IES Institute of Education Sciences

Webinar Transcript: Teacher Qualifications Associated with Success in Algebra I

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Overview

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Facilitators: Mike Siebersma (REL Central), Josh Stewart (REL Central), Neal Finkelstein (REL West), E. Wyatt Gordon (ETS)

Transcript

MIKE SIEBERSMA: And thank you for joining our REL Central webinar entitled "Teacher Qualifications Associated with Success in Algebra I", sponsored by the Institute of Education Sciences at the U.S. Department of Education. We're eager to share the findings of a recently released study of the same title, and to wrap those findings with some background information on the importance of Algebra I as a critical gateway to higher-level math, and some interesting related content about the makeup of math certification exams for teachers. This webinar is being hosted by REL Central, which is one of 10 Regional Education Laboratories funded by the Institute of Education Sciences.

REL Central serves a region that includes the states of Colorado, Kansas, Missouri, Nebraska, North Dakota, South Dakota, and Wyoming. Each Regional Education Laboratory serves the applied research needs of stakeholders in its region. At REL Central, we work closely with our stakeholders to pursue projects that are guided by their needs. Our work is guided by research partnerships and alliances, groups of educators that are united by topical and practical interests and needs.

The study we're sharing today was conducted with the College and Career Readiness Research Alliance. The alliance has two core focus areas, the first being post-secondary success assessment, and the second, Algebra I readiness support. This study came out of the Algebra I ready support focus area.

I'm Mike Siebersma, and I'll be playing host for our webinar today. Our presenters will be Joshua Stewart from REL Central, who will share some background and findings from the REL Central study on teacher qualifications associated with student success in Algebra I. Neal Finkelstein from REL West will help set the stage by sharing some of his research on Algebra I and course-taking patterns in high school mathematics. And Wyatt Gordon from ETS will discuss how they develop math certification exams for teachers and what they intend to measure. I'll ask each of

our presenters to introduce themselves and provide a little information on their background as they begin their section.

The goals for today's webinar are to convey the research that tells us why Algebra I is so important to student success, to review findings about teacher qualifications and how they connect to student success in algebra, and to look at how math certification exams are designed and how that design might help us understand why they're so highly correlated with student success in algebra. I'd now like to turn it over to Neal Finkelstein from REL West to share some of the background research on how Algebra I fits within the larger course pattern of secondary mathematics. Neal, please introduce yourself and take us through your research.

NEAL FINKELSTEIN: Thanks so much, Mike. It's a pleasure to be here today. My name is Neal Finkelstein. I'm with the Regional Educational Laboratory in the Western states. And I'm based in San Francisco.

And for some time, I've been involved in doing studies on these kind of gateway problems between the middle school experience and what that tells us about the trajectory into higher education. What we know is that we can trace the math pathways issues well into younger grades. And I wouldn't for a minute want to take you through a discussion of middle school math and the Algebra 1 challenges without acknowledging that early math is certainly as important in those elementary grades. And we know an awful lot about that, as well.

So what I'm going to ask is for one of my colleagues to advance the slide, and take us through a couple of slides that sort of set the stage on the Algebra I's kind of circumstances, around the eighth grade and ninth grade challenges of Algebra I, and then how that links with our issues in college-bound–the support for students around being college bound. We did, in the Regional Educational Laboratory, a number of studies a few years ago. Those are all available through the Regional Educational Laboratory publications, on mastering algebra and what that meant as it related to math placement policy.

In a piece that we did called "Opening a Gateway to College Access," we reviewed three studies that we did. One was to try to look at the way in which diagnostic testing can work to try and understand which students are ready for algebra in the eighth-grade level. Another one was a study that looked at the progression patterns of English learners through middle school math sequences and special considerations in instruction. And a third looked at mitigating summer learning loss by looking at a program that supported students between their summers of seventh and eighth grade, in order to not lose any practice during the summer months in algebra, as they moved forward through middle school.

All to say that, what this gets us is the whole set of information that lines up to a backwards map. And if you take one thing from my comments today, it's on the screen right now. What's the course objective for the senior year of high school? What do we need to do to get four years of math organized for our students? That then works backward into that algebra question.

On the screen right now is a simple mapping pathway. It's a tool that's available through the Regional Educational Laboratories. It's in multiple languages, and it's a very simple tool that can be used by counselors, and teachers, and parents, and students to just answer the question that I've just posed–what's the four-year backwards map?

And the reason we're so stuck on this backwards mapping question is because the finding of recency, that is, the way in which you connect the math you've taken now to the math you've just taken before, and how much that matters for reinforcing not only conceptual fluency, but also procedural fluency, the two kinds of fluency that we know are absolutely essential in order to not have a gap in that transition between high school and college. So, this is nothing more than asking students to look at their senior year and just go through the exercise of what would you like to take. California, of course, changed standards, as did many states around the country about five years ago.

And we have all sorts of different names of courses on the screen as an example of a sample pathway that allows you to look at an integrated sequence of what we call Math 1, Math 2 and Math 3. It's a way of looping content through the first, second, and third years of high school, ending up in a pre-calculus and trigonometry example here for a senior in high school. Of course, the process of looking at this mapping is to say, how can I make sure that my student is being guided and counseled into four years of math as they move forward?

So, let me look at a specific example, and then we'll work right back to this eighth-grade challenge in Algebra I. Of course, we all know that the connections between these courses have a cascade pattern to them, not only in terms of the content but, as I said before, in the fluencies that are required. In California, one of the resources and kind of corner posts that we use to support students as they're making their way through their high school years–this is true in most states–is depending on a set of required courses that then take our students from middle school through high school, with required sort of courses that meet minimal eligibility and admission standards into public universities.

These standards are generally shared by private colleges, as well. And across the bottom, you can simply see a mockup of grade 9, 10, 11 and 12, moving from left to right, that shows what a student might be taking in order to meet those required courses for admissions eligibility. So, in grade 9, if you look at those light-blue bars, you could take Algebra I, might have English in another one of the required courses as part of your ninth-grade portfolio.

But then, just focusing on those light-blue bars, by 10th grade you would have completed Math and Algebra I and Geometry. By grade 11, you would have moved through an accumulated Algebra II. And that would have met, in the State of California, anyway a three-year minimal requirement that then, as a senior, we show on the far-right slide–the cascade of a trio of Algebra I, Geometry, and Algebra II.

Now, I don't want to confuse anybody. Even though minimal requirements for eligibility in California are three years of math, as shown on the screen, I said a minute ago that one of the

things that's most important in what I'll talk to today is the four-year continued sequence in high school. Looking there at the policy gap between what are minimal standards for college admissibility versus what we know from research are a number of courses that then support students through this challenge of recency as they migrate to college.

Why do I feel so strongly about this? On the screen is an example of cumulative units completed in math. And it's just sort of the way in which students accumulate credits. As much as that cascade I showed a couple of slides ago look so linear, it's generally not that way.

And if you bear with me and look at the slide in the upper left-hand corner for a minute, it shows us the percentage of students in Grade 9 who were not able to accumulate one full unit. Now, the magic to reading these slides is to look at the credit accumulation one on the x-axis. Run your eye all the way up to the top, and you'll see an arrow pointing at the number 1. That's what we had hoped students would accomplish. But you'll see that there are 31% plus 11%, 42% of students to the left of that 1, who didn't successfully complete a full unit of math in Grade 9.

Now move you from left to right, and at Grade 10 on the top right of the slide. Now I'm looking at the sophomores, the Grade 10 students, and they were to have accumulated two full units of math, as denoted by the arrow over the number 2. And in this particular case, you can see that I'm now adding from left to right–16 and 7 are 23 and 19, 42 and 11 is 53% of students are off track for not having accumulated two full units.

If you slip down to the bottom left, same problem. Looking at the arrow above three accumulated units, again, looking at those students who are not able to meet that number 3, 10 and 5 are 15, and 11 is 26, 36, 46, 51, 62% of students were not able to accumulate three units by their junior year. And that's why we have these challenges of trying to understand how to keep students on track.

So, if you accept that as sort of the background of the high school challenge, now I'm going to take us to the squarely Algebra I kind of forecasting about why it's so important. We certainly know from our studies with Regional Education Lab how important Grade 7 math is, and how predictive it becomes, and just how much that locks in a whole set of issues around foundations in proportionality, in numeracy, in the ability to use geometric representation, in being able to use literal symbols, all of the numeracy challenges that make up the fluency of Algebra I as students begin to work into functional form in all sorts of different ways. Math in Grade 7 is such a critical, critical point.

And we can do an amazing amount of predictive forecasting based on how students are doing in seventh grade. And when seventh grade doesn't do well, and as the slide indicates now, students end up repeating sequences of courses related to algebra. Often, students who've been asked to take algebra in the eighth grade find that they repeat not only eighth grade algebra, but they repeat it in ninth.

And as the slide indicates, in the study sample that we used, nearly a third of students were repeating Algebra I sometime between seventh and 12th grade. And those repeated results weren't going very well. Once you're struggling at the Grade 8 level in algebra, there are foundational concerns that can even be brought back to the recognition in real fluency and place value, which then take you back to second-grade standards. And, so, there are many kinds of things that really need to be untangled diagnostically in why students aren't succeeding in algebra.

So, the screen now shows just a couple of examples of the ways in which students are going through these math sequences. I won't spend a lot of time on this slide. It's in the resources that we can provide to you. But you'll see just kind of halfway through, there's a number 33.57 associated with the proportion of the sample, whoever repeated Algebra I in our sample.

That repeats what I said a minute ago, about a third of students. And then you can see just three lines from the bottom that just under half of the students had repeated some course of Algebra I, Geometry, Algebra II. And the last row indicates that there were a third of students, nearly a third, who didn't take a math course as a senior in high school, which is very telling about the challenges that students have had as they've repeated courses, and then feel somewhat frustrated, and maybe disinclined to take a course as a senior, which causes some challenges in the transition into college.

So confirming where we are, now we're just sort of ready to hand it off to our next speaker, I want to set the stage for one more point as we start to move into the discussions of teacher preparation, and the way that our teachers are supporting our students in math learning. And it's in part related to how students are doing in their classrooms, and on all sorts of processes of instruction, and the way that diagnostic testing can be used to help identify the challenges and strengths. But I just wanted to say that one of the things that we acknowledge as a team today is some of the things you hear in your communities really do relate to the acceleration of students' families and students who are really eager to make sure that they've gotten to calculus by the

And, so, I wanted to spend just a minute, as I turn this over to our next speaker today, to show that we understand and are certainly sympathetic to the challenges around acceleration in math, and the role that teachers play. But I did want to contrast for you just briefly this slide on the screen, which shows a student reaching calculus by the 12th grade, indicated by the rectangle on the far right side, and moving back all the way to Grade 6 on the left-hand side of the screen, showing a sequence of courses from Grade 6 to Grade 12 where, in this particular depiction, the decision to accelerate a student was made between Grade 6 and Grade 7. And as I indicated a minute ago, the acceleration challenges can be very significant for some students.

Contrast what's on the screen with this different picture, that also looks at Grade 6 on the left and Grade 12 on the right, having that calculus. But the acceleration decision point is after the eighth grade. So, I want to point out that Algebra I is so important, and Algebra I should be given and provided to students at the right time in their math understanding and conceptual development around math.

This is something that we rely on our teachers a great deal, to support the counseling of the placement process. And on the slide as you see it here, there is no difficulty in reaching calculus as a senior in high school, still having used the sixth, the seventh, and the eighth-grade standards as written before a decision for acceleration is made in the high school years.

So, thank you for your time today. I'll stay on and turn it now over to Josh Stewart. I'll be around for questions later, and really appreciate the opportunity to be with you today.

MIKE SIEBERSMA: Thanks so much, Neal. We appreciate that background information on the critical importance of Algebra I, whenever it's placed within that acceleration sequence. We do have a couple of minutes at this point, and we'll have some more time at the end. But if anyone has a question specifically related to the background research that Neal shared, we'd be happy to have a look at those questions now. If we don't get them now but we get them later, or if we run out of time in this little Q&A period, we can certainly forward those on to the end of the webinar.

JOSHUA STEWART: Great, and I did see a couple of questions coming in through the Q&A box here. I'm Josh Stewart, Senior Researcher at REL Central here. And Mike, thank you for that introduction. And Neal, thank you for the overview on course sequencing and its importance in preparing students to take more advanced mathematical topics.

I'm going to share today a bit about a recently released REL Central study, where we examine the findings of one of our recently released reports. I'm based here in Denver, Colorado. And I'm the lead author on the REL Central study that we'll talk about today.

And my experience in this topical area ranges from some work that we had we done in Mississippi early on, looking at pre-algebra foundational skills, and its association with preparing students to take Algebra I, including this study today, when we're thinking about what skills do teachers need in order to help scaffold students through this more complicated topic. And so that's just a brief introduction of what I'll discuss here. But if we want, as Mike mentioned, to take a few minutes to look at the questions that might be a bit more pertinent to Neal's section, we also have time at the end to talk about questions across the board.

And I'm just looking at the questions now. And I see we had one talking about geometry possibly before Algebra I, which I think we might have time to get into at the end, unless we want to touch on that now, Neal. Fine to wait on that until the end, too.

NEAL FINKELSTEIN: Yeah, I'm happy to just make a comment for a minute. One of our participants today raised the question about the sequencing of coursework more specifically, and some proposals that have been generated through the National Council of Teachers of Math and other organizations, to really look at these sequences more developmentally. There have been proposals made for why geometry as a sophomore couldn't be done as the first year of high school and adapting and adjusting the sequences accordingly.

There are proposals that have been put out very recently in many states on really rethinking the content of courses. All that I would say is, the issue of four years of math can be accomplished in a lot of different ways. And at least in the redesign of the standards that so many educators spent so much time on over the last 10 years, one of the things that was really, I think, consistently implemented was the looping of standards.

That is, it was never seen that you should, for example, touch the topic of conditional probability once. It's a hard topic. A lot of students struggle with probability. That leads to probability and statistics, which a lot of us think is really important to sort of be able to participate as an adult these days, to read data carefully and think analytically. And yet the standard provided an opportunity for something like conditional probability to be wound into the work of the ninth grade, and the 10th grade, and the 11th grade, and then, of course, even later. In fact, you can find examples earlier on that students are working on, where they're given signals about the way in which probability feeds into their math learning.

All that to say that the sequence of math that students take is about the repeating, and the rehearsal, and the deepening of both procedural and conceptual fluency. And if there are sequences that are being chosen that honor the looping of standards, the embedding of algebraic thinking into the course content, there are lots of examples to choose from. And as the attendee writes, the re-sequencing to include an algebra-rich geometry course, for example, in advance of Algebra I is something that some people are talking about.

All that leads to four years of math. And for those of us who see, increasingly, students taking statistics as a senior in high school, terrific. For those who want to do it earlier on, terrific. So, let me put it back to Josh.

JOSHUA STEWART: Thank you, Neal, for that background information. And that leads nicely into what we're going to talk about now, since we think about Algebra I as one of the more complicated topics that students could be engaging in, since they'll be just moving out of basic arithmetic. And, so, a little bit of background on the study that we're going to talk about today.

The study really focuses on the background that Missouri teachers bring to the table, particularly for their middle school students. And because Algebra I in Missouri can be one of those more complicated topics, like we were just talking about, the Missouri Department of Elementary and Secondary Education was really interested in understanding what qualifications are important to help scaffold students through Algebra I as they're beginning to think about taking more advanced courses down the road. So, the current research is mixed in terms of what qualifications are most highly associated with scaffolding students and helping them achieve success in Algebra I.

And, so, with that in mind, the Missouri Department of Elementary and Secondary Education requested support from REL Central to really drill down and figure out which qualifications are most strongly associated with student success. In the current REL Central study, we sought to,

again, examine teacher qualifications. And in this, we used 429 middle school teachers who taught Algebra I at the middle school level in the 2015/2016 academic year.

Now, teachers held a variety of certifications and qualifications that we included in our model. But we really tried to distill down the qualifications that gave us the biggest bang for our buck. And, so, we'll get into that here shortly, but just a little bit of context on the study that we'll talk about.

We do want to get your insight into how Algebra I, particularly at the middle school level, plays out in your local context, in your district, or in your state. So shortly here, you'll see a question pop up on your screen. And basically, we want to get your response to this question. Does your state or district offer Algebra I at the middle school level?

So, you should see the answer options popping up on your screen now. We'll take just a few minutes in order for you to be able to reply to the answer. And then as a group, we'll look through folks' answers to this question before we move on to a second question that we'd like just to pick your brain about, in order to inform what we'll talk about in terms of implications and what we found in this study.

So, take a few minutes. Fill out this question. And then we'll look at the results shortly.

All right, so you should be able to see the answer being shared up on the screen. So, it looks like the vast majority of folks, 75%, answered yes. So the results that we're going to talk about today should be, hopefully, helpful to the context in which you're looking at, or the lens that you're looking at the study through, so district or state offerings of middle school offerings of Algebra I. If you answered no, we still think that the results will be important just to consider, in terms of qualifications, since some of those will still apply even at the high school level.

So, I'm going to shift us now to our second question. So, the next question here–which of the following does your state or district prioritize when placing Algebra I teachers? This could be advanced degrees, performance on certification exams, college major, high school certification, middle school certification, or other. And if you do have an “other”, please put that in the Q&A box, and we'll look through those shortly after we get everybody's responses.

But, similarly, you'll see a box pop up. It'll have some answers. Select all that apply. I'd be interested to see what your thoughts are across the board.

And then we'll review everybody's answers here in just a minute. Great. So, it looks like across the board, we have advanced degree–14% of respondents selected that one. Performance on certification exams, 14% of respondents, college major, 21%, high school certification, 59%, so that's the biggest category here. So, we'll definitely have some results to share with you in terms of the study for today.

Middle school certification, 38%, and then other–and so hopefully, some of you who had selected "other" put those into the Q&A box. So, let's take a quick look at those if I can see what other individuals–I'm not seeing any answers in there. But as we go, when we get towards the end of the presentation here, we'll have some time to ask more questions. And I'd love to hear other sort of qualifications that may raise to the top for you, in terms of what you look for when staffing Algebra I in classrooms.

We do have one question, hold on. Let's see. Are we assigning the algebra teacher based on the fact that we have a teacher who can teach it? So, yes, it is hard to get teachers to teach out here. Yes. So, definitely, I think that's a very valid question, and one of the questions that the stakeholders who asked for this study raised.

So, if we don't have folks with a myriad of qualifications, who do we focus on? And, so, let's take a look and reflect once we get to the end of the study here, and see maybe what rises to the top, and how practical some of those recommendations might be. Because Algebra I at the middle school level, in particular, is a hard-to-place course.

And, so, again, if you're choosing from a small pool of candidates, you might have limited opportunities to actually distill down and select one of the qualifications we're going to talk about today. But I'd love to hear people's responses and ideas once we get to the end here, in terms of what we might balance and things that you might consider in terms of placing folks, considering the fact that it can be hard to get teachers in specific locales or with specific qualifications at your school district. So, hopefully that answers your question here.

So, getting into the study today, as Neal was just describing, success in Algebra I is important because it's a gateway course for taking more advanced math courses down the road. And we know that students who pass and take Algebra I are more likely to take and pass more advanced math courses in high school. This trend has created a need for middle school teachers with more advanced content knowledge that can help scaffold students through these more complicated topics. And, so, with this in mind, as I mentioned earlier, we conducted this study in partnership with one of our states to really drill down and look at what qualifications really rose to the top. And so hopefully, even in thinking about staffing shortages in teacher mobility or teacher attrition circumstances, there'll be some information here that you might consider if you have a couple of candidates, at least.

So, the research questions we sought to address with this study first get at what are the qualifications of teachers in general? Background knowledge, certifications to teach mathematics, high school, middle school, scores on certification exams of the middle school teachers and algebra, or Algebra I courses in Missouri. And that really plays on the idea that prior research has suggested things like educational background, certifications, scores on exams can be particularly helpful for students as they're navigating this more complex course.

We then sought to address which teacher qualifications are most highly associated with student performance on Missouri Assessment Program, or MAP, and of course, Assessment Exam. So,

this is the standardized test that all students take after they take Algebra I in Missouri. How do specific teacher qualifications relate to performance on the MAP EOC exam for underrepresented and disadvantaged subgroups? So, in particular, underrepresented here, we're focusing on black and Hispanic students. Disadvantaged–those students eligible for the National School Lunch Program or those students eligible for special education services.

So, just to understand our first research question, what are the qualifications that teachers across Missouri are bringing to the table, again, we included a large swath of different qualifications. And we are just going to focus on, today, the qualifications that rose to the top that we thought were most associated with, or I would say most related to, their content knowledge to teach mathematics. So, we found that most teachers in this study have a certification that allowed them to teach content up to but not beyond Algebra I. This would be a middle school certification.

Further, we found that the majority of teachers held either a continuous or a lifetime certification. And this indicated that they had passed through the initial entry-level certification phase that lasts for four years, which requires additional monitoring and mentoring along the way. The "recently included certifications" here is because, after looking at prior research, certification seems to be associated with content knowledge, as evidenced by a teacher's ability to scaffold students through more complex topics as they get into high school. And if they're reaching kind of the cusp of their content knowledge, as evidenced by their certification to either teach content up to the middle school level, which would kind of top out at Algebra I, or if they're still in their initial phase, that might express that they have perhaps a lower level of content knowledge of those higher level, more complex topics that they can kind of scaffold students up to by the time, or help prepare them for the time they reach high school.

So, the next finding that I want to present here is a teacher's background education. So, all teachers in the analytic sample at least have a bachelor's degree, and 62% held a graduate degree. About 61% of those teachers majored in math for at least one of their college degrees.

And about 98% of the sample held a graduate degree that was a master’s degree. And so we had 2% of folks who either had a doctorate or an educational specialist degree in an area like School Psychology, Educational Psychology, or Curriculum Design and Development. And so we see that the vast majority of teachers here are highly qualified, and most majored in math, which is a good sign.

So, if we break this down a little bit to just think about where are our teachers falling who are in the high school and middle school certification, we found that most teachers with middle school certifications–a smaller proportion of those teachers in comparison to teachers with high school certifications–actually majored in math. In contrast, however, teachers who taught at the high school level tended to, as I just mentioned, major in math more often than those teachers at the middle school level, but they also had fewer graduate degrees. So we see kind of a disparity here, where more middle school-certified teachers have graduate degrees versus high school, but the inverse is true–more of the high school teachers majored in math as opposed to the middle school teachers, or I should say certified middle school teachers.

Experience teaching math was also a variable that we wanted to consider, because it's associated with student success. So, you'll note here in our figure, the two most frequently noted categories are teachers who had four to six years of experience and teachers who had more than 29 years of experience teaching math. So, we do kind of have this bimodal distribution, where we have a lot of folks who are still kind of early on in their career, we also have a lot of folks who have quite a bit of teaching experience. And, so, we wanted to understand what's the breadth of experience that teachers are bringing to the table, particularly in the area of mathematics.

So, as I mentioned earlier, another proxy for mathematical content knowledge is certification exams. So, about 70% of the teachers in the sample took one of two certification exams, the Praxis II middle school mathematics exam or the Praxis II content knowledge exam. And the remaining 12% of teachers either had no data available about their certification exam or they took another type of certification exam.

So, the 53% that we're seeing here that took the Praxis II middle school of mathematics exam, 96% earned at least a passing score of 158 or above. And the teachers who didn't but were still certified could have received a passing score on another type of exam or they might have been able to take it again down the road. So, we know that the vast majority of teachers pass the certification exam. And when we talk about this later on, we're really thinking about the association between their exams, not the buckets they fall in here, and its relationship to student success.

So, the next frequently taken exam is the Praxis II mathematics content knowledge exam. And so about 25% of the teachers in the sample took this exam; 83% of those individuals passed, receiving a score of 137 or higher. And, again, teachers could take the exam multiple times, or they could have received certification through another venue, through another assessment, essentially. But again, we wanted to look at certification exam scores because these have been, based on prior research, associated with student success.

So, now that we've looked through our first research question–so what are the qualifications among the pool of teachers in Missouri who are certified to teach Algebra I at the middle school level–we want to now turn to our two second research questions, which are looking at the association between those qualifications and student success. So, the teacher performance–or the individual's performance–on the certification exam and years of experience teaching mathematics were the most strongly associated qualifications with student performance on that end-of-course exam. This also held true and was strongly associated for students in an underrepresented or disadvantaged subgroup–so again, black and Hispanic students, as well as students who were eligible for the federal school lunch program, or who were eligible for special education services.

And, so, these are the qualifications that we saw amongst the many variables–teacher qualification variables–that we included in our model, that really rose to the top in terms of the strongest relationship. So, here you can see kind of a breakdown of the findings that rose to the

top beyond just the certification exams. The first column here indicates a teacher qualification that we're looking at in particular.

The second column represents whether or not it was associated with success for students in general, so if it has a "yes" in the box, that means yes, it was an important variable for students in general. And the third column indicates whether or not it was associated with success for students in underrepresented or disadvantaged subgroups. So, here we can see that in addition to the two Praxis variables we discussed earlier related to the certification process, we also see a few other exams here that are related to student success in Algebra I.

In addition to those findings, you can note that education specialist degree–again, these are going to be folks who have a–Educational Psychology, School Psychology, or perhaps a curriculum in design background, tended to have black and Hispanic students who did better in their classes being associated with that higher level degree. And again, that's a terminal degree. We also found that math certification type, basically, if it's a continuous degree, folks who had moved out of that initial phase also tended to have students perform better who were eligible for the federal school lunch program. So, that's kind of our higher-level kind of overview of the findings, and how they broke down in terms of which gave us the biggest bang for our buck in terms of student success, student achievement.

So, and I know we've had a couple of questions here, and I'll get into those right when we get to the end of our section here. So, I want to focus a little bit on the implications of the study, and thinking about the breadth of qualifications, but particularly which qualifications kind of rose to the top or what are the practical implications of those findings.

So, the results suggested certification exams are not merely a compliance feature of the teacher certification process but may meaningfully differentiate between a teacher's ability to support students through Algebra I. So, a potential implication here is that policymakers, state, and local education administrators may want to consider performance on certification exams when determining placement of teachers in Algebra I courses, particularly at the middle school level, since it is one of those more challenging topics that can, in some ways, alter a student's trajectory.

Experience teaching–so again, not surprising, students who had teachers with more experience teaching mathematics in particular tended to perform better on the end-of-course assessment that we just described. And this result held true for students in general, as well as for Hispanic students, and students who were eligible for the National School Lunch Program. This finding suggests that schools and districts might give preference to teachers with more experience teaching math when selecting Algebra I teachers, especially in schools with higher proportions of underrepresented or disadvantaged students. Again, because Algebra I serves as a gateway course to more advanced mathematical topics, schools might consider the benefit of staffing Algebra I courses with their most experienced teachers compared to, perhaps, other courses.

Certification level–we found that, again, thinking about certification as middle school or high school, unlike prior research, we didn't find positive links between certification level and student achievement. So, when you're thinking about whether or not I was certified to teach up to Algebra I at the middle school level, where I might have been kind of topping out of my content knowledge, versus whether or not I had a high school certification, we did not find any positive links there. But again, you may have noted we did find a positive link between teachers who had a continuous certification, which just meant that they passed out of their first four years of teaching experience and moved into a more stable credential.

Educational attainment–so, we did not find a link between educational attainment and the achievement of students in Algebra I. So, this held true for master's degree, doctorate degree. But the one exception to this case was that teachers with an Education Specialist degree tended to have black or Hispanic students perform better on the MAP end-of-course assessment. And again, thinking about this as Educational Psychology, School Psychology, Curriculum Design, a specialized terminal degree. In general, this finding is consistent with prior research, in some ways, that suggest that educational attainment doesn't really have a strong association with student achievement.

And I think that is it for my deck. Do we have time for a couple of questions here or should we wait until we get to the end?

MIKE SIEBERSMA: Why don't we wait until the end?

JOSHUA STEWART: OK, so I do see that there's a couple of questions in the Q&A box, but we'll wait until we get to the end, just to be able to turn it over to our next presenters here. So, thank you for your time. And thanks for letting me talk about the study. And I'll be on deck to answer questions after we get to the end.

MIKE SIEBERSMA: Thanks a lot, Josh. If you're like me and you're out there listening, you're probably fascinated to learn about all the teacher qualifications, and which ones were associated with student success in Algebra I. I was especially interested in how powerfully their performance on certification exams seems to be associated with how their students do in Algebra I. So, because of that interesting finding, we thought it'd be good to bring in somebody who's deeply familiar with the design of those exams and share how they're designed and what they're intended to measure. So, we have Wyatt Gordon from ETS joining us today to share how ETS does just that. So, Wyatt, could you introduce yourself and take us through how those exams work?

E. WYATT GORDON: Yes, sir. Thanks for the introduction. I'm E. Wyatt Gordon. I am the Executive Director of our professional educator programs here at ETS. I'm going to give you guys a bit of background about our practice assessments and also walk you through how we design the majority of our assessments.

So, ETS has been a leader in licensure and certification assessment for educators, including teachers and school leaders, since its founding. And our practice assessments launched in 1993. They're administered on computer in 600 test centers in the U.S. and Canada, and they're used for licensure by, now, over 39 states and territories, and also by agencies.

So, to meet the needs of our practice clients, our tests are adapted to fit different kinds of licenses and to fit with different kinds of standards. So, for a licensure system, Praxis supports the implementation of quality standards. And we do that by working with states to require teachers to demonstrate that they have critical knowledge and skills before taking on new jobs or new roles in education. And we establish for teachers, for teacher educators, and for professional development providers the standards that they're aiming to meet. And we evaluate those standards in the same way for every educator who takes our assessments.

So, we have two major buckets of assessments in the Praxis series. One bucket is our test of academic skills. We also refer to that as our Praxis I assessments.

And we have another bucket which includes our licensure and certification tests that we refer to sometimes as our Praxis II assessments. Our core academic skills for educator tests is broken down into three different subtests, including reading, writing, and mathematics. And the core test measures the academic skills essential for all candidates preparing to be teachers.

Our reading test focuses on understanding, analyzing, and evaluating the different kinds of informational texts across a range of subject areas. Our writing assessment assesses language usage, revision, argumentative writing, and writing of informational explanatory texts. In mathematics, we focus on key concepts in mathematics and the ability to solve problems and reasoning in a quantitative context.

So, for our licensure bucket or our Praxis II bucket, we have over 90 different assessments that assess teacher candidate knowledge and skills. Those assessments focus on the content knowledge in the subjects that teachers will teach, and also an understanding of pedagogy, for example, the knowledge of teaching principles and practices, but also how students learn. We also have assessments in specialized educational roles like school leader, reading specialists, and teacher of the deaf and hard of hearing.

So, our Praxis assessment measures subject-specific content knowledge for new teachers and was developed by ETS in collaboration with practicing teachers and teacher educators. Each state client that we work with adopts the most appropriate tests for their licensure and certification needs. And each state and credentialing agency sets the passing score for each test, based on recommendations from our multi-state standards setting studies.

So, any time that we design a new test, we begin by selecting and reviewing the appropriate standards. And we base that initial domain on existing standards accepted by the profession. We then identify relevant, important knowledge and skills, and we further refine the initial domain based on input from practicing educators.

We then confirm the relevance and importance of the knowledge and skill. And we do that through an independent verification of job readiness of the knowledge and skills that we've defined. We then translate those knowledge and skills into test specifications, and then we build test specifications to reflect the aforementioned identified knowledge and skills.

We then develop test items, scoring keys, rubrics, and ancillary materials. And all of our items are written by educators to measure the defined test specifications. We then have multiple reviews of each test item in order to verify the linkage between test items and test specifications. And then we assemble forms to verify the linkage between those test forms and the defined test specifications. Each of our forms are independently reviewed by practicing educators to ensure the accuracy of the content and the fidelity of what we created to the test specifications.

We then conduct a standard setting study, as I mentioned before. We use educators from multiple states to recommend a performance standard to policymakers. That is, they recommend a passing score or a cut score to the state clients that we serve. And then we verify item and test level performance before reporting our scores.

And the verification of those, of the proper performance of those items is important prior to scoring and reporting. Of course, we do an ongoing review of each practice title to ensure that our content domain continues to reflect the field. And if there are significant changes to the content domains, for example, the creation of new standards, then we redesign our testing again back at the first step.

So, our middle school mathematics test, which is one of the tests included in the study, is based on national and state standards for grades six through eight. Some concepts are not emphasized in the assessment, including statistics, but there are other concepts from high school mathematics that are included in the assessment, including radicals, and rational expressions, and nonlinear equations, and inequalities. The test is about two hours with 55 questions; 35 of those questions are multiple choice and 20 of those questions are in other formats.

The other assessment represented in the study is the mathematics content knowledge test. And that's based on national and state standards for grades nine through 12. And some concepts are not included, like vectors, but there are other concepts from middle school math that are included, for example, ratios, proportions, and percents.

There are some concepts from calculus and discrete math that are also included. That test is about two and a half hours with 60 questions. Forty of those questions are multiple choice and 20 of those questions are in other formats.

So that's all I had prepared today. If you guys have questions, I'm happy to answer them or I guess we'll take questions on any other part of the presentation as well.

MIKE SIEBERSMA: Thanks so much, Wyatt. I really appreciate you kind of just walking us through that. And while I'm a little, kind of, awed by the complexity of all these findings, when you boil it down it really comes out simply.

Neal's research shows us how important Algebra I is in a course-taking pattern. The research Josh shared with us says that, among other things, how well teachers do on those exams has a lot to do with how well their students perform in algebra. And what you just told us is, you set good standards for what good teaching looks like, you measure how people do against those standards, and the better they do, the better their students do. So, it's really kind of beautiful when a plan comes together.

So, thank you all for bringing us what turns out to be a pretty coherent body of research and practice in this area. I do want to orient you to the questions on prompts on the screen, which are, what might be some policy or practice implications of the study on teacher qualifications? How do they affirm or challenge your prior understanding about what influences student success? And then just other questions that you have for the presenters.

And while you think about that, I'm going to share a question that I think was posed to Josh and invite Josh to kind of weigh in on this. Dara said, "We've found that more experienced teachers tend to get assigned students who are more likely to score well on their exams anyway. Is there anything in your regression that can imply causality in one direction or another?"

JOSHUA STEWART: Yeah, that's a great question. So, in terms of extant research, and in terms of what we looked at in our study, we didn't look at the prior–well, we looked at prior experience of students by taking their prior year's exam score into account. But in terms of placement of teachers based on students who may have had higher or lower exam scores, our regression doesn't include that particular piece of information.

It does include, since it is prior experience, or sorry, prior test scores, it does include that in the model. So, it helps mitigate the impact that that would have on our results. I will say, and probably to more directly answer your question, a lot of the research that we cite, particularly in the appendix of our report, suggests that teachers with more experience, higher degrees, tend to gravitate towards more congenial teaching conditions. So, to your point, it seems as though, based on a lot of the prior research, teachers with higher qualifications tend to teach students who are doing better anyways.

And so I think that that's one point of major consideration is that students who might be at greater risk of struggling, students who need more of the scaffolding through this particularly challenging course, since they're transitioning from basic arithmetic to more abstract thinking in terms of mathematics, it seems to really benefit them to have a teacher who has that strong content knowledge. So, I would direct you to the appendix of our report, where there's a bit more research that specifically looks at that topic, looking at teacher mobility patterns as it relates to this topical area. And again, a lot of it suggests or points in the direction that teachers who have that more robust–better qualifications–tend to elect districts that are easier to teach and that have higher performing students. So hopefully, that answers your question there.

MIKE SIEBERSMA: Thanks Josh, appreciate that. And Dara, thank you for the question. Any other questions or responses to these prompts? What are maybe some policy and practice

implications for the findings? How do they relate to what you would have thought when you walked in, virtually, to this webinar today? And again, any other questions you have for our presenters.

Just going to give a moment to allow people to consider those questions. But I am going to move off to the next slide and just kind of share with you the resources and some of the pieces that went to build the content of this webinar. This will all be sent out, the slide deck as well as the recording, after the webinar for all who have registered to attend. So, we appreciate that, and you'll be receiving the recording or link to it within a few weeks.

And–just want to mention again that–we appreciate the way that each of our panelist presenters has come together to help us see a comprehensive picture of how you build a successful Algebra I student in middle school and beyond. So, we thank you, Neal. We thank you, Wyatt and Josh for this study, for sharing it with us. And to all of you who have attended today, we appreciate your attendance. And happy to stay on for a few minutes if a few questions roll in. There will be a survey as you exit the Zoom webinar platform. And we would appreciate it if you'd take that survey and provide us your feedback on today's webinar.

We have a couple of questions coming in. Heather said, "We find that many of our teachers with advanced degrees have those degrees in administration or principalship. Do you have any way to determine the success of students of teachers whose advanced degrees are in mathematics or math education versus some of those other ones?" I think Josh would be happy to answer that one.

JOSHUA STEWART: Definitely. So, when we were thinking about math majors, the way that the data were structured, we knew that folks had a math major. And either that could have been in their bachelor's degree, master's, or an advanced topical area. But we aren't really able to desegregate the other endorsements that they had, at least under the purview of this research.

So, thinking about advanced degrees around administration or principalship, I would hypothesize that some of those might be related because they perhaps have a better sense of the pedagogical skills that might help build students' capacity in that regard or help scaffold students' capacity. In this case, we just looked at content knowledge, and those, I guess, I'm kind of thinking those might help lead the way in terms of pedagogy. And so, the short answer would be, we did include some of those certifications. They didn't rise to the top, but we also didn't have a large share of the sample that had those types of certifications, or we couldn't really disaggregate if their advanced degrees were in those topical areas.

So, there is a bit of limitation in the data set there. I wish I could answer your question more fully, but I will say that if they did major in math at some point, we note that that wasn't a variable that stood out in terms of the association between teacher qualifications and student success. But I would love to, down the road, look at some of these additional variables because you raise a lot of important points there.

MIKE SIEBERSMA: Great, thanks, Josh. Wei-Ling has another question, and it kind of cuts to the chase at the end here. So, I'm going to speak slowly so Josh has a little time to think about this. Josh, can you elaborate–what's the implication of the findings that teacher certification does not have a statistical relationship to student achievement in Algebra I? Does that mean we don't need to look at a teacher's certification to teach algebra in the future?

JOSHUA STEWART: Yeah, so that is a great question. So, I would say when you're thinking about this study, do think about it in terms of the fact that it's a correlational study, and it's also based in a single state. And so, I feel like the model that we used in this case was able to take into account a lot of variables.

So, we used elastic net regression, which is a way of looking at all the variables that are lumped into a teacher's qualification and certification process, and then just distill down what were the ones that had the strongest association. So, when you're looking at the results from the study, there's a lengthy appendix. I would suggest that when you're considering all of these other qualifications, the certification exam and the years of experience kind of rose to the top.

Personally, I had hypothesized that certification level would have made a difference, which we didn't see in this particular circumstance. But I think that it would bear additional research and some replication on that front, just to help paint a more complete picture. So, like you, I think that certification level–I would hypothesize–I hypothesized it would make a difference. I hypothesized it would have been associated.

We didn't see it in this circumstance. And I wouldn't say that it's worth discounting, by any means, but based on the data that we had here, the teachers included in the sample for the one academic year, we didn't see that relationship. But rather than saying it doesn't matter, I would say it probably requires some additional research before going that direction, because I do still feel like it is important.

And there is prior research that does suggest there is a relationship there. There's just research that we couldn't find in this circumstance looking at the middle school level. And there's just fewer studies that look at it at the middle school level at this point. So, hopefully that answered your question.

MIKE SIEBERSMA: Thanks Josh, and thanks for the question. It looks like we've addressed all the questions that have come in through the question and answer feature. Again, we will stay on for just a minute or two longer, if any other questions come in. But, again, thank you for attending our webinar today. We hope it's been informative for you, and that it helps make good decisions, or at least informs in some way that the decisions that you're able to make around how to help students be successful in Algebra I.

Alright, it looks like we don't have any additional questions. So, thanks everybody, again, for joining us and we're going to close it out for today. Please be sure to take that survey as you're prompted to do so upon leaving the webinar.

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