
LANDSCAPE
Algebra
Mapping the
LANDSCAPE of Districts'
Stances on Early Algebra I
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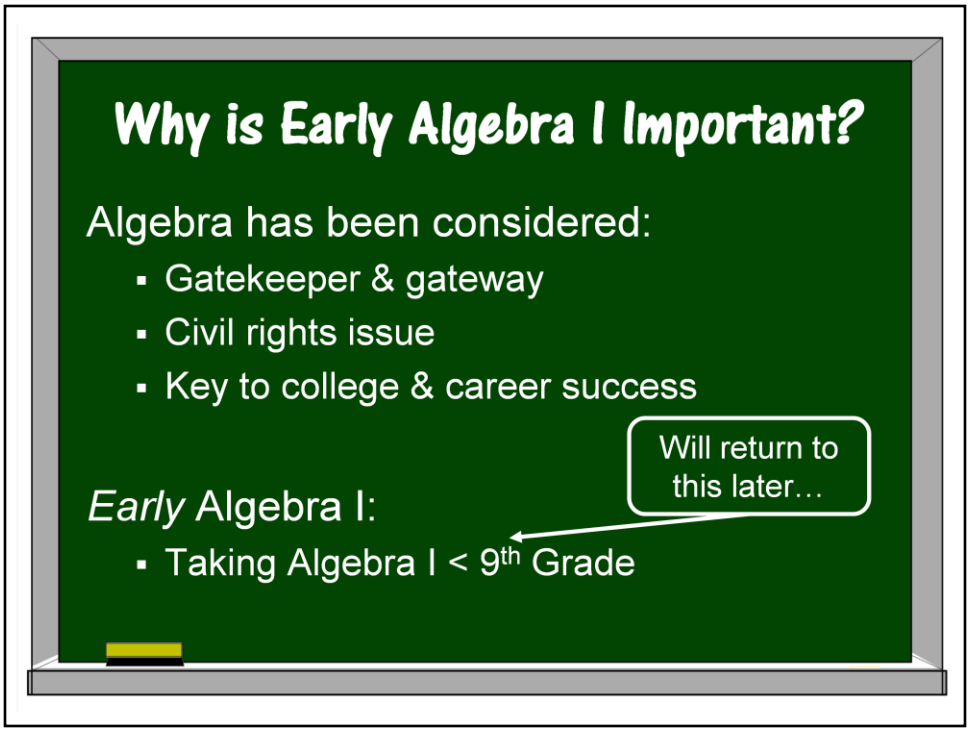
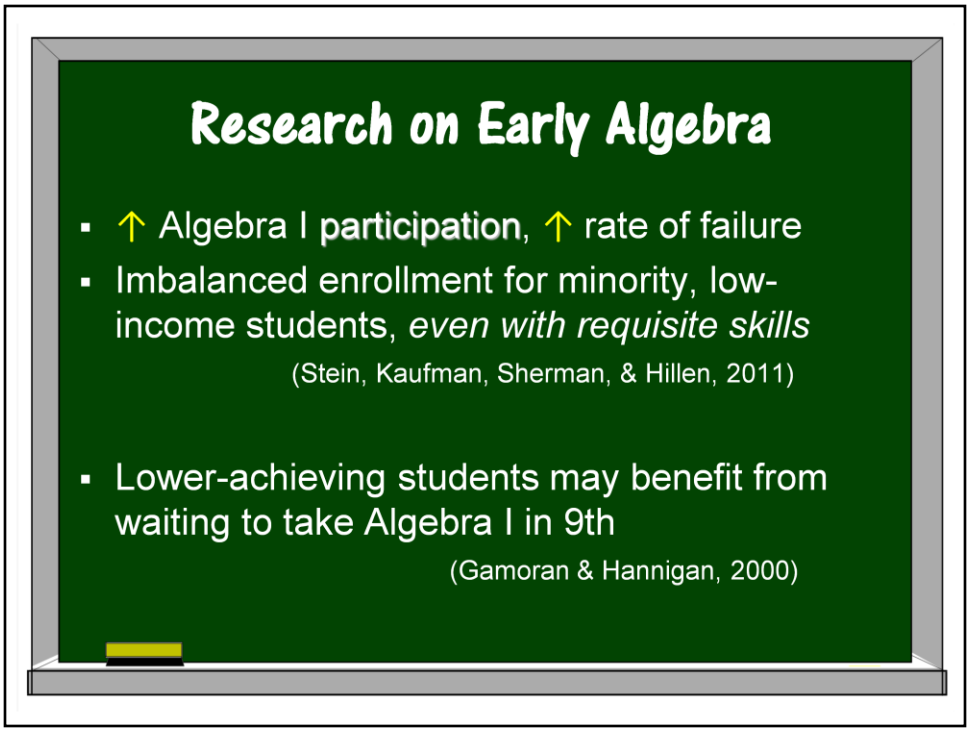


For decades, algebra has received considerable attention, in an effort to improve students' overall academic achievement and also as a way to bolster economic progress. In particular, Algebra I has been considered a gatekeeper to academic success, a cornerstone of college and career readiness, and hence, a key component of global competition. Many argue that early participation in algebra—in other words, taking Algebra I prior to high school—puts students on the right track for advanced studies in mathematics and science in high school and college [e.g., National Mathematics Advisory Panel, 2008; United States Department of Education, 1998; Spielhagen, 2006].

Promoting access for marginalized populations has also been recognized as a civil-rights issue [Kaput, 1995; Moses & Cobb, 2001].

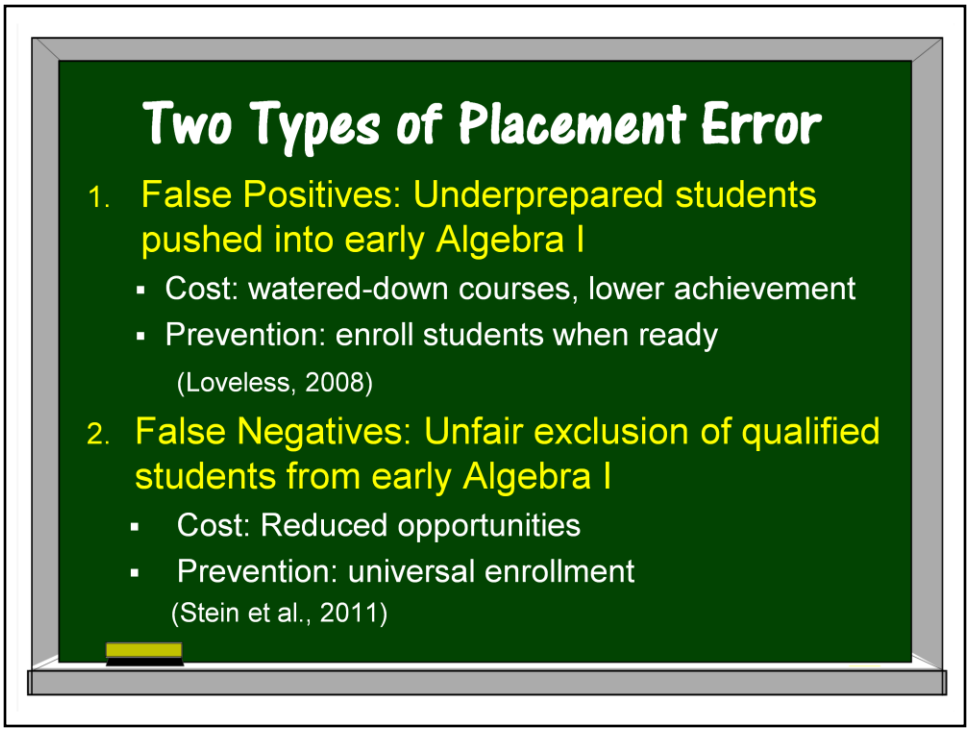
At the same time, if we assume that early access to Algebra I is desired, the literature offers no widespread agreement on how to increase the proportion of students' in early Algebra I, particularly for historically marginalized populations. Further, little is known about specific approaches that districts nationwide use in making enrollment decisions or the influences that shape them. These were some of the reasons for undertaking this study.



Stein, Kaufman, Sherman, and Hillen's (2011) review of studies that examined Algebra enrollment patterns and associated student outcomes in the U.S. found 8th grade Algebra I completion to be a strong predictor of advanced mathematics course-taking and higher achievement. They also noted that *universal-enrollment programs*, in which all students complete Algebra I by a certain grade, have both positive and negative effects. According to their research, even though early Algebra I participation rates have increased, the rates of failure have also increased. Stein et al. (2011) found, too, that minority and low-income students continue to experience imbalanced enrollment opportunities--and what is key, here--even AFTER demonstrating the requisite skills.

Gamoran and Hannigan (2000) complicate this landscape further, suggesting that all students benefit from taking Algebra I, but that

lower-achieving students may benefit more by waiting to take Algebra I until high school.

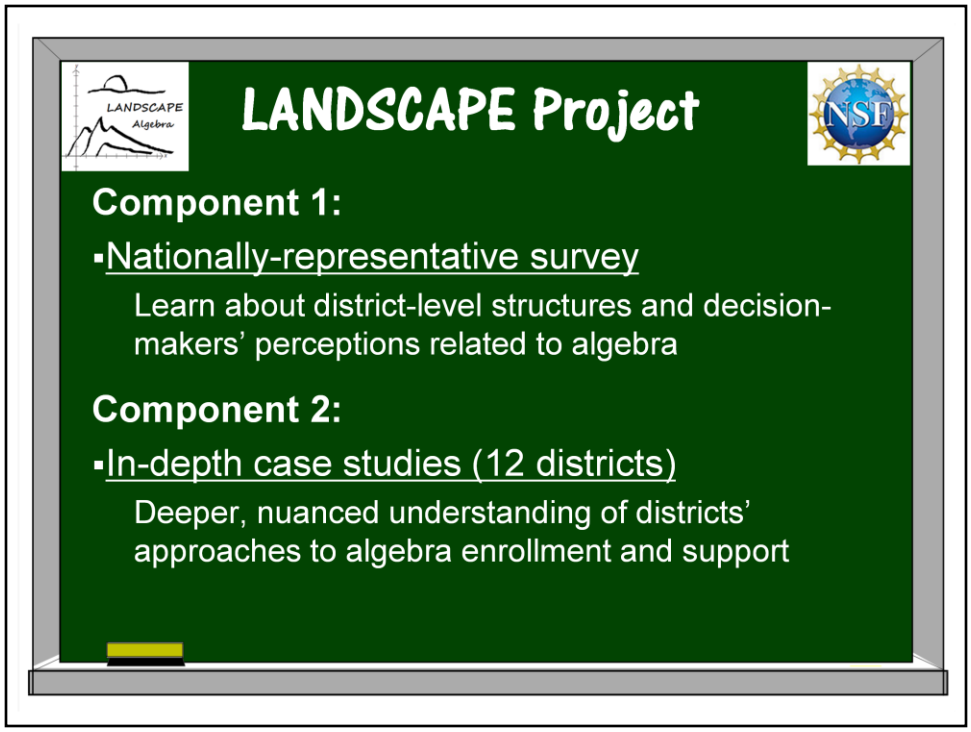


The literature paints a COMPLEX picture on enrollment policies:

Stein et al. (2011) highlighted the possibility that *universal-enrollment programs* could PREVENT the unfair exclusion of qualified students, standing in contrast to *selective-enrollment programs*, in which only a small group of students is permitted to take early Algebra I. Selective-enrollment programs raise the questions: who decides? And how?

Loveless (2008) warns of another type of placement error: too many underprepared students pushed into early Algebra I, yielding watered-down courses and lowered student achievement.

Little is known about the types of decisions that districts make, nor how they make them, when considering Algebra I enrollment policies. Our study is designed to understand how districts address these issues of placement error, through a nationally-representative survey and case studies which represent diversity across 4 regions of the U.S. We investigated the case study districts policies and stances on Algebra I enrollment. By policies, we simply mean how the districts enroll students in Algebra I, and by stances, we simply mean their rationales for these decisions.

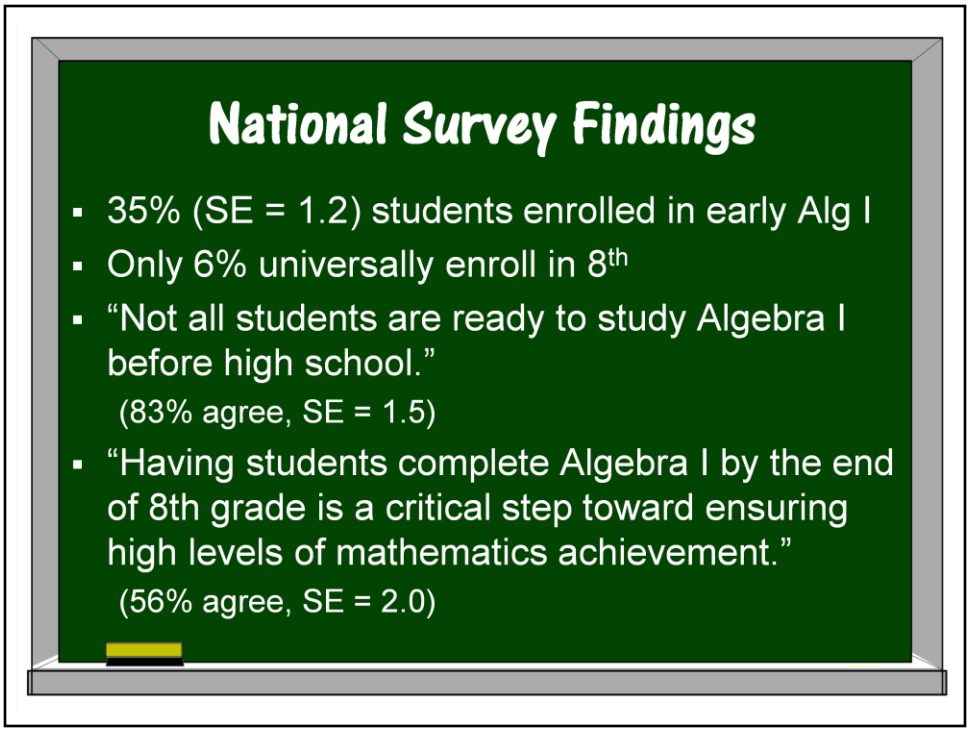


Our case study research is part of a larger, NSF-funded project, called the LANDSCAPE Project [which stands for…?]. The Project has two components:

The first component was a nationally-representative survey of district decision-makers for mathematics representing 993 school districts in the U.S. We asked questions about district-level course structures, curriculum, and assessment related to Algebra I, as well as decision-makers' perceptions.

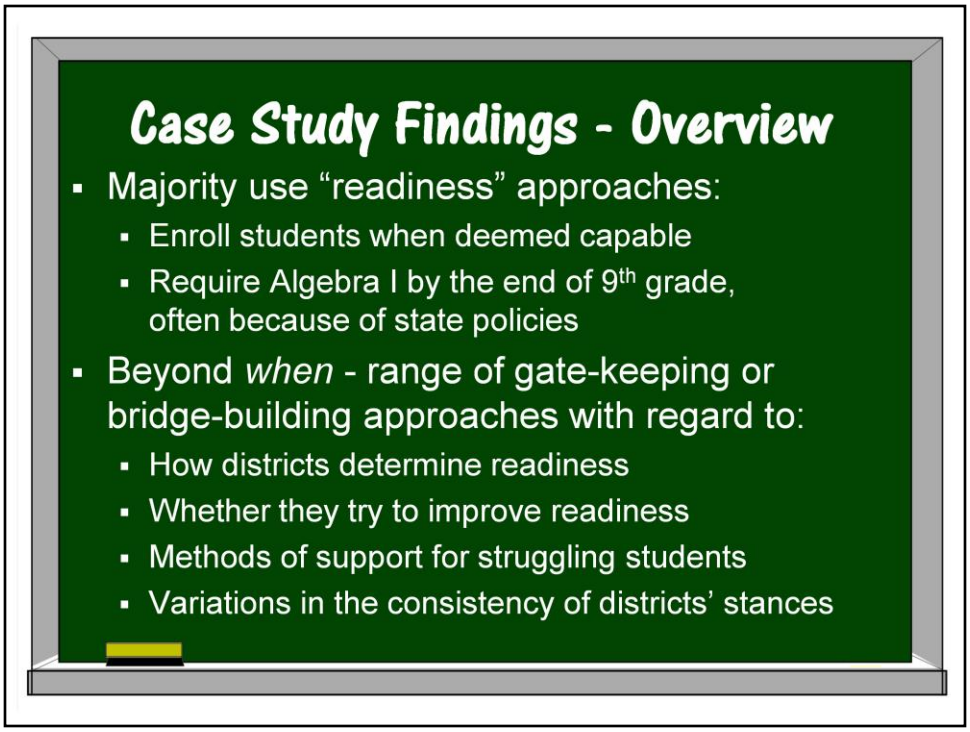
The second consisted of extensive interviews with key informants in twelve districts. These twelve districts were also sampled to have variation in size, located in urban, rural, and suburban settings, achievement levels, and student demographics. Key informants included district superintendents, curriculum supervisors, department chairs, and middle and high school algebra teachers. We also collected artifacts from these informants on an ad hoc basis.

To do our analysis, the two of us (and another grad student on our team) reviewed each transcript, and looked for themes related to Algebra I enrollment policies, using a grounded theory approach. We wanted to understand what districts did with regard to Algebra I enrollment (if they had early Algebra I enrollment, specifically), how they made enrollment decisions, what rationales they used, what pressures they were responding to, etc.



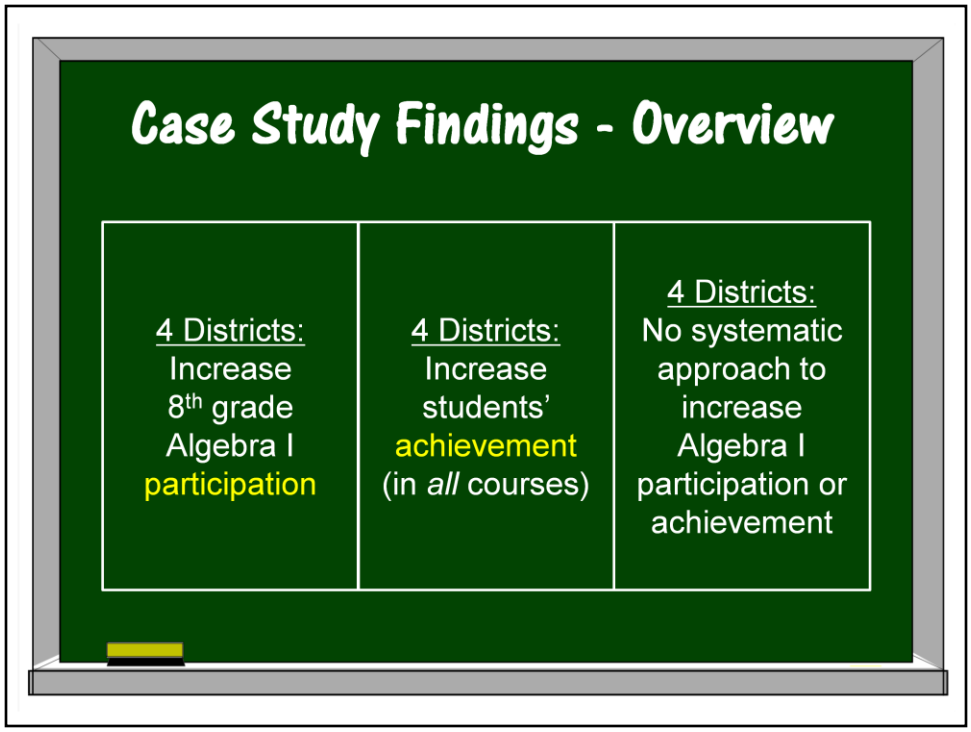
SURVEY RESULTS PAINT A COMPLEX PICTURE, indicating that school districts' nationwide enroll about 35% (SE = 1.2) of their students in Algebra I prior to 9th grade. And only 6% have a universal-enrollment policy for 8th graders taking Algebra I. This is consistent with the review of prior research conducted by Stein et al. (2011). Indeed, a sizeable portion of district decision-makers (83%, SE = 1.5) agreed with the statement that "not all students are ready to study Algebra I before high school." This is consonant with Loveless (2008) and NCTM's (2008) position statement on algebra.

Complicating this picture, though, the majority of district decision-makers (56%, SE = 2.0) indicated agreement with the statement that "having students complete Algebra I by the end of 8th grade is a critical step toward ensuring high levels of mathematics achievement." Case study data addresses this apparent contradiction, since very few districts employ "universal high school algebra." Instead, the bulk use a variety of "readiness" approaches that enroll students in Algebra I at whatever point they are deemed capable. (At the same time, most districts require students to complete Algebra I by the end of 9th grade, regardless of readiness, due to state requirements.) We explore the ways in which districts determine students' readiness, the ways in which some work to improve readiness, and any influences on whether or not districts perceive a *need* to improve algebra readiness.



So, if districts—by and large—do not employ universal-enrollment, what do they do? The great majority used what we call a "readiness" stance—enrolling students when they deem them ready for Algebra I, sometimes as early as 6th grade and extending into 9th grade. (One district was not part of a state that required completion of Algebra I in 9th grade and, at the time of our interviews, was planning to offer a pre-algebra course to a sizeable number of 9th grade students—to firm up their foundational skills.) Most states from which our districts were drawn required completion of Algebra I by 9th grade and a few also required four additional years of math beyond Algebra I; in many cases, districts found these requirements very limiting and had to find novel ways to support students who were not going to or did not successfully complete Algebra I in 9th grade.

Overall, with these readiness approaches, we observed variation that goes beyond *when* students take Algebra I. There are a range of gatekeeping or bridge-building approaches taken by districts—or various ways in which districts may open or close opportunities for students in successfully completing Algebra I prior to high school. Approaches also vary with regard to increasing 8th grade Algebra enrollment, as well as the ways in which data is used to support enrollment decision-making and interventions.



Four districts described initiatives to increase students' access to Algebra in 8th grade. In four other districts, district-wide efforts focused on raising students' achievement levels across *all* courses through various forms of assessment and supports—which took precedence over promoting enrollment or success in Algebra I, specifically. Four other districts, however, did not have systematic district-wide efforts to improve student achievement or opportunities for Algebra.

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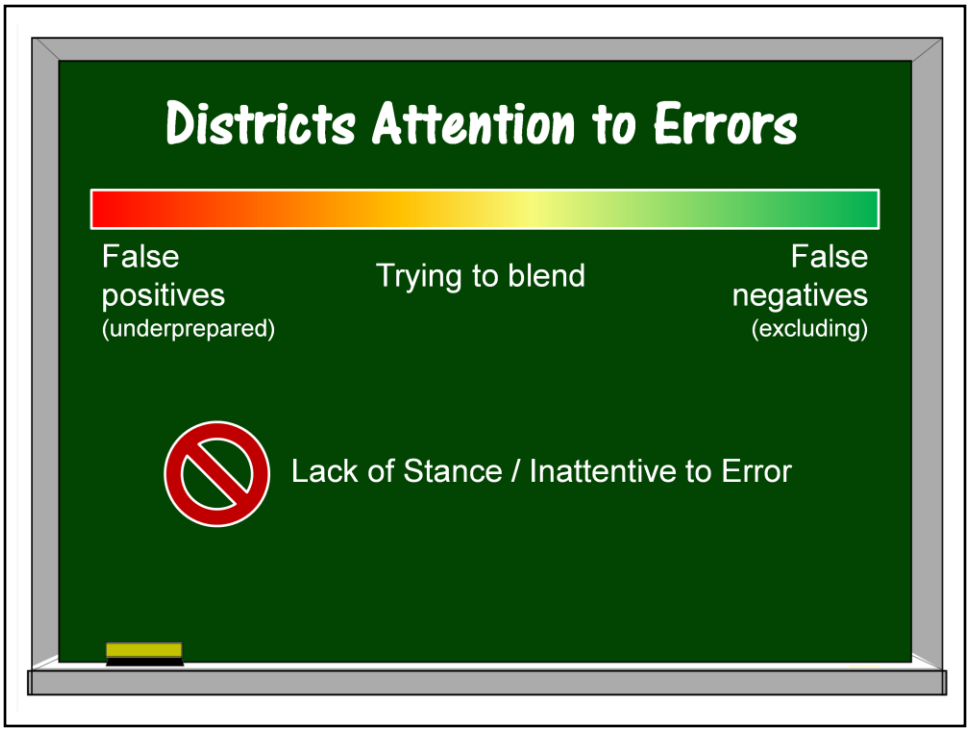
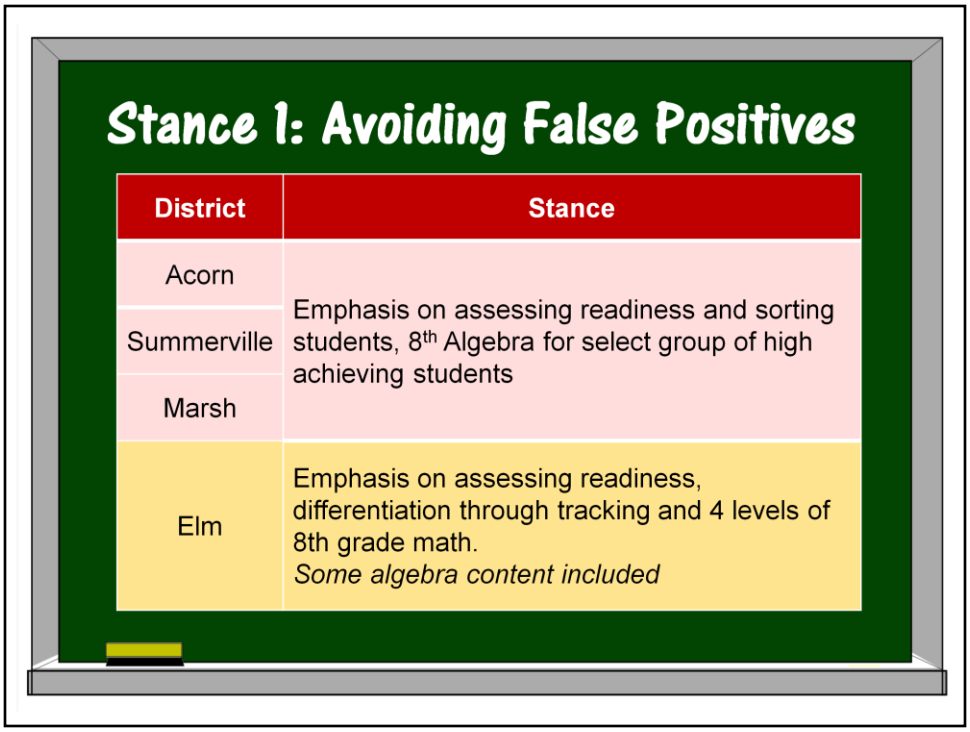
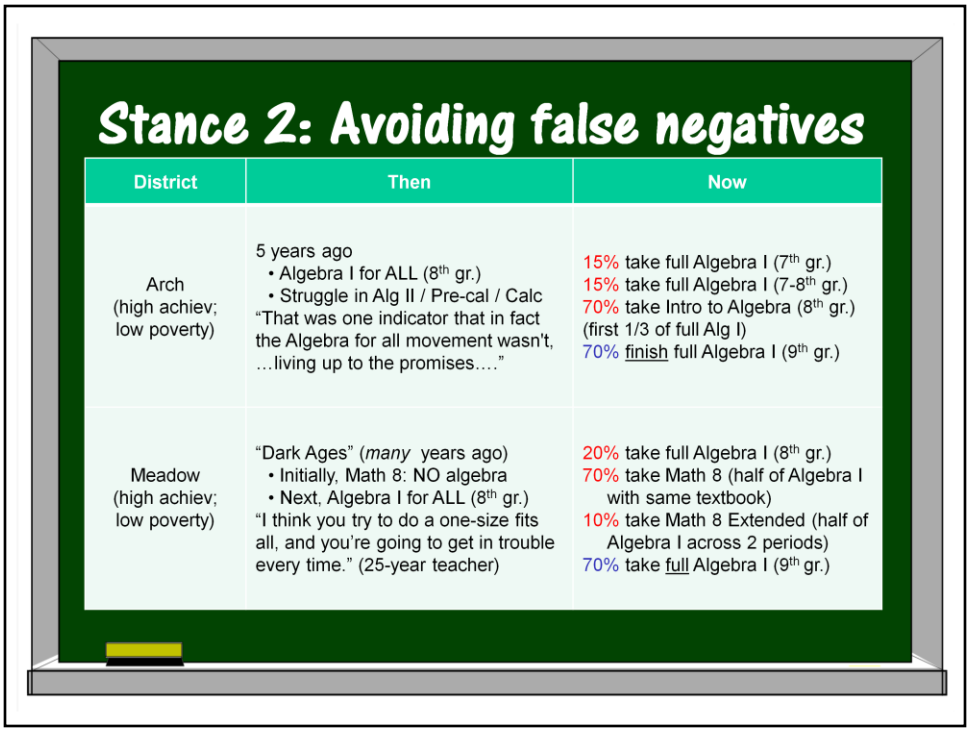
Here, we noted a variety of approaches to understanding and implementing Common Core State Standards initiatives. We also found that districts varied in the cohesiveness of their stances. In some, decision-makers described policies and practices that appeared to be uniformly understood and applied. In others, our interviewees articulated practices that appeared inconsistent across schools and among teachers. Following Argyris (1980), we suggest that significant misalignment could be a barrier to improving access to Algebra I for historically under-served populations and/or providing a high-quality instructional environment for all students.



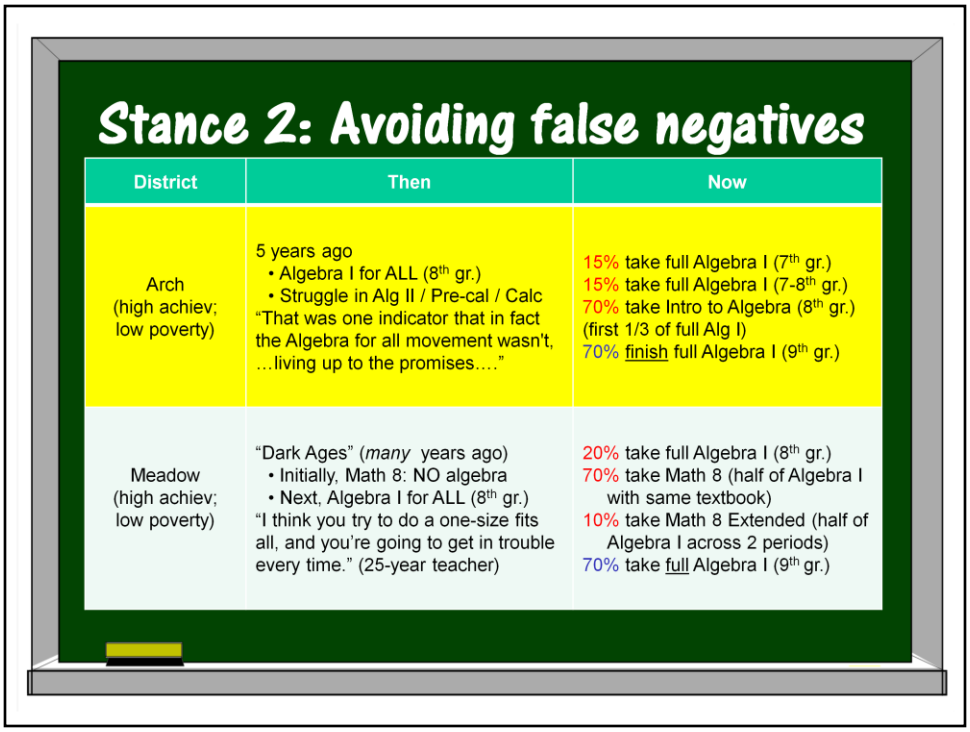
We envision the districts' stances falling along a general continuum—ranging from attempts to avoid false positives, to false negatives, or some sort of blend. Remember that false positives involve enrolling students who may not be prepared for early Algebra I; false negatives are excluding students who may be ready for Algebra I. We also found one district did not express a stance on the errors, at all, or was just inattentive to them.



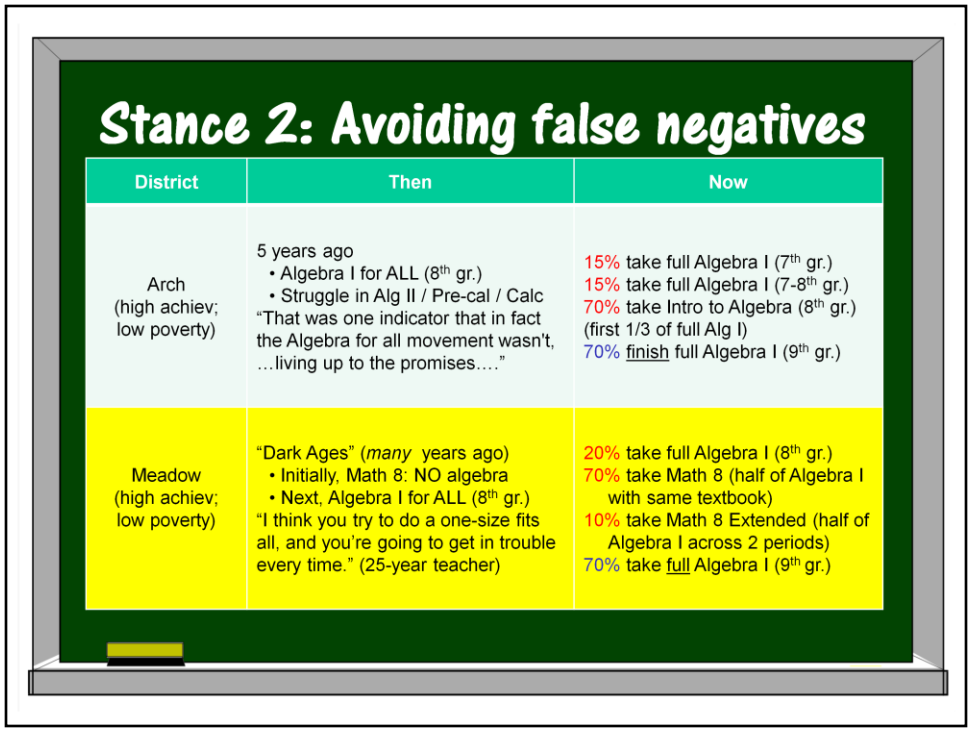
Four districts emphasized a need to assess readiness, and strong concerns over the error of false positives, where students might be placed into Algebra before they had the prerequisit knowledge needed to be successful. These districts placed primary emphasis on developing strategies for better assessment of students readiness… and developing better sorting mechanisms to sort students into the class that was appropriate for their level of readiness. Each district, of course, was unique. But as we looked across the districts we call Acorn, Summerville, and Marsh, we noticed this theme to emphasize proper sorting of students. These districts offered the Algebra I course to a select group of students. In Summerville, for example, it was named a "gifted" class. Another district, Elm, also emphasized sorting students into different levels. They stood out as being a little more different from the rest, because they were differentiating students' readiness by creating four different levels for 8th grade mathematics. 1 of these courses was Algebra I for HS credit, and the next two courses incorporated some level of algebraic content, as much as they felt the student was ready for. The fourth course was pre-algebra for the students deemed "not ready" for learning any algebraic content. This district still focused primarily on assessing readiness and sorting students. We have begun to think more about how this approach of incorporating algebraic content into middle school courses is helping algebra readienss later, while not "early". There are a few more districts like this that we will talk about soon.



At the time of our study, there were no districts that could be classified as leaning toward avoiding false negatives. There were, however, two districts that made a point of telling us that they had tried an 8th grade universal-enrollment policy in the past; both deemed it as a failure, relatively quickly, and are now taking another stance. Interestingly, both districts are similar in that they have high achievement levels on state standardized tests and low poverty relative to their state populations.



In particular, in the Arch district: when ALL students took Algebra I in 8th Grade, they found that students struggled in Algebra II & pre-calculus. Calculus enrollment was expected to increase, but it remained flat. A district curriculum coordinator says "That was one indicator…." 5 years ago, they switched to a new program; now 30% of students complete Algebra I by the end of 8th grade, 70% take the first 1/3 of the Algebra I course and complete it in 9th grade.



And the Meadow district is similar. They say that, many years ago, in what they call the "dark ages"--all students were asked to complete Algebra I by the end of 8th grade (that's after a previous program that had no algebra content in 8th grade). Students struggled, they said. One experienced teacher says, "I think you try to do a…." Their current program has been in place for many years and they feel much better about it; they have 20% of students taking full Algebra I by the end of 8th grade, 70% complete about half of the full Algebra I program, 10% do the same over a double-period within the schoolday. In 9th grade, this 70-80% of students take full Algebra I (it seems that they repeat the portion of Algebra I they took in 8th grade).

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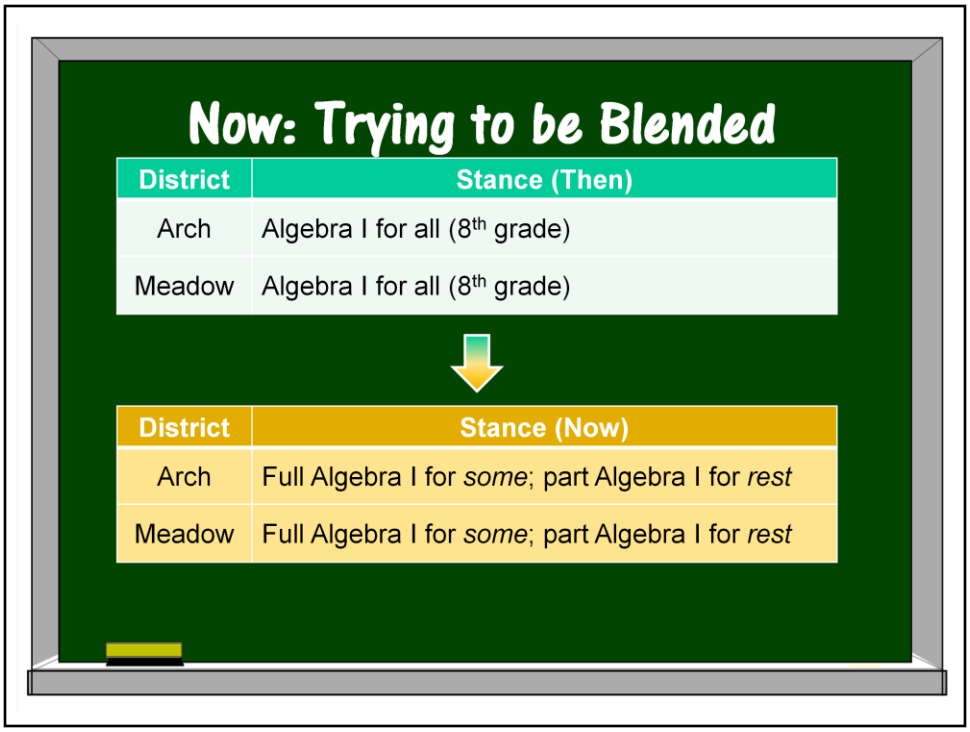
ARCH quote:

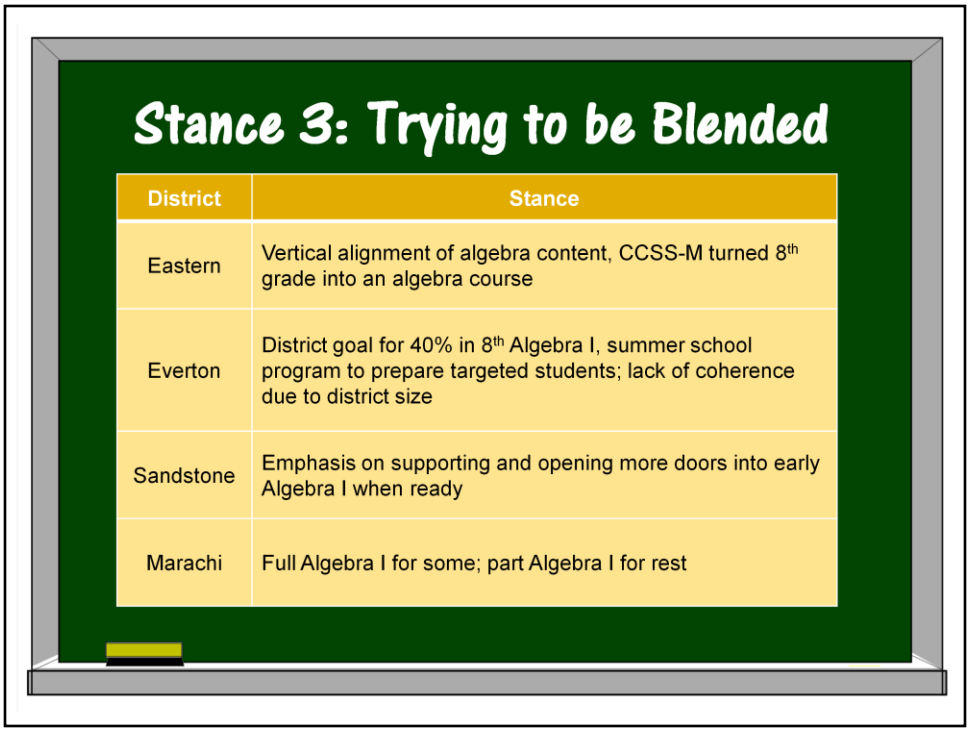
[ARC-101F: "It was course three, Algebra1, Geometry. They're, they're flying along. But as we started to watch enrollment patterns at the high school, were more of these kids truly getting to Calculus? Um, that was one indicator that in fact the Algebra for all movement wasn't, it, it, in all honesty, living up to the promises that we thought it would. Um, we imagined that we would see significant increases in Calculus enrollment. In fact those students who were at that regular level even for ARCH who would have typically been students who would, prior to the Algebra for all, taken Algebra, would have taken Algebra in ninth grade and would have made their way to Pre-Calc by the time they were seniors. Um, the majority of those ended up dropping at least one level, but, over the course of their high school math career. So in fact..."]

Meadow quote:

"Well, we had the Dark Years, where we tried to do it, and it was a disaster. I think you try to do a one-size fits all, and you're going to get in trouble every time. So, I'm a proponent of Algebra should be taught when the kid's ready to learn Algebra as opposed to a timeline that someone else has set. 'Cuz I think we get...I can see it now, that some of those basic skills are being lost because we're trying to push Algebra earlier and earlier and it's not helping - it doesn't seem to be helping the majority of the kids. I shouldn't say that - it's not hurting a majority of the kids. It's helping a lot of them, but not all of them. We still have that - we're trying to do a one-size fits all."

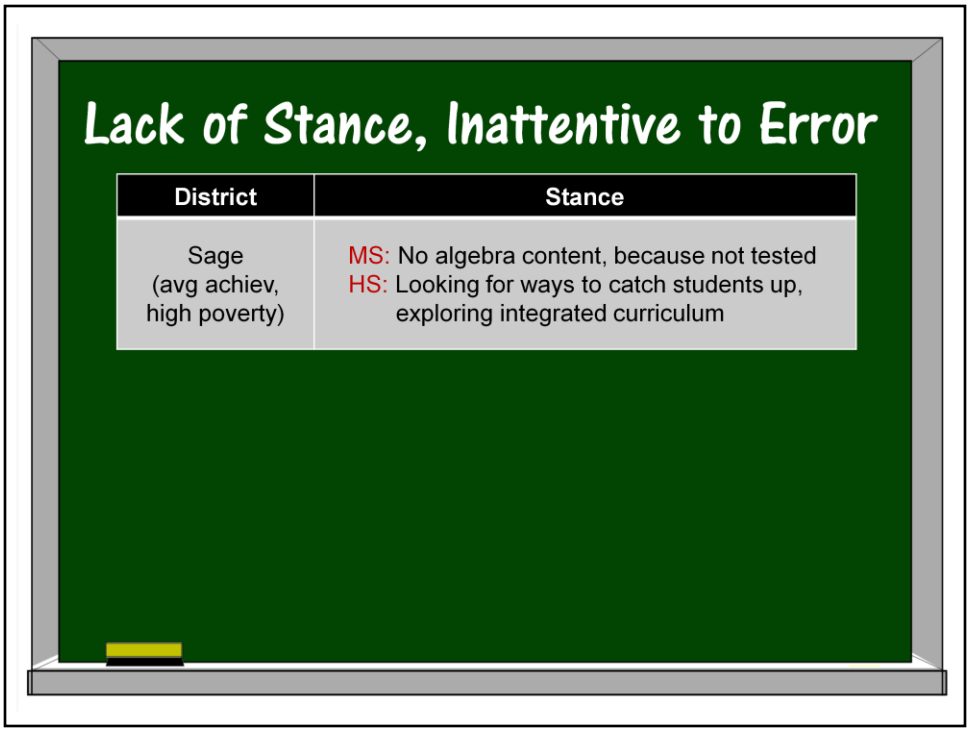


So, really, these two districts demonstrate what a blended approach seems to be: offering full Algebra I for some of their students, and part of a typical high school Algebra I course (with a high school textbook) for the rest.



All of these districts had an emphasis on assessing and sorting students' readiness (which is like having Stance 1). In addition, though, their approaches also included some consideration of how to provide better opportunities for students to become ready for the Algebra I course. Eastern, for example, was concentrating on aligning all of their curriculum with the Common Core and saw the 8th grade course as largely consisting of the same material as in a typical Algebra I course. Everton provided a summer program for certain students with the goal of having 40% of 8th graders take Algebra I (although they were not near that goal).

Its hard to categorize districts into this category because no district takes every possible attempt to reduce false negatives, or they attempt this in different ways. AND what they say they do is not always consistent across every school.



The Sage district is an interesting case, that lies outside of the continuum we've mapped. This district didn't really have a stance on the two placement errors, or they were just inattentive to the errors for various reasons. First, this is a district that has achievement scores in line with the state average and poverty rates that are high above average.

It seems that the enrollment policy in Sage is largely a response to pressures related to state standards and achievement tests. In the Middle Schools, they offered no algebra instruction, and said that the reason was that it was not tested on the state test. (In the past, some middle schools had taught Algebra I, but students had performed poorly on the state test, which was largely pre-algebra content, so they abandoned this approach.)

The high school teachers, though, noted that the students were not coming into 9th grade prepared to study Algebra I (or in the case of the honors students, 10th grade Algebra II). They were looking for ways to catch students up to where they thought students should be. They were hoping that a new integrated curriculum, used across the middle and high schools (I think), would be able to achieve better alignment across grades.

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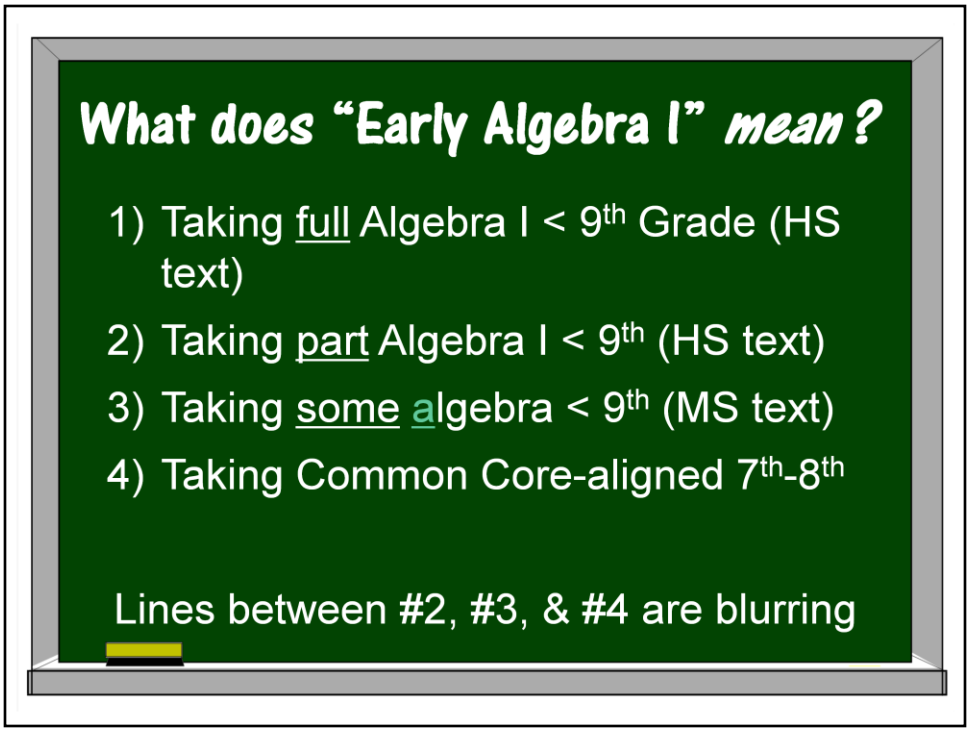
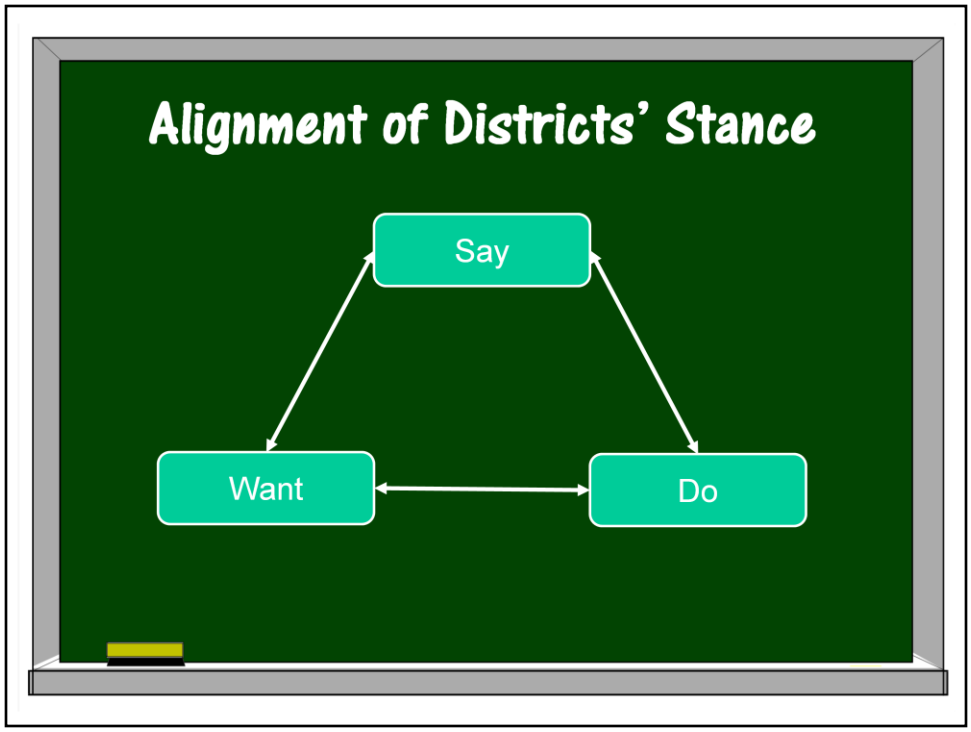
[In case] Their course progression: all students are heterogeneously grouped in 7th grade and take an integrated curriculum. In 8th grade, there are honors and regular designations, but both groups of students take a pre-algebra course. In 9th grade, the regular track takes Algebra I and the honors track takes Geometry. In 10th grade, the regular track takes Geometry and the honors track takes Algebra II—but it's important to note that these students have NOT taken Algebra I!



So now we return to the question from the beginning of the presentation: what does "early Algebra I" *really* mean? As it is traditionally defined, it means taking a full year of high school Algebra I before entering 9th grade and typically receiving high school credit.

But in our case studies a number of districts seem to be loosening this definition. A number offer part of a high school Algebra I course to students before they arrive in high school—with some districts having students repeat that material in high school and others having them complete that material in high school (like a two year sequence for Algebra I). In these cases, they use a high school text, often have the same exams as high school students do, but do not offer high school credit for the middle school course.

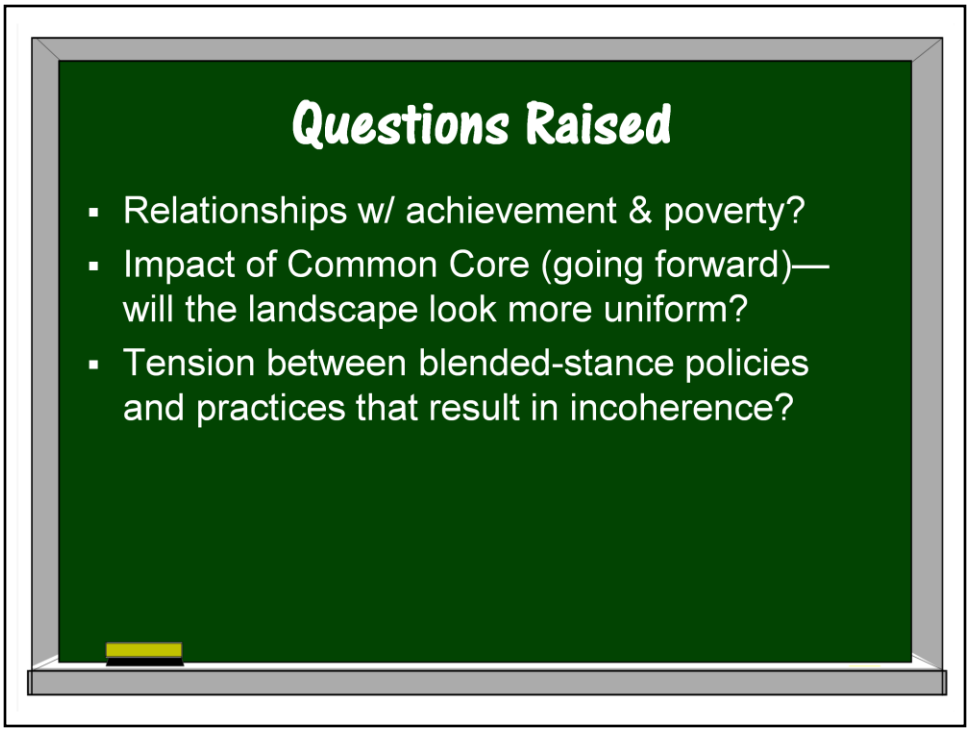
Some districts also have algebra (small "a") content for students as part of their middle school program, using a middle school text—or, in one, as part of a high school oriented integrated program (Sage). And many districts are recognizing that the Common Core is locating algebraic content (especially solving multi-step equations and working with linear functions) in 7th-8th grades. So, as districts continue to transition to Common Core, its possible that definitions #2-4 are blurring together.



We also found that districts varied in the cohesiveness of their stances. In some, decision-makers described policies and practices that appeared to be uniformly understood and applied. In others, our interviewees articulated practices that appeared inconsistent across schools and among teachers. In particular, what interviewees SAID their district was doing was sometimes in tension with what interviewees WANTED their district to do, and with what we are inclined to believe they ACTUALLY do.

With an eye to organizational theorists like Chris Argyris and Donald Schon (1980), we suggest that significant misalignment could be a barrier to improving access to Algebra I for historically under-served populations and/or providing a high-quality instructional environment for all students.

[If anyone asks, returning to Sage slide might be a good example.]



This work, we feel, raises a number of questions. First, we haven't looked at, but we are interested to know more about the relationship between districts' stances and their relative achievement and poverty levels. We are also interested in the impact of the Common Core, going forward; when we conducted the interviews (around 2012), many districts were in the process of aligning to the Standards and to the new state tests. Finally, we wonder how to understand and think about districts' aiming for a blended stance, but then having incoherence in practices (or misalignments) emerge? In particular, some districts were uniform in their understanding of a blended approach, while others because of size or other factors tried to adopt a blended approach but had practices that were either one or the other across schools/teachers. [Everton is a good example.]

Thank You!

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Gamoran, A., & Hannigan, E. C. (2000). Algebra for everyone? Benefits of college-preparatory mathematics for students with diverse abilities in early secondary school. *Educational Evaluation and Policy Analysis*, *22*, 241-254.

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