, comments from DAoM students mirror these conclusions:

> *I was engaged throughout the entire class and for once in my life not dreading math class when it came around. — DAoM Student*
>
> *We do the work, we ask the questions and we learn. — DAoM Student*
>
> *The fact that it was never easy to find an answer to the problem made me want to find it so much more. I would sit at my table with my three classmates and work so hard on one problem until we got the guts to ask for help. But we were so personally determined to get the answer ourselves that we almost did not want to hear what we were doing wrong. And even when we asked for help, we were never told the answer. Rather we were given suggestions to turn different corners to possibly find the answers there. It taught us to think for ourselves. — DAoM Student*

A recent metaanalysis of 225 studies involving active learning in science, technology, engineering and mathematics (STEM) disciplines confirms the benefit of active learning. [3] Among the results of this meta-analysis are the following:

1. Active learning increases student performance across the STEM disciplines.
2. Average examination scores improved by about 6% in active learning sections.
3. Students in active learning sections were 1.5 times less likely to fail then students in traditional lecturing sections.

Bibliography

Further resources can be found in our IBL Teaching Bibliography.

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