Active Learning
Workgroup 1

Abstract

In this paper the authors work with a specific definition of active learning in the classroom and discuss some open questions, conclusively answering one question and giving some recommendations for the successful resolution of the second question.

Keywords. Active learning, active lectures, training.

1   Results

Definition. Let *active learning* in the classroom be a class where students collaborate with each other, where students are (actually) thinking, where there is a frequent feedback flowing in both directions, and where at most 2% of the class is composed of lecturing.

We now use this definition to tackle two questions.

Question 1.   Is it possible to give an active lecture?

Theorem. *It is not possible to give an active lecture.*

Proof. This may seem false at first glance, and although it is theoretically possible, in practice it is not possible.

In fact, some people in the working group had evidence comparing inexperienced, "bad", passive lecturers to experienced, "good", highly interactive lecturers. The students' final grades were similar.

The conclusion is that even though instructors may believe that they are giving interactive lectures, in reality they are not. □

After settling these question, we turned our attention to active classes and what it takes to deliver it well.

Question 2.   Does active learning require formal preparation by the teacher and students for it to be successful, and if so, what would that look like?

Theorem. *Active learning requires formal preparation by both the teacher and the students for it to be successful.*

Proof. Trivial. Left for the reader. □

To finish our reply to the proposed question, we finish our paper with two corollaries.

Corollary. *Instructors need the following preparation:*

1. ***Buy-in.*** *Instructors need to be convinced that this is the correct approach to teaching the specific class. This can be achieved by sitting in a colleague's active class and witness first-hand students working together to discover difficult ideas through scaffolded problems and without being told;*

2. ***Materials.*** *Creating materials for the first time is time consuming and the tasks will not be honed to this type of class, so teachers starting to teach active classes should reach out to experienced colleagues for their materials;*

3. ***Practice.*** *Start by guest teaching a colleague's active class. This allows to focus on the active teaching and not have to deal with the culture development or other details;*

4. ***Hybrid.*** *Instructors should start teaching active classes gradually, e.g., by changing their current course to teach 1 class/week using active learning;*

5. ***Mentorship.*** *Seek a mentor that can help curate the tasks and give suggestions about how to handle students and how to moderate activities. Someone local that can visit your class is ideal.*

Corollary. *Students need the following preparation:*

1. ***Buy-in.*** *Students need to be convinced that this is the correct approach to teaching the specific class. This should be achieved as early in the course as possible and using an active learning approach. There are several activities designed for this specific purposes, e.g., activity showed in one of the showcase talks;*

2. ***Day One.*** *Students will form an opinion and set their expectations on the first day of classes. Set the correct tone for the first day. The first day will buy you the first week, and the first week will buy you the first month, from there you can cruise to the end.*

3. ***Questions.*** *You need good questions to convince the students of the usefulness of the course and active learning. See the previous corollary about materials.*

4. ***Transparency.*** *Be transparent with your students. If they feel that you are trying to trick them or hide information from them, they will quickly lose their trust in you and on active learning. Be very transparent about what you are doing and why.*

5. ***Culture.*** *This is the hardest part. Changing a class from traditional to active learning will be painful at first. Persevere and you will change the students' culture about the course and how Mathematics should be taught.*

2 Call to arms

2.1 Repository

Create a repository of **very good** activities for active learning with an instructor guide on how to run them and what is the learning outcome for the students.

This will be very useful to both experienced and starting active teachers.

2.2 Mentorship

Create a system to pair up experienced and starting active instructors.

Active Learning – Working Group 4

Focus: Practice and Theory

Working Group Captain: Lauren DeDieu

Our working group defined *active learning* to be any classroom experience where the students are not passive zombies. One challenge we discussed is that it is difficult to identify when a student is actively learning, since learning takes place in the students' mind. We discussed how *active learning* is different from *active teaching*; students who are standing at the board may not be thinking and students who are sitting quietly may be actively engaging with the material.

Our group agreed that *lecturing* could still be considered active learning. Some instructors work hard to create an atmosphere in the classroom where students are willing to jump in and be a part of it. We discussed the need to teach students metacognitive skills so that they could actively engage in the lecture, such as taking good notes, self-regulation, and reflection.

We believed that active learning is a spectrum and that there is no magic pill. A flipped classroom is not a Band-Aid. The extent to which an activity is successful can be very dependent on the instructor and the implementation. We discussed literature which reports that active learning techniques can be harmful to student learning when implemented by an inexperienced instructor. We believed that instructors should start small and gradually introduce new activities as they gain experience.

Our group believed that lecturing does not need to be teacher-centered. There must be a synergy between the students and the teacher – both can contribute equally while doing different things.

In order for active learning techniques to be successful, we believed that preparation by both the teacher and students is necessary; the amount of preparation will depend on the technique. Using a classroom response system and think-pair-share will require less preparation than completely flipping a classroom. However, no matter where the activity falls on the spectrum, we believed that it is important to motivate the activity to gain buy-in from students.

FYiMS 2019 Day Three: Theme: "Active Learning"
Working Group 6 Summary
Focus: Trends and the Future

Possible questions:
Q1 Active learning in other disciplines
Q2 When should active learning be used in a math classroom?
Are there obstacles/barriers in relation to particular course/material?
Q3 What is the future of active learning?

The group agreed that active learning has to be embraced.
The paper by Freeman (referenced in Dr. Braddy's talk) was discussed in support of this.
The group noted that the best sessions were ones where we (the audience) did something.

It was noted that, as students, many of us did not have any classroom experience with active learning.
Learning happened when doing assignments or homework.

We discussed active learning in our own classrooms.

- discovery based activities consisting of board work in groups. Students are sometimes resistant. These activities help with engagement.

- tutorials done as board work in groups.

- questions with Top Hat (or other classroom response system). These types of activities work well for large classes.

- problems for students to try in class. Some instructors get students to submit this work for grades or participation marks.

We discussed obstacles and barriers.

- multiple sections

- issues with software

- too time consuming

- investment (clickers)

- large class sizes

We discussed benefits of active learning.

- retention

- attendance

- increases performance (not necessarily!)

- students are encouraged to ask questions during the learning activity.
  Active learning brings the frustration students experience when working on problems into the classroom.

We discussed the future of active learning. How do we get colleagues on board?

- Encourage professional development.
  It was noted that talks/presentations that demonstrated active learning strategies would be particularly effective.

- Provide support for instructors to make changes in their classrooms.

- Provide TA to help in the classroom for these activities.

- Provide a repository of resources (such as Top Hat questions).

There needs to be a cultural change within our departments.
This may come about through generational change.

WG3 – Trends and the Future

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Although our group spend a lot of time fleshing out the obstacles and barriers, we should just acknowledge that there will always be problems because we live in a constraint environment (time, money, resources are never where they should be).

Each of us should focus on resources that we can use to overcome these barriers.

We briefly reflected on the speakers that enriched this conference and concluded that there are **appropriate methods for appropriate content** and instructors have the freedom to choose and to be knowledgeable about the supporting structures inside and outside of the classroom.

Discussion on what is active learning:

- **Replace "active" with "engaged" which may or may not be visible, this means needing to find a place where students care.**
- Distinguish between active and passive
- Let's also distinguish what is good and bad learning and not to assign good and bad to active and passive
- Anything that is not passive
- "yes" active learning should be in all disciplines
- Calling students by name
- Quality time with students
- Creating a sense of belonging for students by building relationships
- Emotional investment of students in their learning (Rob gave an example of students finding a linear relationship)
- Constant assessment and feedback (resources, time and money)

Instructor

- Each class is unique and as instructors we need to accommodate and find the right strategies
- How do you make sure students get fair treatment and are motivated to learn?

Students

- Students exhibit a variety of learning styles
- Students are adults making decisions that may not be what we recommend (diagnostic test results, stats)
- Students taking responsibility of their actual knowledge when they come from a culture having been told they are good at mathematics
- Disengagement – 25% students not coming to class
- This generation is the first crop of on-demand students, but we present a rigid experience, so it becomes a weird role for the student to fulfill
- Places that look engaged – online assignments, clickers – may not be engaged because a different person then was intended is sitting behind the scenes
- Instructional-Video-watching data provides evidence that students stop/pause/go back and forth when they encounter something difficult; what does this say about a live class – would students want us to pause and go back?

Obstacles:

- Language
- Culture
- Time
- Class size
- Scale factor when introducing current/trendy technology
- Inexperienced instructors
- Students' mathematical background
- Gender/ethnicity an impediment to some teaching techniques and styles
- Math is a culture of cleverness
- Shutting down a student (calling out answers that intimidate other students; instructor saying a student's answer is wrong or not timely; …)

Thoughts to Overcome Obstacles:

- Mentorship
- Co-teaching
- Finding a balance how you treat strong and weak students to move the entire class forward

Resources

- Build a repository for pieces that work; little, well-worked out tools/ideas/problems are much more likely to be adopted by other instructors than elaborate constructs
- App *telegram* – ability to provide recorded voice-feedback to students
- Tool *compare* – novice is not able to provide feedback on a single piece of work, but novice is able to compare two items what work is better or not