

Higher Ed Rewired
Season 1, Episode 3
Active Learning in Mathematics
Host: Oliver Wong
Guest: Dr. Rajee Amarasinghe

[Setting - IN CLASSROOM]

ERICA SAWYER: "Alright good morning everyone"

OW: It's 10 am on a Wednesday and we are listening into a first-year math class at California State University Fresno.

[Setting - IN CLASSROOM]

ES: "Stand up and re-arrange into groups"

OW: About a dozen students are in a small classroom with whiteboards surrounding them on all sides...

They huddle together to apply some class concepts to a real-life math challenge.

[Setting - In Classroom]

ES: "We're going to talk about retirement planning today. Super fun."

OW: The idea here is for students to practice a new concept they've been learning - mathematical sequences - and apply it to calculating compound interest, a vital way for people to determine how much they'll need to save for retirement.

The instructor - Erica Sawyer - is there to answer questions... but otherwise, the students are on their own... they have to rely on each other to complete their calculations...

[Setting - In Classroom]

STUDENT: "When I add these am I going to have to divide again?
Or just add? No it's just the total."

OW: The students are at it for more than half an hour. Erica’s hands-off approach is by design

[INTERVIEW]

ES: it's really in the students' hands. We provide them these activities and I'm there to support them. But it's really a collaborative learning based model in the sense that they're all working together

OW: This is a new kind of math class — developed by Dr. Rajee Amarasinghe, head of the math department at Fresno State...

RAJEE AMARASINGHE: Rather than me going to the classroom with a lecture I get the students to explain things to the rest of the class.

[FADE IN MUSIC]

OW: Dr. Amarasinghe has spent two decades figuring out the best way to teach math and help students excel in the subject matter.

Nationwide... students’ math skills are sinking... scores on the ACT standardized tests are at 20-year lows... even as math skills have become all the more important with the rise of the high-tech economy.

On this episode, we look at how a novel approach to TEACHING MATH at Cal-State Fresno, is adding up to some big results.

I’m Dr. Oliver Wang and this is Higher Ed Rewired.

[POST - MUSIC THEME]

[SHOW OPEN PROMO - :20 - [Language Here](#)]

PROMOTION: Higher Ed Rewired is a production of the California State University — the largest, most diverse four-year public university system in the country, and an engine of social and economic mobility. Higher Ed Rewired examines exciting

innovations taking place across higher education that have the potential to improve student success and to positively change the environment in which we teach, learn and discover.

[MUSIC UNDER - AND FADE OUT UNDER INTRO]

[SEGMENT A]

OW: Welcome to this episode of Higher Ed Rewired. I'm Oliver Wang - professor of sociology at California State University, Long Beach.

We're talking about math today and I know, for a lot of us, that hasn't always been our best subject. There's a good chance that's because of how we were taught math.

Here's a common scenario: a teacher introduces a formula... you do a bunch of practice problems...and then rinse and repeat -- over and over...sound familiar?

If you ask Dr. Rajee Amarasinghe, he'd say that's the entirely wrong way to help students learn math. He's seen the results at Cal State Fresno... where a lot of freshmen are coming in needing extra help with math... What does that mean for their first year of an undergraduate program? That's where we begin our conversation.

[INTERVIEW]

RA: *Students came up with a very procedural knowledge. So the skills in the analytical skills and the problem solved solving skills were not there. If you give them a problem for them to solve that is something that they have seen before, they can solve it but if they are given a more complicated problem for them to sit down and analyze and think about how to solve this problem using what I already know that thinking skills that problem solving skills were not there for most students.*

OW: *So it sounds like they were missing simple critical skills.*

RA: *Correct. Correct. That I believe that is not the students fault but that is how our system was designed in many K through 12 reeducation. And not only that actually university education to the orphan. If you look at a textbook teachers teach through Chapter 1 Section 1 Section 2 3 and so on. All those sections that teachers will show*

them how to do problems and then usually textbooks have those very sophisticated very nice beautiful math problems to the very end of their problem sets and those problems are not assigned to the students to do they normally do. Problem number one through maybe 30 and then skip the interesting nice problems at the end of the text that has been the culture in most of the classes in our indication system. So because of that one students do not get a chance to engage in those kind of problems. Those are the problems actually allow students to develop those critical thinking skills problem solving skills but then they didn't get opportunity to use them.

OW: *Were there what you would have considered to be basic kinds of math skills. I'm thinking of anything from let's say algebra or trigonometry basics that you would have expected incoming first year students to have that simply didn't seem to be there.*

RA: *Not even. I mean you don't have to even go even that far even if you think about like basic skills like fractions. I can see many incoming students do not have the skills to solve that kind of problem. So just simple multiplications of two fractions or dividing two fractions. If you give them a problem pencil and paper and asking them to solve it they will recall the procedure that they learned to solve that problem and do it but they don't have a conceptual understanding what's going on.*

OW: *So it sounds in other words that they understood what the set of instructions were to follow but not necessarily, what the core ideas behind those instructions were. And I think more to your point they don't know how to they didn't know how to adapt those same instructions to a similar problem that they hadn't seen before.*

RA: *Exactly*

OW: *you started teaching at Fresno. You said in the early 2000s which would have been right around the time that no child left behind as a federal education policy was coming into play. And certainly when I started teaching at Cal State Long Beach in 2006 a lot of my students were amongst that first generation of primary school students who had been impacted by the changes that were brought about by No Child Left Behind.*

How do you think that set of policies influenced a generation of how students were trained in math.

RA: I believe the accountability of the school systems for the assessments and No Child Left Behind assessments and the assessments and then the funding coming from those things push the teachers to make the students perform for those test questions. So the teachers taught procedures for students to perform well in those tests. So that means they took away the problem solving skills because they were not type of questions they ask. They took over a more critical thinking questions because that is those are not the type of questions that they see in those assessments. It is very procedural kind of questions. So the teachers taught into those procedures because school districts asked the teachers to perform. And based on the student performance they were rewarded. I have visited K12 classrooms very often in those classrooms. They used the model called I do you do we do. I do. We do you do. We are the teacher comes and shows students how to do a sudden procedure and they get together and practice that procedure. And then students do that procedure on their own. But it took away the students to see a problem and try to figure it out how to do that problem on their own. They have to always rely on the teachers to show them something and then blindly follow that procedure oftentimes without even understanding what they're doing. There was no or no reward or no incentive for teachers to show them what is the meaning behind those those concepts that they are doing or procedures they were doing because the students were just meant to perform well in those procedures. That is what was tested

[END OF SEGMENT A INTERVIEW]

[SEGMENT B]

OW: That's Dr. Rajee Amarasinghe - head of the math department at Cal State Fresno...

We'll pick up our conversation in a moment but first, consider this. TRADITIONALLY — if a college student is weak in math or English, we've assigned them to remedial classes. But that creates its own kind of problems. ...

Take Chimezie Ebiriekwe (Shah-MEE-zee Ah-BREYE-qwey). He's in his FIFTH year studying business finance at California State University, San Diego. He could have finished in four years except...

[INTERVIEW]

CHIMEZIE EBIRIEKWE: *"You had to take a test before prior to enrolling in the school -- is the placement tests and learning ELM EBT test. Unfortunately, I didn't do so well on those two tests that I was placed in remedial classes. And those classes that I was placed in were classes where the math and English were just words so basic and just so easy that I passed with flying colors but. I was put in a bracket where I was and they will where I wasn't at the same learning level as my peers. So I just fell behind my whole first year. Now I'm actually behind so it's going from falling behind to actually being line and it just always that notion of just you being behind and playing catch up with your peers."*

OW: Students like Chimezie Ebiriekwe (Shah-MEE-zee Ah-BREYE-qwey) wind up behind AND paying for classes that don't count towards graduation.

At the same time - universities have been trying to figure out how to help more students graduate - and graduate ON TIME in four or five years.

Recently, the California State University system decided to stop placing students like Chimezie in separate classes. and Dr Amarasinghe was tasked with figuring out how to RE-design first-year math courses to incorporate ALL students. He relied upon some of the innovations he'd already come up with at Cal State Fresno and that's where we pick up our conversation

[SEGMENT B - INTERVIEW]

Amarasinghe: *The very first thing actually I tried to use in my classes -- engaging students in this learning process. So rather than me going to the classroom with the lecture I get the students to explain things to the rest of the class. So I kind of put the students into the groups and gave them the responsibility of certain concepts and their responsibility was to that particular day. Explain that concept to the other students in the classroom so they had to really think about what needs to be taught and what is the*

idea behind it. So I met with the students ahead of the time. That group who is supposed to present I met with them in my office and talked about the meaning behind what they were teaching and help them to learn. So I was trying to that is that my first very first thing I did when I came here. And so the students took turns and tried to explain things in the classrooms. That was very time consuming job for me because I've been meeting with every group every week spending a lot of my time but I saw the value of that one in the in the in the classrooms and from the students because they are much more engaged in the learning process. And the same time they work with everybody else in the group to learn the concepts that they were supposed to teach rather than blindly following the procedures.

Oliver: *You're essentially teaching students how to teach one another. And I think that because of the ways in which we conventionally think about how education works is students learn they're not meant to be simultaneously students and teachers and they would have to imagine that not all students were at least initially comfortable with that role where they're now expected not simply to kind of soak up knowledge but now they're expected to be able to pass this on and become teachers themselves and so how was it. How were you able to get students to rethink the very notion about how they learn by teaching others.*

RA: *Students were reluctant at the beginning but they as we go on they saw the value of what we were doing*

OW: *A few years ago the Cal State system made that decision which was controversial at the time and perhaps still is to eliminate what are known as non-credit remedial math courses right. So these are courses that students who were considered to be have remedial skills were required to take except they wouldn't get credit for it. And the idea behind eliminating those classes was a way to get students to start taking college level math for credit as a way to help them towards graduation. And for you especially being in charge of these first year math classes it meant that you were now mixing in students who had I think very significantly different levels of math skills. So how is that process gone now that you have are integrating remedial students in with what used to be what would have been considered college level math classes.*

***RA:** We had to rethink how we prepare students or take the college classes particularly the Fresno State. Half of our students are remedial students. So we'll have to really think about if these students are going to take our general education college level classes what should we do or how can we help these students. How do we address the missing parts in these students knowledge so that they can be successful in the undergraduate level classes. So we saw actually three pieces three parts that students need to have one part is these students who did not ready to take these college classes. They had a very they didn't have basic skills like a studying mathematics studying skills or even has a Bodum mindset toward what mathematics is often students thought that there is a math gene that they are they are born with something that they are not good at math. So we'll have to really think about changing those ideas so we help incorporate those changing attitudes and beliefs about the students before when they try to take these college classes. And the second part is the basic skills like those fractions or decimals and solving simple equations, they did not have those conceptual knowledge. So we had to provide that knowledge if they wanted to be as successful in their general education classes. third part is those students who are coming behind they needed additional help to be successful in the undergraduate level classes so we had to provide additional instruction additional practice sessions and additional problems for them to work on. So those are the three pieces that we saw that that that can help them. So we created these co-requisite classes for the students today. So while they are taking the undergraduate level classes they have to take these co-requisite class parallels with the parent class. So we tried this one in the last fall semester and we are doing it in the spring semester. So this is off. Still we are in our first year of implementing these core classes for these students who are not supposed to be college ready.*

***OW:** According to the previous assessments I know this is early to ask about results because really you've only just began to implement these things but how do you begin. Have you begun to see the results in terms of how students have adjusted to these changes.*

RA: Yes. We have not done the complete analysis of this one but the past rate of these classes compared to the regular classes and I say regular classes those are the classes that the students who are college ready would take we did not change the content of that parent class at all. So both groups of students are taking the same general education class. The past rates of those classes have very slight different probably vote. The board eight point nine point percentage difference in the past reads. So that is a major achievement because earlier we thought that these students are not capable of taking college level classes unless we remediate them.

Now with this process we have they managed to pass the classes not just same rate as the other ones but they are close enough. I think we have to. We have to fine tune the things that we are doing. So I'm hoping my hope is in the future we can get the same path straight from both groups at the end.

[END OF SEGMENT B INTERVIEW]

[Setting - In Classroom]

ES: "You're gonna find the yearly living expenses"

OW: We now return to that 1st-year math class we were eavesdropping in on at the beginning of our episode.

[in classroom - daisy flores]

DF: "The living expenses, are we just gonna like put what we think?"

OW: That's Daisy Flores, she's 19 years old out and trying to work out that retirement income problem with others in her class. She's a freshman, studying animal sciences. In the previous system - Daisy could have ended up in a remedial math class.

[interview]

DF: "I usually do find math difficult. // But I like it when I know what I'm doing. So right now I like math. When I don't know it, I'm like - uh... I don't like it. But right now I do. (Chuckle)"

OW: And that's the good news. Amarasinghe's redesigned class that incorporates students of various skill levels — IS working for Daisy.

[INTERVIEW]

DF: "I think it helps a lot. Cuz, it gives me more opportunity to go over the course, actually understand it. I have extra help with the professor and instructor."

SEGMENT C

OW: Daisy is not alone. Dr Amarasinghe has been encouraged by the success he's seeing.

When he first got students to teach each other - he saw a near-20-point jump in pass rates.

Now, he's looking ahead. His next goal is to fix math classes at the HIGH SCHOOL level. And to do that - he's teaching the students who will go on to be math teachers.

[SEGMENT C - INTERVIEW]

RA: The number of people we are number of math teachers we are producing is not enough and not of my effort last few years has been trying to increase the number of math teachers not only the high schools actually in the middle schools math teachers and not only the number but the the quality of the teachers. We want to have teachers more teachers at the same time the teachers who are capable of really affecting the future generations of students because it is kind of a vicious cycle when we do not have enough good math teachers the students who are coming from the pipelines will be less because they don't get good enough instructions and they will not get interested in math or the STEM majors. So then then the fewer people become math majors and when fewer people become math majors we produce less math teachers so we'll have to inject somewhere and try to change the cycle. So we have been doing a lot of outreach activities and try to recruit students who would be good future math teachers and our college and the even with the support of the universities and different grant funding and so on. We have been crying to increase the number of math teachers we produce. I'm one of the things I actually read very recently to develop a program called integrated credential program. Students when they joined the university gave the option of taking

these math major with a different option. It's option is called integrated credential. We are they will finish the math major and the credential program within four years. And so that will actually help us to have cracked some strong students into the into the major who would like to become teachers at the same time graduate them into and have before they are otherwise if they're going the normal route.

OW: *At an institutional level what do you think other schools can be starting to implement as a way of rethinking their approach to math again not just at the level of the individual teachers but rather as schools as colleges et cetera.*

RA: *I think the graduate programs students who are taking the the graduate classes like a Master's in math and curriculum and instruction and those kind of the graduate programs having those kind of pedagogy classes not only the classes but the having some way to give the students experience while they are taking those classes to really engage in teaching and learning process.*

Get those tools to those students because those students who are going through the graduate programs will become either the future professors in the either universities or the community colleges or the high schools instructors.

So then having that skill. When you are redesigning your programs having that kind of a pedagogy class as well as giving opportunity for those students who are going through those programs to really teach and experience that kind of teaching in their programs. So putting those students into some kind of the graduate classes on undergraduate classes to assist students and really talk about how to change that instruction will give that experience for the students and that's what we have. We have done it here but it can be done in any place.

Most of the programs that have graduate programs they can they can think about how can I really. How can we really change our programs such that the experience is an integral part of a whole program. So that's something that any program can think about.

[END SEGMENT C INTERVIEW]

[FADE-IN MUSIC]

OW: Dr Rajee Amarasinghe is the chair of the Math department at California State University, Fresno.

One of the future math teachers coming out of his program is Erica Sawyer -- the instructor in the math class we've been visiting throughout this episode.

[INTERVIEW]

***ES:** One of the most striking realizations I've had is how students are able to get through high school just fine without ever having that your understanding or fractions for example like I remember last semester. At one point there was a group of students up at the board and they were trying to multiply two by one half and they were getting these answers like oh well there's a two in this one and two in this one so it must be four or you know one half of two. Like I just I was getting these crazy answers and that just really surprised me especially at the beginning of the semester. I get a lot of like you know oh I'm so dumb there like oh I'm just bad at math. You know math makes me feel really stupid and of course part of my work is trying to try to help them see that there is no just good at math good at math bad at math and a lot of times I do see improvement in that throughout the semester. But coming in it's a whole lot of you know I just can't do math. So why try to teach me. Then there's not that pressure of like the teacher looming over you asking you the questions like you're just kind of having a discussion with one another. I notice a lot of students that know just they don't seem to know quite how much they know but when they're discussing it with their peers then it kind of helps them solidify that.*

Absolutely. I am learning a lot of good techniques and ways to foster that type of culture in the classroom that I hope to take on or take with me wherever I end up teaching after I leave Fresno State or after I earned my master's degree.

SHOW CLOSE

OW: That's Erica Sawyer - a grad student at Fresno State.



And that's it for this episode of Higher Ed Rewired. If you liked what you heard -- please head to our website Higher-Ed-Rewired-dot-com.

There, you'll find links to subscribe to our podcast -- AND, info on how you can LIKE our show on your favorite listening app... it helps our ranking and it gets more people to know about us -- so please help us out.

[CLOSE show promo]

***PROMO:** Higher Ed Rewired is produced by the California State University Office of the Chancellor and the Vox Pop Collective. Our music is provided by Conjunction Entertainment. Our artwork is designed by professor Mario Estioko of Sacramento State University. This podcast is made possible, in part, by the support of the College Futures Foundation: more graduates for a thriving California. Learn more at 'college-futures-dot-O-R-G'. Subscribe to this podcast at HigherEdRewired.com, or on your favorite podcast app.*

[END PROMO]

OW: From beautiful Long Beach, California -- I'm Oliver Wang... and for all of us here at California State University -- thanks for listening!

[MUSIC POST - AND OUT]