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The NASBE Interview

*The Charles A. Dana Center at the University of Texas–Austin works with educators, administrators, policymakers, and other partners to dismantle barriers in education systems while creating and scaling the types of math and science education innovations that support student success. **Elisha Smith Arrillaga** is managing director and **Dave Kung** is director of policy at the center. Paolo DeMaria, NASBE’s president and CEO, interviewed them in March 2022 about their center’s efforts to help states improve math instruction.*

Do you think there is a shared understanding of how to help students achieve at higher levels in math? How can we create a stronger imperative for improvement?

Smith Arrillaga: What we have seen not only within states but also within the math community more broadly is there is not consensus around a vision for modern math—what students need for humanities or social science, for example. We all agree that we need to do better in math, but there is not general agreement on the how.

In K-8, there is general agreement around the core concepts for students to understand. But once we start getting close to eighth grade, we start to see more disparity in terms of what math folks think students need for various careers or pathways. It doesn't mean that K-8 math is perfect. Although we have the content piece right, there is still work to do on implementation.

Kung: Higher education plays an increasingly large role as you get through high school. There is not the same consensus within higher education about what these pathways should look like.

If there's greater clarity in the K-8 space why don't we see more change? There is an idea in our culture that some people just aren't good at math. Is there enough awareness that children should have a “yes, I can do this” mind-set?

Smith Arrillaga: We were working with some folks who did some polling in the fall. Ninety percent of the parents and teachers surveyed believe that either you can do math when you are born or you can't. That's a big statement, right? It is not acceptable to say, “I can't read.” Immediately, folks are like, “Let's figure out how to solve that.” We should have that same reaction about math. There is work to be done in changing mind-sets, and a lot of that work could happen in K-8.

Even though the content is there on the K-8 side, we don't necessarily have the math teachers we need due to the teacher shortage. Even though we have the tools, we haven't really taught people how to use them. Even though the way that the content is lined up shows students how to be critical thinkers, we don't necessarily teach it that way. So they don't see math in the world around them, which is actually where math is and what makes math come alive and helps folks to see themselves as math people.

How do you help students see relevancy and the reasoning behind math?

Kung: Everybody does have potential to do great math. The question becomes, “What’s going to hook this particular student?” Then the challenge is to come up with a system that is better at getting students to do that and making sure we are not leaving particular communities behind.

Smith Arrillaga: The folks at Family Math are doing good work in the early grades, not only with students but to bring in the whole family around building a math identity. There is also great work in states to rethink eighth grade through higher education and make sure those pathways have options, for instance, so students are getting data science and statistics earlier. In Algebra II, it helps students see all the ways that math is being used in the world.

Kung: We are seeing interesting work at the intersection of education and social science. In behavioral sciences, the growth mind-set work of Carol Dweck and others has been powerful. That has morphed into questions about how to structure things in the classroom to make sure students see themselves as mathematicians. There are some easy tools to make sure everybody feels a little bit more like they belong in those spaces.

How do we create the conditions for student success, even if it means a bit of productive struggle?

Kung: Everybody hits a place where it’s hard. The question is, how do you respond? People who don’t see themselves as part of the math community, as that being a safe space, are more likely to hit that barrier. People who feel more confident and feel like they belong are like, “This is getting hard. I should double down and work a little bit harder.” It also goes back to students seeing math as this thing that requires brilliance or genius. If that’s your belief, then when you hit something hard, your reaction is, “I’m just not one of those people.”

This is an example of a *wicked* problem—something incredibly complex with a lot of

facets. You have to get above the system to see it. A dozen years ago, math standards revisions in a lot of places brought fantastic new strategies. But we didn’t give teachers all the tools they need to implement it well and all the ideas that went along with it. Part of it being a wicked problem is that those teachers came through a system that inculcated in them so many things about the idea of brilliance, about speed being important. Those of us who are mathematicians don’t think of speed as particularly important. We think of deep thinking as important.

One of the programs I’ve run is Mathematical Association of America Project NExT, professional development for new postsecondary math faculty. We can make a huge difference, especially when we get professors early in their careers. We also see real strides in teacher preparation once those students understand the point of modern math education. We see also that it’s difficult to send people out into a system that’s not built to support that kind of teaching and learning. That’s the struggle. I don’t know about you, but I’m way too impatient to make change one retirement at a time.

Does that mean better professional development for practicing teachers? Or making sure principals and teacher leaders understand what the approach should be?

Kung: There is no silver bullet, and there never will be. We have to attack this problem on multiple fronts, including attacking the idea that math requires brilliance. No first-year teacher is going to attack it by themselves. That’s something we have to work on collectively. Is it something where the math community and the business community come together and say, “We have to have very persistent, consistent messaging to continue the drumbeat of, ‘Everybody can do math?’”

Smith Arrillaga: There’s no silver bullet, but there are definitely things we’ve been thinking about: Bringing the math community together around this shared agreement on modern mathematics is key. The way we think has to change from static mathematics to mathematics that can evolve as technology shifts. The other piece is working with communities around math

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identity and mind-set: empowering communities and students to see the math that is at work all around them in the world. On the policy side, K-12 work often is dictated by what's happening in higher education, particularly around admissions. More and more we're seeing coalitions in states work across K-12 and higher education—in Ohio and Georgia, for example, where we're seeing changes in terms of alignment and getting general agreement on what we need.

Kung: Somewhere right now, there's a high school junior who wants to study French literature or Russian history, and they are going to take AP calculus next year because they think it's going to get them into a better school. But they would be much better off in quantitative literacy or statistics. The thing that kills me is that they're right: Calculus will get them into a better school. That's a system that needs to change.

Do you think parents understand that you shortchange your own child if you don't hold the system accountable for nurturing their math competency? It's an essential tool in the life toolbox.

Smith Arrillaga: I had a meeting with an organization called Oakland REACH, which works directly with parents and has done amazing work in literacy. They did this program with parents where the students and those schools' literacy scores increased in the midst of COVID. More than eighty percent of parents they surveyed say the next thing they want to work on is math. As they talked about math—and the fact that at some of those schools, fewer than one in 10 Black and brown kids are doing math at or above grade level—the number one thing they said was, “No one is coming to help us.” That was a super powerful statement. They were talking about the mismatch between how we currently teach mathematics and the math students actually need for today's society. How do we do that work with parents so that we can save ourselves? For me, it was an exciting moment, because we always want people to have autonomy, but also a sad moment. It just compounded for me that we are urgently called on, now more than ever, to fix these issues.

Kung: There are organizations like Just Equations that focus on equity and mathematics, following Bob Moses's important claim that algebra is a civil right. We need to broaden that. It's not just algebra; access to high-quality math is a civil right. They are focused in the transition space in high school and transitions into college, and they have done great work on understanding why calculus is held up as this golden ticket [and] on the power of admissions and what we need to do to change that.

People are increasingly understanding that effective reading instruction is connected to content knowledge: A teacher might do a unit on soccer, but if students don't know what soccer is or how it works, it's hard to make the text make sense. How do you help people see the math in other areas?

Kung: If you ask people, “Do you use algebra in your work or your everyday life?”, the vast majority say no. If you say, “Do you use spreadsheets in your work?”, a huge percentage say yes. There is a complete disconnect, as if a huge portion of what we're doing in spreadsheets is not algebraic thinking. That disconnect is entirely on us: We in the math community have managed to teach the subject as if it has no relevance.

Are there other barriers that stand in the way of improvement in K-8 math?

Smith Arrillaga: One huge issue is teacher workforce shortages, especially in subjects like math. There's a lot of work to be done in teacher prep programs, making sure that teachers have the tools they need. Teachers are not immune to that identity concept. If they are having those same math identity issues and are then trying to teach students not to have those issues around math, it becomes very complex.

Kung: There's interesting data about teachers' mind-sets: whether teachers have a growth mind-set or a fixed mind-set about student learning. Teachers with a fixed mind-set can inhibit students so that even if you try to push

growth mind-set implementations, teachers can counteract it. It is about making sure we have the right content and the right framing, but then teachers need to reinforce that every day.

Let's imagine a dean of a college of education was part of this interview. Would they recognize that their support for math instruction might not be aligned with what practitioners believe teachers should be doing?

Smith Arrillaga: I was on a panel of some deans of schools of education at the Just Equations conference, and there is a lot of diversity. Some are trying innovative things; other folks are more hemmed in. There are bright spots out there; you just have to find them. What those deans seemed even more concerned about was modern math itself and the proliferation of math-related tools like informatics and data science. A top major at University of Texas–Austin right now is informatics, which requires math. How are we training math teachers for these new math-related subjects? How are math departments partnering with those areas? How are math and informatics departments partnering with schools of education?

Kung: I see great work in college departments of education, but they don't have the power to define what mathematics is. Students going through those educator preparation programs may get great messages from the education department, but they are still taking math courses in the math department. High school teachers especially are getting a math major, which is constructed around a 1950s or 1960s vision of getting a few people through calculus—a wicked problem. It's a structural issue that no department of education by itself is going to solve.

It sounds like there has to be collaboration between colleges of education and their respective math departments around what teachers should know and be able to do.

Kung: You hit on a key point, which is about alignment. There are a lot of problems within

our system, and one of them is that when future teachers talk about math in education classes, it doesn't always align with their experiences in the math department. But there are so many other issues, including the transition from K-8 math into high school math, the transition from high school math into college math, which is happening earlier and earlier.

The dual enrollment space is exploding. We have places in this country where a third of community college students are high school students taking dual enrollment courses. We need to make sure there is alignment there and then alignment between those programs and four-year schools to make sure students are not caught in a system that is not fighting for them.

Most of the policymakers I talk to went to a single four-year institution and then graduated. That is not the experience most students have, but it is especially not the experience for students experiencing poverty, especially Black and brown students. Those students are much more likely to be caught up in these gaps and the misalignments in our system.

Can you share a description of the work you are currently doing at the Dana Center?

Kung: A lot of our work, including the Launch Years initiative, could be framed in a very simple way: Each student deserves the *right* math at the *right* time with the *right* support. That's about it. Systems are not set up to do that. The right math for many students is not a path toward calculus, it's a path toward statistics or quantitative literacy. They are not getting it at the right time. Some students eventually get to quantitative literacy, but only after they have gone through what some call the death march toward calculus. And they are not getting the right support. A lot of students are either placed into courses and struggling, or they are placed into developmental sequences that lead nowhere. Few students get through those.

To reach this goal, we have to attack this problem at different levels. One is the policy level. We need to make sure there are state policies that support the idea that we need the right math for these students. We worked with

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Georgia in the first phase of the Launch Years project. We were able to get a policy change, which changed the definition of Algebra II to include more data science and a lot more statistics. It's a huge win for the students of Georgia. It is not just about policy; it's about how that policy gets implemented. We also work with state leaders, district leaders, and teachers to make sure they understand what it means to teach a different version of Algebra II than the one they took and the one they may have been teaching for 10, 20, or 30 years. We are trying to attack these problems at multiple levels simultaneously.

The first Launch Years project has completed, and we are moving to the next phase. Different states are in different places. This wicked problem is, from a game theory perspective, a problem of who is going to make the first move. The most effective way is for higher education to make the first move. We're going to be working with states where higher education has yet to make that move.

When I say, "make that move," I mean create greater alignment between different systems, common course numbering, and structured pathways that include paths toward statistics, quantitative literacy, data science, programming. Can we get higher education on board? And then can we start to work downward into K-12? Eventually, we need to go further than just high schools. What can we be doing in grade schools to set up students so that they have early experiences with data so that when they get to high school, it's not such a heavy lift. The ability to work with data is power.

Some elementary teachers get that. And it's great to see young students graphing data in elementary classrooms—they love it. It's about laying foundations for data analysis, identifying patterns and trends, and making predictions.

Kung: Let's start with really small data sets. Then when we get to more advanced kids, let's give them electronic devices to collect data. Then let's have them deal with big data sets. There's a lot to be learned from the U.S. Census

and from all these data that students find fascinating. We need to make sure that students have the mathematical tools to address the questions they have.

Smith Arrillaga: We have seen innovative examples recently in terms of climate data in places where there are fires. Students are using local data to predict all kinds of things. Helping students see that the whole world around them is mathematical is powerful.

Kung: The systems we have are not set up to support problem-based learning. Some policies have detailed learning outcomes that force teachers into a mode of teaching this little fact and that little fact instead of giving bigger, open-ended modeling problems that we know are more in line with what students are going to need later.

Are you finding fertile ground within the higher education community?

Kung: Having conversation is fertile ground. Progressing toward consensus is a little bit harder. These conversations have never been more important but also never been more fraught. We've never been in a more difficult messaging environment, a more difficult political environment. When you dig into that phrase "every student," that brings up all sorts of issues that some people are going to grab onto to drive a wedge between groups.

Smith Arrillaga: I attended a conference where the CEO of the National Science Foundation started talking about accelerating the pace of research around innovation and accelerating research-practice partnerships. She also talked about the key to that work being to diversify the foundation and the base of folks doing research to ensure that we have all the most innovative ideas possible. Dave and I were in another meeting with the Mathematics Association of America, where they are trying to work with math departments. [But] while we wait for math departments to come to agreement, there is still an accelerated pace of growth in informatics, data science, and other math-related topics. Bifurcation can mean that some students get to take those branches and others do not, so [how fast] we can come to agreement

around what modern math is and how math departments want to sit in that space is going to be really important for students.

Where is the business community on this?

Smith Arrillaga: We have started to see the proliferation of workarounds because departments and systems are not moving fast enough on the education side. That is why we're seeing, for instance, a proliferation of certificate programs that employers are offering themselves that may be math related because they are finding there are not enough folks who have the training they need for the roles they have open.

Since the education system is slow to change, in some ways businesses are trying to create their own solutions. In some places they are trying to work closely with schools and colleges to help them transform the work they are doing, but I would say those examples are few and far apart.

Kung: Higher education, especially four-year schools, has not always been great at working closely with the business community. The places that are excellent at this are community colleges. Community colleges are fantastic at responding to the needs of the community and, in particular, to needs of local employers. We are seeing some of that innovation in work we've done on math for nursing and for manufacturing at the local level in community colleges. If there were greater coherence on the message about what math is needed, then we could have some of that innovation scaled across the country. Right now, that innovation is very localized.

Are there other states that are pushing the envelope?

Kung: We are seeing a couple of models, including in Ohio. Getting all the math chairs together, along with K-12 leaders, has led to this vision where they have five versions of Algebra II. State policy said, "You need to take Algebra II or its equivalent," so they took that and ran. Now it is a path toward STEM, statistics, quantitative literacy, a data science path that they're developing now, and programming. The other model is

in Georgia, where they keep Algebra II together but then modernize it. We are seeing some of that in the Pacific Northwest. There is a lot of innovation out there.

The challenge is finding coherence because if you want change at scale, you need things like excellent classroom materials. We are not going to get excellent classroom materials if all 50 states are doing things differently. So bringing some coherence to the system will help as long as we are attentive to things like implementing changes with equity in mind and leveraging the increased use of technology that everybody is more comfortable with than they were before the pandemic.

What is the role for state boards of education?

Kung: One of the things that is coming out clearly is that in states that require four math classes for high school students, students take four math classes. In states that don't, you see a huge drop-off. In that last year, if students are not taking math, they are much less likely to go on and pass math classes when they get to higher education. That is a place where policy-makers have a really important role.

Smith Arrillaga: There are only two things I would add. The state boards' convening power around setting a table and then making sure that table includes students and communities is a powerful role as well. Then, in thinking about assessments, if there are ways that state boards can help ensure formative assessments are aligned to more national measures and are used along the way so that teachers are getting that just-in-time information they need to adjust math instruction to what students need. That's a powerful tool. In addition to the formative assessments, having growth metrics based on summative assessments is key to see how students grow versus just that point in time.

Kung: We are eager to work with states, and we are getting funding to work with states and to have the boards in that position where they are convening. We would love to be working with more states. ■

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