Science AMA Series: We are a group of science educators & researchers, and we're talking about what university STEM teaching looks like. AUA!

STEM$_E ducators^1 andr/ScienceAMAs^1$

[1]Affiliation not available

April 17, 2023

Abstract

Hi Reddit! We are part of a big cross-university team that has been investigating what teaching practices are taking place in university classrooms. We attended and documented over 2,000 classes taught by more than 500 STEM faculty members across 25 institutions... that's a LOT of hours spent going to class, and we are happy to talk about what we saw. From our observations, we analyzed the time spent on various teaching practices (both instructor and student behaviours) and published our findings in Science. In a nutshell: There's lots of traditional lecturing going on, but there is a huge variety in what university teaching looks like! Joining today, on behalf of the whole team: Dr. Marilyne Stains (MS; @MarilyneStains) - Associate Professor in the Department of Chemistry at the University of Nebraska-Lincoln. My work focuses on closing the gap between research & practice in university STEM education. Dr. Jordan Harshman (JH; @theonlyletteR) - Assistant Professor in the Department of Chemistry and Biochemistry at Auburn University. My research primarily revolves around identifying effective practices in science graduate education. Dr. Megan Barker (MB; @meganbarkerase) - Lecturer in Biological Sciences at Simon Fraser University; former postdoctoral fellow of the Carl Wieman Science Education Initiative at the University of British Columbia where we did some of this work. I'm interested in first-year experiences in biology, and teaching assistant training. Dr. Stephanie Chasteen (SC; @sciencegeekgirl) - Research Associate at the University of Colorado Boulder. I'm interested in faculty development and institutional change. Dr. Renee Cole (RC; @ChemCole) - Associate Professor of Chemistry at the University of Iowa. I am interested in issues related to how students learn chemistry and how that guides the design of instructional materials and teaching strategies, as well as how to effectively translate discipline-based research to the practice of teaching. Dr. Stanley Lo (SL; @stanleylo302) - Assistant Teaching Professor of Biological Sciences and of Math and Science Education at the University of California San Diego. My research looks at faculty beliefs and how these beliefs inform teaching and influence student learning. We're excited to be here today, and happy to talk about our analysis and findings, as well as a broader discussion of undergraduate STEM education, discipline-based education research, evidence-based teaching practices, and where your classroom could (or should?) be going. We would love to talk with people from all backgrounds - researchers, students, instructors, parents, and anyone else interested. We'd love to hear your questions and perspectives! The paper (behind a paywall): http://science.sciencemag.org/content/359/6383/1468.full The press release (free): https://news.unl.edu/newsrooms/today/article/lesson-learned-massive-study-finds-lectures-still-dominate-stemed/ Featured by Science Daily: https://www.sciencedaily.com/releases/2018/03/180329141007.htm ———— Edit ———— Signing off for now, but feel free to post further questions and we'll answer them when we have a chance. Thanks for all the questions and contributions! Please do keep the conversation going – you can reach out to us on twitter above. This was fun!

the WINNOWER

REDDIT

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STEM_EDUCATORS R/SCIENCE

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We attended and documented over 2,000 classes taught by more than 500 STEM faculty members across 25 institutions... that's a LOT of hours spent going to class, and we are happy to talk about what we saw.

From our observations, we analyzed the time spent on various teaching practices (both instructor and student behaviours) and published our findings in Science. In a nutshell: There's lots of traditional lecturing going on, but there is a huge variety in what university teaching looks like!

Joining today, on behalf of the whole team:

Dr. Marilyne Stains (MS; @MarilyneStains) - Associate Professor in the Department of Chemistry at the University of Nebraska-Lincoln. My work focuses on closing the gap between research & practice in university STEM education.

Dr. Jordan Harshman (JH; @theonlyletteR) - Assistant Professor in the Department of Chemistry and Biochemistry at Auburn University. My research primarily revolves around identifying effective practices in science graduate education.

Dr. Megan Barker (MB; @meganbarkerase) - Lecturer in Biological Sciences at Simon Fraser University; former postdoctoral fellow of the Carl Wieman Science Education Initiative at the University of British Columbia where we did some of this work. I'm interested in first-year experiences in biology, and teaching assistant training.

Dr. Stephanie Chasteen (SC; @sciencegeekgirl) - Research Associate at the University of Colorado Boulder. I'm interested in faculty development and institutional change.

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We're excited to be here today, and happy to talk about our analysis and findings, as well as a broader discussion of undergraduate STEM education, discipline-based education research, evidence-based teaching practices, and where your classroom could (or should?) be going.

We would love to talk with people from all backgrounds - researchers, students, instructors, parents, and anyone else interested. We'd love to hear your questions and perspectives!

The paper (behind a paywall): http://science.sciencemag.org/content/359/6383/1468.full

The press release (free): https://news.unl.edu/newsrooms/today/article/lesson-learned-massive-study-finds-lectures-still-dominate-stem-ed/

Featured by Science Daily: https://www.sciencedaily.com/releases/2018/03/180329141007.htm

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READ REVIEWS

WRITE A REVIEW

CORRESPONDENCE:

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I teach undergrad networking at a technical school, and we currently run our campus courses in a hybrid model. Our pedagogy covers an eclectic mix of educational models, with a heavy focus on hands-on learning (approximately 8 hours of lab work/week with 4 hours of lecture). My department is currently undergoing the creation of an entirely online degree program to run in parallel to the campus degree program.

My question: What have you found to be most effective (if anything) concerning student engagement (enjoyment even) in an online course, particularly of a highly technical, applied nature? What should likely be avoided in these scenarios?

Losing availability in-person to assist and engage students is going to be difficult on both ends (I feel more so when it comes to applied computer networking). My current plan is to offer students lessons in multiple formats (white pages, slideshows, pre-recorded and live lectures, etc.). I am however concerned with offering too much “choice”.

Thanks!

prestonsmith1111

[SC] One persons whose research in this area might be helpful is Richard Mayer, who focuses on multimedia learning. Many of his principles for effective multimedia instruction are useful for putting together videos, PowerPoint, and other online materials to best support student learning.

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prestonsmith1111

[MB] I would also add -- providing instructor immediacy in an online environment can be challenging, but you can still have a strong online presence. Be a human being and let them know who you are. If possible, having some teaching assistants who reply promptly to messages and help generate discussion among the community is a good idea. You can also look into some recommendations from the world of MOOCs, which may have some tips.
(I also recall reading somewhere that videos which have instructor faces are better than videos without, in terms of student perception. Can't remember the reference though.)

In terms of "too much choice" - I would suggest that however much choice you offer, make it clear from the outset what options students have. Principles from Universal Design would say that choice is good! but you're right to want it not to be overwhelming. Make sure it is really, really obvious how students can contribute and be graded. You don't want them to spend all their mental energy figuring out how

your course works.

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Thanks!

prestonsmith1111

[JH] Online focus was not really a focus of our study, but there does exist a fair amount of literature regarding online programs and courses. I don't really deal with this type of research, but I might suggest searching google scholar (not google) for review articles, I would imagine there are at least a few reviewing best practices, how to engage students, and how to effectively develop social networks in online courses.

I have a BS in Biology and a BA in Psychology and have to agree with your findings. As a student, I performed better in classes that were more interactive and not just lecture based. I always performed better in the lab portion associated with the lecture course. If all my lectures were more like the lab settings, I would have performed better in my STEM courses.

Khaleeasi24

(MS) Thank you for sharing our experience with active learning. Students' voice is really important in any conversations that we have with faculty who either do not know yet about active learning or those who know but are skeptics.

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Khaleeasi24

Thanks!
If you have a chance, let your university (and your instructors) know this. We depend on student feedback and it really can guide the change you want to see!

Hello, Im a physics major and im thinking about going into secondary education(being a high school

teacher). I know id have a job out of college, but i don't want to go on welfare as soon as i start working, do you think that there's a chance to actually make a living as a teacher?

Pandrew5002

[JH] This wasn't really the focus of our paper, but you can absolutely make a living as a high school teacher. Where and what you teach will definitely factor into how much and what kinds of bread you put on the table, but many of the high school teachers that I worked with in grad school found their jobs very rewarding. That being said, if you're interest is to look at undergraduate teaching, then graduate school is the right option.

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Pandrew5002

[SL] I taught high school for a few years right out of college. It was a phenomenally rewarding experience! I would not say that it is a nine-month job, as the job never really ends, although one does have more time to do other things like additional employment, e.g. teaching summer school.

Your study talks about how even in smaller classroom settings many faculty aren't mobilizing active learning techniques that studies suggest may be more effective than lecturing. I'm curious about two things related to this:

1) A lot of instructors I've spoken to said it wasn't just lack of training in those methods but also a belief that undergrads simply won't do the pre-work needed for that kind of method to be effective. In other words, they don't think they'll do the readings or watch a recorded lecture prior to showing up. How would you address that concern?

2) Did you look at courses that combine lecture and discussion section/lab? In anthro, for example, a huge % of our courses require attending 3 lectures/week and going to 1 section or lab/week. The 1 hr section/lab is all student-centered where they are supposed to come having read the materials and ready to discuss or do a hands-on activity. Is that kind of set-up any better than straight lecture?

- one issue with the lab/section (having taught a number of them) is half the class never does the readings and so I'm not sure how much they get out of discussion. But at least labs have hands-on activities that may introduce concepts in novel ways.

firedrops

(MS) I will address your second point first: we only looked at the lecture portion of a course; we didn't characterize lab or recitation. This is a limitation of our study. Regarding your first point is that you have to develop a culture in your class where they recognize the benefits they gain from doing pre-class work. In order for that pre-class work to be beneficial for both you and the students it is better if it requires the students to answer questions about the content contained in the reading to ask reflective questions about their understanding of that content. More importantly, a feedback loop has to be in place. this means that students have to see explicitly that you, the instructor, is leveraging the work they did prior to class to make the class time more efficient and meaningful. Having an explicit conversation about your pedagogical strategy and its purpose and benefit is also helpful. The following article provides useful strategies to address students' resistance:
https://link.springer.com/article/10.1186/s40594-018-0102-y

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[SC] to add to Marilyne's comment, it's also best to build in some accountability for doing that extra work. In the class I just observed for instance, the teaching assistant checks off at the start of each class whether students have made an honest attempt to take notes on the pre-lecture video, to check that they are indeed viewing it and processing. Some others will ask clicker or other types of quiz questions on the pre-lecture video or reading for some accountability. Then everyone is more on the same page and ready to discuss. Some more articles about student engagement can be found at series that I wrote at http://physport.org/expert/framing.

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firedrops

[SL] In my experience, when a new course or curriculum begins, it takes about 3-5 years for students' "institutional memory" to fade, and the pre-class assignments in "lecture" courses, scientific uncertainty in course-based undergraduate research experiences, etc. become the new norm. It also tend to help when there are undergraduate learning and instructional assistants who have gone through the new course structure to help convince students.

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[MB] To add to the replies about your #1 question - Students do more pre-reading than we think. Banet and Heiner found that about 80% of biology and physics students reported doing the pre-reading work (paper and poster).

The highest motivator was marks; but you only need to allocate ~2-5% of grades for pre-reading quizzes to achieve this amount of buy-in. If we use grades to signal what we as instructors think is important, then this is a reasonable choice to make.

Have you looked at the impact of the personality of the instructor on the effectiveness of a given strategy? Do you see any evidence that students perceive discomfort in an instructor and that discomfort/perception influences the outcome of a given course or even single class meeting?

If so, do you conclude it is better to implement a strategy the instructor is uncomfortable with, but which is, in your opinion, more pedagogically sound, or should teaching strategy be placed behind an instructor's style?

S_and_M_of_STEM

[MB]
Based on your username, sounds like you're a true lover of the discipline ;)

Absolutely the instructor's personality is important in the classroom.
However, instructional approaches are not a dichotomous choice (active or lecturing).

In terms of a specific approach, it is an interesting balance between finding what works for you, among the many evidence-based, active practices from which you can choose.

My personal opinion is that we have a responsibility to our students to be using evidence-based practices.
Freeman's paper essentially shows that more active is better, and so as a community of scientists, we should be following the evidence - and we should be pushing ourselves out of our comfort zone. This can mean getting support, trying things out, talking to colleagues, etc. Just like a research scientist will try out a new experimental technique, and be okay with not getting it perfect on the first try, and practice it to find a way to make it work for them... so should we be viewing our teaching.

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S_and_M_of_STEM

(MS) The key is to help the instructor buy-in and become comfortable with the strategy by educating them about its benefits, best ways to implement it and possible effective adaptations as well as providing them opportunities to watch others use and giving them some practice with targeted feedback. I don't think forcing someone to teach in a particular way would result in positive outcomes.

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S_and_M_of_STEM

[SC] This wasn’t the focus of study, but two things to consider.

One is that research (I know at least one study from Colorado) shows that inexperienced instructors using active learning methods can perform as well as or better than experienced instructors using traditional lecture. So regardless of experience level, active learning strategies can help newer instructors quickly achieve high levels of student learning.

Second, many instructors who try active learning discontinue these methods over time. Research from Charles Henderson and Melissa Dancy have documented this discontinuation. One hypothesis is that Instructor stop using active learning or are afraid to start it because of the perception that students don’t like it. So while I don’t know of research indicating that students sense instructors’ discomfort, I think that confidence and a sense of mastery of active learning techniques on the instructors part can help an instructor feel more certain of their approach, and likely that will bleed over into an increased student perception that these methods are useful.

Here are my three questions:

1) What types of mathematics courses did this study include, and did you only look at 4 year undergraduate institutions?

2) When you say student centered, did you mean that for a large portion of a lesson students lead the discussion (IBL?) and teachers played a minimum role, or did you mean something like a instructor giving out a worksheet with drill problems and students working on it around a table?

3) Did you observe many questions from instructors or students during the lesson in the three groups you mentioned?

Thank you very much!

upf9602

(MS) We looked at mathematics courses primarily taught at research intensive institutions. Our sample was mostly collected from freshman level courses. Regarding our second point, our label for broad style is based on the frequencies of the behavior we saw. I n general, in student-centered style we saw a lot less time spent on lecturing and time on students working on worksheet (Cluster 6), or talking to each other when answering clicker questions. Regarding you last point, for all the seven clusters, on average the instructors were asking student questions during about a 20-30% of the 2 minutes time block. The supplementary information may be of interest to you in that regard, especially Figure S4.

FYI:

Classroom Observation Protocol for Undergraduate STEM – COPUS (PDF)

COPUS Analyzer

jhansonxi

Thanks!

Were instructors observed adjusting their presentation style based on perceived student interest? Did this change throughout a session or in subsequent sessions on the same day (fatigue factors)?

jhansonxi

[MB]

Hi jhansonxi - this is really interesting, but unfortunately the tool that we used doesn't really capture this. We'd have to know what the instructor planned to do, and what they perceived, and what they changed... there's a lot going on here :)

We do have a few instances of classes that were taught a couple times a day by the same instructor. This would be interesting to look at, but the sample size for this is pretty small so it would be hard to make any large conclusions.
Anecdotally, having done observations of the same instructor, same course, 2nd class of the day: I haven't seen much overall changes made to the class. Lesson plans and lecture material is often decided in advance, and it is difficult to completely change the lecture at the drop of a hat. However, I have seem some awesome examples of instructors being responsive to student questions, and letting student interest decide how to approach some of the material.

I teach in an amphitheater

Yes, but learning happens inside each individual mind. It's a much more 'syntonic' process, to use the Seymour Papert term, is his work considered? (I know he was more about ECE)

The ability to acquire and the ability to impart are wholly different talents. The former may exist in the most liberal manner without the latter. – Horace Mann

mwscidata

[MB] I absolutely agree with the Horace Mann quote - I try to keep the idea in mind when I'm teaching. (Just because I say something doesn't mean that they learned it.)

There are lots of great examples of active learning approaches in large lecture courses -- the more student-centred we make things, the more we are letting students learn "inside each individual mind,"

as you put it.
If people have a hard time seeing what active approaches could look like in a big class, here are some short videos!

What a fantastic subject and accomplishment to have this published, congratulations!

I've always found "learning by doing" to be the most impactful way to learn for me, rather than the read and regurgitate approach I experienced at university (even in engineering). The volume of work was meant to prepare you for the "real world" but also meant multitasking and prioritizing test scores versus conceptual learning.

I often felt that the higher focus of professors on research vs teaching inherently limited the quality of teaching as well.

1) Do you see opportunities for universities to take a more experiential learning approach? Could you share any best practices?

2) Are professors generally more driven to do research rather than teach? Is it an issue of incentive? Training? Time? Curious your perspective.

Thanks! yllb

Bandarker

[MB]

Why thank you! Agree about learning by doing! The evidence in favour of active learning approaches (over traditional lecturing) is overwhelming -Freeman's big PNAS paper apparently could also be titled "The Lecture is Dead!"

There are definitely opportunities for universities to tackle this, even within the structure of big courses in large lecture halls. There are lots of examples of courses where we saw a very student-centred approach (group work, worksheets, clicker questions, student discussions) and the learning gains from these approaches is worth it. In my view it's more important as an instructor to at least try something small, rather than waiting until your course is completely overhauled. For example, giving 5 minutes of your lecture time to students working in groups on a practice test question is a great first step.

From my experiences working with instructors, they generally all want to be good at teaching, but there are issues of what they believe is the best practice (e.g. "lecturing worked for me when I was a student, so that's what I will do"), as well as training ("I have no idea how that would even work"), and time (they have lots of priorities in their jobs, and completely (re)developing a course takes a lot of time). Formal incentives would definitely help, and are generally sorely lacking.
I thing Marilyne can better comment here as well -- her research is on the gap between evidence-based recommendations and actual teaching practices.

In the paper, you note that:

"...flexible classroom layouts and small course sizes do not necessarily lead to an increase in student-centered practices..."

Your [already huge] work did not look at the use of effective active learning in traditional lecture spaces. At our university, we do many different methods of high-level active learning within 400- and 750-person lecture halls. My question: **How do we convince instructors that the physical space is not a barrier to active learning?**

I worry particularly that colleges and universities will continue to waste money on 'active learning classrooms' that use costly and constraining technology and furniture when they really just need better design and instruction in their classes.

benlwiggins

[JH] Our aim was not to measure teaching in active learning classrooms, but rather tried to get "in the wild" data, so our sample includes those who teach in active spaces and traditional lecture halls. To your question, I think that that learning assistants and/or graduate students can go a long way in facilitating group work, so that's one way. Another is to incorporate better training with active learning techniques specifically for large lecture classes. Lastly, the incentives need to be in place. If instructors are not encouraged to use active learning strategies in large spaces, they are less likely to. And to your last point, yes, we need more research on how instructors interact with these spaces before we can rationalize the funds to build them.

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benlwiggins

[MB] In my experience, the best/easiest way to convince instructors is to show them. Invite them to your classroom and let them see it happen. Then go for a coffee with them afterwards to chat.
(This heads off many of the "but what if thing X/Y/Z happens..." questions - which often end up being irrelevant in practice.)

You can also show videos - there are a bunch of relatively short oneshere

In the paper you say, "Specifically, institutions should revise their tenure, promotion, and merit-recognition policies to incentivize and reward implementation of evidence-based instructional practices for all academic ranks. Ideally, implementation of these practices would be an expectation for promotion and tenure to be obtained and factored into annual merit decisions." Might you know of any institutions currently doing this? Might what they're doing vary by tenure track vs. fixed term instructors?

bgoffe

(MS) I don't know of any institution. Your point about differentiating promotion and tenure criteria based on the type of faculty is interesting. I think it is more challenging to raise these expectations on fixed-term instructors since they may only be there for one year and probably are not well evaluated. Putting the focus on long-term instructors and tenure-track instructors would help shape the culture of the institutions in term of teaching and raise expectations for temporary instructors to use these practices.

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bgoffe

[SC] I do actually know a few institutions. You can look at the case studies in a report called Phys21 (you can Google it) for some examples. For example, some departments include an element within teaching evaluations about whether or not they have innovated and tried something new, and whether or not student learning gains are on par with the rest of the department. If an instructor is using active learning techniques but not getting good student evaluations on end of term surveys, the student learning gains can be used to indicate that the instructor is teaching is effective regardless of that (often biased) student evaluation data.

1. Have you looked at online courses? Or hybrid online courses where there's a group meetup with the TA/professor?
2. What *IS* the best way to design a student centric course?
3. How do you make the argument to administrators who are stuck on 19th century teaching methods?
4. What about online courses for distance learning?

drewiepoodle

[JH]

1. Online focus was not really a focus of our study and so far as we are aware, we did not have any hybrid courses included in our study. I don't know that COPUS has been tested in those environments.

2. This is likely subjective in nature, but in general, I think a backwards design is most effective: Develop objectives, assessments to demonstrate those objectives, and then learning activities that make sure students are taking charge of their own learning and not passively recieving information.

3. For our fellow science colleagues, I think the best appeal is that from a science perspective. When it comes to something like spectroscopy (I am a chemist), the whole goal is to systematically manipulate something, measure how it responds, and then according to relevant theory, infer something about the sample. The same should be true in education: we should perturb the system (students) with something that causes a response (carefully designed assessments) and consider how they would respond if they have a full understanding of a concept (theory). Usually, we gloss over this assessment point and assume that one question is just as good as the next. It is only from the results of a very calculated study that we see, quite clearly, that students ace the class and yet leave with enormous knolwedge gaps. This then, should serve as the impetus for thinking "that didn't work; I should try something that according to learning theory will get my students to where I need them to be." Summary - if we treated education like we do science at the benchtop, I'm fairly convinced there wouldn't be a lot of evidence to support the notion that traditional lecture methods lead to marked improved as compared to active learning strategies. Related, Melanie Cooper from Michigan State has a term "Private Empiricism" (https://jh.hosted.panopto.com/Panopto/Pages/Viewer.aspx?id=c5e393a9-060c-47da-ba9d-9375daa82ac1), which has applicability here.

4. See #1

1. Have you looked at online courses? Or hybrid online courses where there's a group meetup with the TA/professor?
2. What *IS* the best way to design a student centric course?
3. How do you make the argument to administrators who are stuck on 19th century teaching methods?
4. What about online courses for distance learning?

drewiepoodle

[MB] These are lots of good questions - others can also chime in.

To address a couple of them: 3. One thing we can do is a grassroots approach: we can explain our choices (and the evidence) to our students. In my experience, once we had implemented some active approaches in our first-year course, they started asking their upper-year instructors for similar changes in those courses. It's a slow movement but it gains traction. We can also think about universities from a consumer mindset. If we push pre-university students to think about the classroom environment when they're making their university choice, this can impact how schools operate. If crowds of student applicants turned down admission offers because of classroom environments, then universities would have to start making changes.

For 2. A quick idea is to change a mindset: Just because you have told them something does not mean that they have learned something. They need practice and feedback, in the course. Make the time USEFUL to them.

You can't go wrong with backwards course design (see Dee Fink). Start with the end of the course -- what you want students to be able to DO (learning objectives that aren't just "know this stuff"). Then think about how you will know that they can do it (your assessments), then think about how you will help them practice so that they can achieve on your assessments (practice and feedback).

Do you have a good way of getting students to work past the common issue of regarding science as merely a collection of facts? I find that though many of my classes have had a 50/50 student centered format that critical thinking was still rather uncommon in those classes.

TempAccount8891

(MS) At its core, student-centered teaching requires engaging the students physically and mentally. The nature of the content students work on, the questions and tasks students are asked to do should be aligned with those critical thinking goals. These ways of thinking are also challenging and takes time to develop. Curriculum in chemistry that have addressed these issues include CLUE (https://clue.chemistry.msu.edu/) and Chemical Thinking (https://sites.google.com/site/chemicalthinking/) and POGIL (https://www.pogil.org/). These materials could give you an example of how these levels of thinking can be promoted. One of our co-author, Renee Cole, is also developing rubrics to measures students development of process skills (http://elipss.com/). Those could also guide the design of content and activities aimed at developing these skills among students.

Do you have a good way of getting students to work past the common issue of regarding science as merely a collection of facts? I find that though many of my classes have had a 50/50 student centered format that critical thinking was still rather uncommon in those classes.

TempAccount8891

[SL] Also CREATE (https://teachcreate.org), POGIL (https://www.pogil.org), and many other examples!

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Do you have a good way of getting students to work past the common issue of regarding science as merely a collection of facts? I find that though many of my classes have had a 50/50 student centered format that critical thinking was still rather uncommon in those classes.

TempAccount8891

[SC] that's a bit disheartening to hear that you've been in so many student centered classes focused more on facts than on reasoning. This is a bit discipline specific, as some disciplines have more face s needed to engage in the concept (e.g.biology has a lot of terminology). That said, part of the idea behind the active learning classroom is that it allows more time for chewing through the conceptual reasoning.

For example in our classes we always have students talk about the reason for the answer to clicker questions, not just what the correct answer is, and then we go through the reasoning as to why each of the answers are incorrect or correct . That focuses students on the idea that the process of getting to the answer as the important part. But I think this might be a bit rare, I have seen a lot of active learning classroom where students are just trying to get to the right answer and the instructor reinforces that by only talking about which answer is correct at the end of the day. Also, if you want students to recognize that reasoning is important, you have to test them on it. That means using long answer exams, or multiple choice questions where students have to choose not just the right answer but the correct reason.

How do you balance covering all the necessary material with student centered learning?

rayhond2000

[RC] A key thing here to look at the "necessary material" and identify what it is that you actually want students to know and be able to do. I've found that I don't have to give up any core content, just focus on what I think is actually important. Instructors also often spend more time than they realize working multiple examples and reviewing material. If you "cover" more but students learn less content overall, then you are valuing teacher knowledge rather than student learning. There is evidence that students who have "covered" less material often do as well or better on common exams and tend to retain the knowledge longer - so what is the goal in terms of student learning?

How do you balance covering all the necessary material with student centered learning?

rayhond2000

[JH] Many researchers suggest that the curriculum should change (not just to accommodate active learning strategies, but for a variety of reasons). If covering the content is the top concern, perhaps it's time to focus it down a bit. However, assuming that the curriculum is unchangeable, you can certainly incorporate speedy active techniques like think-pair-shares, clicker questions, just-in-time-teaching, and even Socratic questioning are good, fast ways to get engagement of students. Flipped classroom scenarios also can offer good ways to offload content outside of classes, but we should be careful how much we ask students to do outside of class.

How do you balance covering all the necessary material with student centered learning?

rayhond2000

[MB] This is a pretty common concern that we hear. Ideally we should be moving towards curriculum change, but it can be difficult to trim content when the instructor is not the only person who decides what content belongs in what course (e.g. pre-requisite courses, etc.)

One reasonably easy tool to 'save' class time is to do a more active form of review. Two-stage reviews are an easy way to do this: essentially, rather than lecturing/reminding students about the pre-requisite material, you can instead give a series of questions that students answer individually, and then repeat the questions in groups. This allows the students to get up to speed with the necessary background material, and allows the instructor to target class time on only the points that students really struggle with.

One of our co-authors (Lisa McDonnell) found that she could spend two fewer class sessions on review (of genetics material), with no change in the amount that students learned. Pretty efficient and effective!!