The Review of Higher Education
Fall 2018, Volume 42, No. 1, pp. 61–101
 (ISSN 0162–5748)

Practices of Remedial Mathematics Students Who Succeed in College: A Case Study of Developmental Math Education at Chief Dull Knife College

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Abstract: If our nation's colleges and universities are to become able to educate differentially prepared students, we need to understand better the ways that the

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growing number of underprepared students navigates college. In particular, research is needed that identifies the practices of the underprepared college students who complete remedial education and successfully continue their education. This case study of an innovative remedial math program at a tribal college explores the practices of successful underprepared students and the ways in which faculty and staff scaffold these practices.

Key Words: higher education; remedial education; student experience; mathematics—study and teaching; case study; Minority-Serving Institutions; Tribal Colleges and Universities

While only four in ten adults have attained a two- or four-year degree, most Americans believe that completing "some college" is important (Lumina Foundation, 2013). In response, policy initiatives from the White House (Obama, 2009), the National Governors Association (Fitzpatrick, 2007), and various states, associations, and foundations have emphasized the need for more citizens to earn a degree or certificate.

The most widespread justification for increasing college-going rates is economic. Many policymakers and researchers proceed with the assumption that national economic competitiveness depends on higher levels of educational attainment. For the foreseeable future, high school graduates will continue to struggle with unemployment and underemployment and low wages in a labor market in which two-thirds of jobs require some postsecondary education or training (Carnevale, Jayasundera, & Hanson, 2012). At the same time, our society will struggle to compete globally because too few members possess the knowledge and skills that come with a postsecondary education (Grubb & Lazerson, 2005). The reason that most Americans embrace the value of college is clear: if the United States is to maintain its competitive position in the world along with its current standard of living,

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Americans need to complete enough college so as to be able to participate in and contribute to an economy that has been restructured by high technology and global networks of exchange. Yet while this economic framing of the importance of at least some college is broadly accepted, it is augmented and sometimes challenged by justifications that emphasize the contributions of postsecondary education to the development of citizens and communities, the production of new knowledge, and even social cohesion and equality. Whether college attainment is perceived to increase national competitiveness or benefit individuals, there is a general agreement that in the twenty-first century, more Americans will need some college.

Increasing postsecondary educational attainment in a society rapidly becoming more diverse has meant bringing into college students from communities that have not historically sent many members to college. In turn, colleges and universities have been tasked with educating more students who are academically underprepared and more students who come from communities that have limited experience with formal higher education. Remedial education programs—what Bailey (2009) calls the "developmental function" in colleges—are at the heart of preparing underprepared college students for the rigor of college-level courses. Through these programs, colleges and universities develop operationally useful definitions of underprepared college students ("preparedness") while, at the same time, pursue various strategies for supporting underprepared college students as they move toward their educational goals (Bahr, 2012; Bailey, 2009; Bettinger & Long, 2009; Deil-Amen, 2011a; Dowd, 2007). Increasing higher education attainment requires a shift in emphasis toward research and practice from *which* students—represented as bundles of characteristics and outcomes—are and are not prepared to *what* contributes to the learning and success of students who begin college underprepared (Deil-Amen, 2011a, 2011c).

To that end, this study uses an instrumental case study design to explore the success of underprepared students enrolled in the remedial math education program at Chief Dull Knife College (CDKC), a Tribal College that has redesigned what underprepared math students do in college math classes and changed the odds for these students by adopting a common, computer-based math learning system that supports a mastery approach to advancement in math. We draw from studies of literacy development a framework that refocuses analysis from what characteristics remedial students have and what outcomes they achieve to what activities are taken up by successful college students who begin their education in remedial math classes. The study was designed to answer the question: What activities do remedial math students—as members of a "community of practice"—take up to become "ready" to take advantage of their access to college?

BACKGROUND TO THE STUDY

In many ways, initiatives to increase college attainment are success stories. Between 1980 and 2010, a period during which college enrollments grew by nearly 75 percent, minority enrollments increased by nearly 300 percent (U.S. Department of Education, National Center for Education Statistics, 2012a). Most noteworthy, Hispanic student enrollments increased from less than 500,000 to nearly 2.75 million. While many students continue to begin their college career shortly after high school, a glance at 2008 student enrollments indicates that college is not only or even primarily a place for students who have just graduated from a college-prep high school program: over one-third of students were 24 or older, more than one-half were part-time, nearly one-half were financially independent, and one-third began college in at least one remedial course (U.S. Department of Education, National Center for Education Statistics, 2012b). Colleges and universities in the United States now provide access to postsecondary education to more diverse students than ever before.

While access must remain open to students with a range of prior educational experiences if our diverse nation is to meet the Obama Administration's 2020 goals, access is not enough. Consider the findings of a recent study of first-time-in-college degree-seeking students who initially enrolled in public, private nonprofit, and private for-profit two-year and four-year colleges and universities nationwide in the fall of 2006 (Shapiro et al., 2012). Six years after beginning their college careers, just over one-half had earned degrees and one-third were no longer enrolled. Completion rates were lower for the students who started college over 24 or part-time or had moved between institutions. A national sample of students who begin college at community colleges in 2003 found that three years later nearly four in ten have had left college without a degree and a third had stopped out for at least 5 months (Horn, 2009). Success in opening access to postsecondary education has been matched by significant barriers to completion.

The complexity of persistence rates notwithstanding, the single most important barrier to student success remains preparation (Adelman, 2006; Deil-Amen & Turley, 2007; Horn & Carroll, 1996; Perna, 2004, 2006). Net other characteristics, prepared students are more likely to succeed in college while students who enter college in need of substantial remedial education are less likely to succeed. Underprepared students are disproportionately students of color, students of low socioeconomic status, and students with limited proficiency in English (Attewell, Lavin, Domina, & Levey, 2006; Dowd, 2007; Sparks & Malkus, 2013). Far too often, students who matriculate with limited educational, social, and economic resources do not attain "enough college" to achieve their goals for school or work (Adelman, Daniel, & Berkovits, 2003; Marcotte, Bailey, Borkoski, & Kienzl, 2005). Put simply, getting more of the

students who are now coming to college to an education that "matters" to them will involve improving the odds for success of underprepared students.

The traditional approach to improving the odds for underprepared students—remedial education—has had uncertain effects. While completing an appropriate sequence of remedial courses in math and English can put underprepared students on par with their "prepared" peers (Attewell et al., 2006; Bahr, 2008b, 2010a, 2012; Bettinger & Long, 2004, 2009), remedial education is costly for students and institutions (Bettinger & Long, 2009; Breneman & Haarlow, 1998; Melguizo, Hagedorn, & Cypers, 2008). It appears to function almost as a challenge that one-third of all students and two-thirds of community college students must face before they can successfully engage the college curriculum—a challenge that students manage unevenly (Bailey, 2009; Melguizo, Bos, & Prather, 2011).

In the National Education Longitudinal Study (NELS) sample, less than one-quarter of community college students who enroll in remedial education complete a degree or certificate in eight years (compared to 40 percent of students at the same institutions who do not enroll in any remedial courses). While two-thirds of these students pass all of the developmental writing or reading courses in which they enroll, only one-third of these students pass all of the developmental math courses in which they enroll (Attewell et al., 2006). With many colleges having developmental courses or placement test scores as prerequisites for introductory level classes, it is imperative for students to pass their developmental courses to begin taking courses that will count towards their degree. But this is only at institutions that require the completion of developmental course sequences to progress. Some students are merely referred to developmental courses and left to make their own decisions. At Achieving the Dream colleges, Bailey (2009) found that one in five students referred to developmental math courses and one in three referred to developmental reading never take a remedial course and that well under one-half of the students referred to developmental reading and under one-third of those referred to developmental math complete the sequence of courses their placement evaluations recommend. While remedial education can effectively guide underprepared students into college, most underprepared students are not ready to take advantage of it. Too little is known about successful college students who begin college in remedial education classes.

Review of Literature

Remedial Education Basics

Almost all of the research on remedial education is variously anchored in three "basic" findings concerning remedial education that have been confirmed by research using large-scale data sets and sophisticated designs and

methods of analysis (for recent reviews of the basics see Bahr, 2012; Bailey, Jeong, Cho, 2010). First and foremost is the recognition that remediation is part of American higher education. Though the need for remediation is greater at community colleges, substantial numbers of students in every sector of higher education have long started college underprepared. There is no golden age in American higher education when every student matriculated college-ready (Adelman, 2004; Attewell et al., 2006; Horn & Carroll, 1996; Melguizo et al., 2008; Merisotis & Phipps, 2000).

Second, remediation plays a complex and controversial role in mediating access to college degrees. It serves as a gate that must be negotiated and at the same time a necessary resource, especially for students who have historically struggled to gain access to and succeed in higher education—students of color, students from poverty, the children of immigrants (Attewell et al., 2006; Bahr, 2007, 2010a; Bettinger & Long, 2005; Dowd, 2007; Roksa & Calcagno, 2010; Sparks & Malkus, 2013). As a gate, remedial education is a barrier for many students. Starting in college in a remedial class makes attaining a degree or certificate less likely (Bailey, 2009). Students who place into remedial education in California Community colleges experience "escalating" attrition independent of the point at which they enter a remedial sequence (Bahr, 2011b). And though students' level of skill is related to their progress in remedial math and writing, independent of their level of skills, remedial students have been found to be less likely to attempt the next step in a remedial sequence, including the college-level course to which the sequence led them (Bahr, 2011b; Bailey et al., 2010). Still, remediation provides many students access to what Merisotis and Phipps (2000) have called the "functional literacy" that college graduates are believed to possess and that a college education needs to cultivate if it is to offer an adequate return on investment (Bahr, 2007; Bailey et al., 2010; Bettinger & Long, 2009).

Finally, whatever its relation to educational attainment, remediation has significant direct and indirect costs. Individual colleges and universities dedicate substantial resources to developmental education (Bailey et al., 2010; Breneman & Haarlow, 1998), and remediation absorbs students' time and financial resources while potentially diminishing their motivation and limiting their academic options (Bahr, 2012; Bettinger & Long, 2009; Jepsen, 2006; Melguizo et al., 2008; Rosenbaum, 2001; Rosenbaum, Deil-Amen, & Person, 2006). At the same time, remediation is perceived by some to dilute the higher education mission, double-billing taxpayers for secondary education and potentially causing institutions to dilute their focus on *post*secondary education and rigor (Oudenhoven, 2002).

While these basic understandings of remediation are broadly accepted, they are haunted by uncertainty in several ways. To begin, there is widespread uncertainty about the defining characteristics of students who are college-

ready. In the absence of consensus about the functional literacy that defines college-readiness, institutions adopt various tests and policies for defining underprepared students and their paths into college (Perin, 2006). The resulting dichotomy between remedial and college-ready students appears to mask the educational needs of a substantial number of students who fall near the cut score used by their college (Bailey, 2009; Deil-Amen, 2011a). In turn, students are uncertain as to whether they are ready for college or what remedial courses contribute to their education (Rosenbaum, 2001; Rosenbaum et al., 2006). Not surprisingly, many students who are referred to remediation delay their enrollment, never take any remedial courses, or fail to complete the recommended sequence of courses (Bahr, 2012; Bailey et al., 2010).

There is also uncertainty about what policies, programs, and practices help underprepared students succeed in college. To be sure, there are broadly accepted approaches to remedial education. In a working paper for the National Center for Postsecondary research, Zachry and Scheider (2010) sort studies of remedial education into four types of interventions: programs for avoiding remedial education (dual enrollment, early placement testing, summer bridge); programs for accelerating remedial education (fast-track courses, modularized courses, mainstreaming); programs that provide contextualized-learning opportunities; and programs that provide remedial students with supplemental supports (Supplemental Instruction, tutoring, advising, college strategies courses).

In recent reviews of developments in teaching remedial math and writing, a set of common principles emerge (Zachry & Schneider, 2010). Effective remediation is believed to integrate multiple teaching and learning strategies and activities in instructionally and technologically enriched settings that are designed to promote student progress by focusing education on reflective and collaborative learning and achievement in a domain with particular attention paid to affective factors. Yet, while a set of promising policies and practices have emerged, Zachry and Schneider (2010) found few that have been rigorously evaluated; those that have been evaluated have shown small or negligible increases in student success.

Uncertainties about what it means for a student to be college-ready and what programs can do to increase student success is matched by uncertainty about what remediation overall contributes to students becoming college ready. The bleak educational prospects for underprepared students are clear. Students who enter college in need of substantial remedial education are less likely to achieve their goals for school or work. The factors that affect students' progress through remediation are also clear: grades in first-remedial math courses, depth and breadth of remedial needs, delay in taking a first or next remedial course, and a non-passing grade in any remedial math class

all matter (Bahr, 2008b, 2010a, 2012, 2013a). Why these factors matter is less clear. Placement in remedial education has been thought to be associated with stigma and a negative perception of self as student (Hadden, 2000) or with frustration with slow progress toward educational goals (Cox, 2009a) or with undisciplined behavior (Rosenbaum et al., 2006). While quantitative approaches to the impact of successful remediation on student progress have been able to show positive relationships to transfer, persistence, and graduation (Bettinger & Long, 2005, 2009), grades in the first college-level math course for students (Martorell, 2009), and the accumulation of credits (Calcagno & Long, 2008); these studies struggle with limited data (Kirst, 2007; Mazzeo, 2002; Zachry & Schneider, 2010), potential threats to validity (Melguizo et al., 2011), and limited representations of student activity (Bahr, 2013b).

Views of Remediation

Remediation is widely-understood as a kind of production function, with much of the research on remediation framing remedial education as a core postsecondary education policy (Bailey, 2009; Handel & Williams, 2011; Mazzeo, 2002; Oudenhoven, 2002) or practice (Attewell et al., 2006; Bahr, 2012; Bailey et al., 2010; Boyer, Butner, & Smith, 2007; Carpenter, Brown, & Hickman, 2004; Melguizo et al., 2008; Merisotis & Phipps, 2000; Perin, 2004; Phipps, 1998; Schwartz & Jenkins, 2007; Zachry & Schneider, 2010). Explicitly or implicitly adopting a human capital framework, much of the research on remedial education also understands remediation as investment in the productivity and earning potential linked to postsecondary degrees and credentials (Bettinger & Long, 2009; Calcagno & Long, 2008; Cox, 2009a; Levin & Calcagno, 2008; Melguizo et al., 2008). Research that views remedial education as a means of increasing human capital poses questions about whether remediation contributes to degree attainment by individuals, whether that contribution is efficient and equitable, and how students move through remedial sequences (Bahr, 2010a, 2012; Melguizo et al., 2008). Typical research designs analyze the impact of remediation and the costs of providing and not providing remediation and make recommendations about strategies both to reduce the need for remediation and also to improve the effectiveness of remedial education. Remedial education practices are represented as placement tests, the offering and staffing of courses, and course-taking. The progress of students through remedial remediation is typically approached through input-output models (Bahr, 2013b).

Studies of remediation as a "production function" have clarified relationships between students' participation in remedial sequences and their subsequent attainment of skill benchmarks, completion of credentials, and progress within and across programs. This research has explored input characteristics from race and ethnicity to high school GPAs and scores on place-

ment tests and initial course selection as well as a limited set of enrollment behaviors. While this research is suggestive of the kinds of prior experiences and course-taking behavior that are aligned with student progress, research that analyzes increases in students' human capital as a function of students' precollege characteristics or early college experiences is largely unable to explain the relationship between what students do and what outcomes they achieve. The conventional approach tends to oversimplify complex processes. Students who enroll in and complete an initial remedial math course are engaged in deciding whether taking the next course in the sequence makes sense, whether and how to complete assignments, what feedback from teachers means and what to do with it, and myriad other activities. In short, the relationship between variation in achieving college-level competency cannot be explained in any simple way by duration of enrollment, and persistence in college cannot be equated with educational success for remedial students who must develop a set of functional literacies if they are to attain meaningful credentials (Bahr, 2013b).

There is growing interest in taking what remedial students are doing out of the proverbial black box. Promising quantitative research—what Bahr has called "deconstructive" approaches—is making use of transcript-level data (Bahr, 2010b, 2012, 2013a; Calcagno, Crosta, Bailey, & Jenkins, 2007; Hagedorn, Moon, Cypers, Maxwell, & Lester, 2006; Roksa & Calcagno, 2010). This work is providing more detailed models of how students—including students in remedial education—progress or fail to progress through sequences. But quantitatively oriented deconstructive research can do little more than speculate about why students do what they do or why certain events or behaviors like failing a remedial course or delaying enrollment in the next remedial course have the impact that they do.

A small body of qualitatively oriented research is seeking to deconstruct what remedial students do in order to explain why remediation can be inefficient and how underprepared students successfully negotiate college. A growing number of researchers, for instance, are conceptualizing remediation as socio-cultural activity (Deil-Amen, 2011a; Grubb & Cox, 2005; Grubb, 2001, 2010; McCurrie, 2009) or an opportunity for psychosocial development (Ironsmith, Marva, Harju, & Eppler, 2003; Zavarella & Ignash, 2009) or to acquire literacies (Callahan & Chumney, 2009; Kynard & Eddy, 2009; Lamos, 2012). This work has begun to document what students understand about remediation (Rosenbaum et al., 2006), what happens inside remedial courses (Grubb, 2010), and what uses students make of remediation (Grubb & Cox, 2005). The present study contributes to qualitatively oriented research on the activity of students in remedial math classes by analyzing the practices of successful remedial math students in a highly supportive college.

CONCEPTUAL FRAMEWORK

The analytical focus on the practices of successful students as opposed to students' background characteristics or even their precise outcomes is central to this study. This case study of the remedial math program at Chief Dull Knife College (CDKC) is drawn from Minority Serving Institution (MSIs) Models of Success, a national study of 12 MSIs that were selected because of their promising initiatives to support minority student achievement—including learning, retention, and degree attainment. The MSI Models of Success project is a study of the practices of individuals and institutions. That is, this study set out to explore the "recurrent, goal-directed sequence[s] of activities" through which students, staff, faculty, and institutions make use of tools, knowledge, and skill (Scribner & Cole, 1981, p. 236). The project was developed to identify and highlight models of success at Minority-Serving Institutions—specifically Historically Black College and Universities, Tribal Colleges and Universities, Hispanic-Serving Institutions, and Asian American and Native American Pacific Islander-Serving Institutions. Drawing on a widely accepted model of student engagement (see, for instance, Kuh, Kinzie, Buckley, Bridges, & Hayek, 2007), the MSI Models of Success study describes the ways in which signature institutional practices contribute to student behaviors associated with persistence, degree attainment, and learning. As we visited a dozen MSIs over three years, our inquiry became increasingly focused on the ways in which programs scaffold complex collaborative practices of students, staff, and faculty within their institutional context. Accordingly, our inquiry was guided by what stakeholders and institutions did—their collaborative practices—that, from their perspectives, contributed to the documented success of a program or initiative. The MSI Models of Success Project aimed to understand and call attention to these practices.

In this case study of the CDKC remedial math program, we explored the student activities that participants at one campus understood to contribute to students' progress through a remedial math sequence and into an academic program. That is, we studied the activities that students at CDKC took up in order to become able to participate successfully in remedial math classes and, in turn, what institutional practices support students in taking up the practices of successful remedial math students and at the same time reshaping those practices to their own ends. To sharpen this focus, we drew on the New Literacy Studies (for an overview see Gee, 2011).[1] New Literacy Studies

[1]The awkward label "new literacy studies" has come to be applied to the work of a group of interdisciplinary scholars who assembled a sociocultural approach to language and literacy development in the 1980s and 1990s. This work emerged as part of a broad movement in the social sciences at roughly the same time as broadly Vygotskian approaches to language learning and cognitive development (Luria, 1976; Scribner & Cole, 1981; Wertsch, 1985,

(NLS) frameworks have been used to study the experience of primary and secondary students in math and science classrooms and of English language learners more broadly (Gee, 2005, 2007, 2008; Moschkovich, 2002) as well as somewhat more selectively to approach topics directly connected to the teaching of writing in college (Barton, Hamilton, & Ivanic, 2000; Horner, 1996; Lea & Street, 2006; Street, 2004). Similar frameworks are beginning to be used to analyze students' experience of college, most often with an emphasis on students' ability to write in academic Discourses or succeed as readers and writers in a particular college class (Colyar & Stich, 2011; Henderson & Hirst, 2007; Johnson, 2012; Schachter & Rich, 2011).

As diverse as the NLS, these studies share an approach to studying educational practices that shifts attention from deterministic social structures or decontextualized cognitive processes and abilities to social activity.[2] In the case of remedial education at CDKC, an NLS framework leads us to focus on the ways that remedial math students take up the identities and practices of college-level math students and the ways that the CDKC remedial math program supports them in doing so. Consonant with this view, college readiness refers to a set of activities rather than test scores or background characteristics or cognitive abilities. Students who are ready for college are those who have acquired the capacity to participate in one or more communities of practice at a college and to switch between communities.

Because this framework is rarely used in studies of college student progress, we elaborate it at some length here. NLS explanations of effective participation in a community of practice are often linked to having acquired the capacity to understand and be understood in the community. Gee's explanation of acquiring a "Discourse" (capital "D") provides a general view of this process. For Gee, a Discourse is a set of social practices—characteristic ways of talking, listening, reading, writing, acting, interacting, believing, valuing, and using tools and objects, in particular settings and at specific times—that enable

1998). Empirical work within this movement elaborated the ways that literacy practices are linked to ways of knowing and making sense of the world (Brandt, 2001; Heath, 1983; Scollon & Scollon, 1981; Street, 1984) and in turn called into question epistemological distinctions between primitive and civilized cultures and with them the notion that it is literacy—the cognitive ability to read and write—that makes humans able to engage in complex thinking and so to sustain complex social systems (M. Cole, 1996; Graff, 1986; Scribner & Cole, 1981).

[2]This work broadly raises empirical questions about the sufficiency of individualist theories about thinking and problem solving—what Street (1984) called the "the autonomous model" of literacy—and at the same time offers theories of the development of the human ability to make meaning as a socially situated process, a process that takes place outside people's heads in their relationships with places, tools, technologies, and others.

individuals and groups to display and recognize particular social identities (Gee, 1989, 2004, 2011; Gee, Hull, & Lankshear, 1996). Repurposing Krashen's (1985) distinction between acquiring and learning a language, Gee argues that individuals get primary Discourses through acquisition, a process of attaining something by trial and error through exposure to models and practice and without formal teaching. "Secondary Discourses," on the other hand, are acquired outside early home and peer-group socialization but also learned through teaching and other experiences that promote conscious reflection on and some degree of metacognitive awareness of the knowledge and skill being attained. Always multimodal ("language plus 'other stuff,'" Gee et al., 1996, p. 34), Discourses provide individuals and groups with the identities (the "whos") and the practices (the "whats") that they need to do the work done in a public domain and situation.

Gee's notion of Discourse informs in several ways our understanding of what it means for students to participate in remedial math education. First, the mastery of Discourses like those at work in college math is through acquisition. Learning can facilitate the metacognitive awareness and deepen the use of Discourses, but without access to social practice, "you don't get in the Discourse, you don't have it" (Gee, 2011, p. 168).[3] Second, an individual's primary Discourse serves as a framework for acquiring and learning Discourses like those associated with doing college math. By extension, that individual's family and home community contribute to not only how she sees the world but also how compatible a secondary Discourse is likely to be and what will be involved in learning about it and acquiring it.[4]

Finally, the structure and function of Discourses put non-dominant learners and teachers in a bind. Getting a dominant secondary Discourse—for example, one of those used by students in college-level math classes—requires acquisition to the point of mastery. Those learners whose home Discourses share features with a dominant Discourse have already practiced some aspects of the new Discourse and feel little conflict with the models, settings, and practices that are part of the Discourse. Others may have home Discourses that are in conflict with the dominant Discourse. For instance, a law student whose primary Discourse values a close connection between language and lived experience or cooperation among group members will have to learn

[3]There is no functional fluency in a Discourse: users are recognized as in the group or not. The user of a Discourse who has partial control of the Discourse is effectively enacting part of an identity and announcing very clearly that he does not yet have the identity.

[4]Gee (2011) points out that cultures differ in respect to the relative value of acquisition and learning, some tending to expose children to adult modeling a target practice until the child gets the knack, others valuing systematic instruction that breaks apart core Discourses into component parts, explains each, and tests the extent to which each has been learned.

practices and take up identities that are at odds with his primary discourse in order to engage in case analysis or class interaction (Minnis, 1994). More, learners with little experience related to the new Discourse are dependent on opportunities to apprentice in the new Discourse in order to acquire it. Since American schooling rarely provides such opportunities (Varenne & McDermott, 1998), those students may struggle to achieve adequate mastery of superficial forms (Shaughnessy, 1977).

Gee suggests that non-dominant learners do have one advantage. Struggling to acquire a secondary Discourse forces a would-be participant to become consciously aware of what she is trying to do and what she is being asked to do. That is, she develops a meta-cognitive awareness of the Discourse that can be empowering in two ways. For one, if she manages to acquire the Discourse after all and if it is the right kind of Discourse—the kind that allows for talk about how societies are arranged and how such arrangements might be resisted—she is put in the position of active and critical participant in the social spaces in which the Discourse is dominant. Even if she does not acquire the Discourse, she may develop strategies to make do: Minnis (1994) noted law students use writing strategies that dissociate language in legal case analyses from everyday usages or conversational strategies that put them in a short-term competitive relationship with peers and faculty.

This view of educational progress focused our analysis on the social activities that are associated with becoming and practicing as a college-level CDKC math student. The framework is useful to these ends because it provides a means of thinking about a remedial math sequence as an opportunity to adopt and adapt new social positions that summon students "to speak, listen, act, read and write, think, feel, believe and value in certain characteristic and historically recognizable ways, combined with their own individual styles and creativity" (Gee, Hull, & Lankshear, 1996, p. 128). This view of remedial education led us to hypothesize that while a developmental math student may choose to learn about what college math students do, she will become able to participate in those classes only if she engages in a process of trial and error with the models and activities that she understands to be necessary to function in a way she wants to function. This framework, we believe, is particularly promising for understanding and explaining the practices of successful CDKC remedial math students because it focuses attention on the activities students and the institution are adopting and adapting to in order to make space for underprepared students to learn college math.

Methods

We approached our study of the CDKC remedial math program as an instrumental case study, examining a "particular case" to gain "insight into an

issue or refinement of theory" (Stake, 1994, p. 237). The case itself facilitates our understanding of what it means to be an underprepared college student who nonetheless makes academic progress. The remedial math program at CDKC is well positioned to facilitate our thinking about this issue. CDKC is the sole access to higher education for students who often assume major family responsibilities with limited resources and, more often than not, discover that their high school education did not adequately prepare them for the demands of college-level math. Over 90 percent of the students at Chief Dull Knife College are Native Americans. Many of these students are enrolled members of the Northern Cheyenne Tribe who live and have been educated on or near the Northern Cheyenne Indian Reservation. As such, the college is a single bounded context in which underprepared students get ready to make use of college.

An instrumental single case study design served one additional purpose. It allowed us to explore the complex practices taken up by remedial math students within their "real-world" contexts (Yin, 2009, p. 18) rather than framing remedial education as a kind of production function of student characteristics and abstract program components. This design allowed us to take a positioned subjects approach (Conrad, Haworth, & Millar, 1993), one that assumes that people, as positioned subjects (where subjects refers to people with particular needs, perceptions, and capabilities for action, and position refers to the environment in which they are located), actively interpret and make sense of their everyday worlds.

Site and Sample

This case study is drawn from the Minority Serving Institution (MSIs) Models of Success study (2011–2013). In a competitive process, the MSI Models study selected 12 institutions—three Historically Black Colleges and Universities, three Tribal Colleges, three Asian American and Native American Pacific Islander-Serving institutions, and three Hispanic-Serving Institutions—with promising initiatives to support minority student achievement—including learning, retention, and degree attainment. As the study got underway, project staff completed a systematic study of each program, collecting documents from institutional web sites, program staff, and electronic databases (Education Research Complete and ERIC). Between two and four project researchers made a multiday site visit to each campus during 2012 and 2013 to conduct participant observations and interviews.

In April 2012, we visited CDKC, one of the tribal colleges involved in the national study. Of the just under 550 students who attended CDKC in 2011–2012, over 85 percent were Native American and over 75 percent tested into remedial math. Two of the college's 13 full-time faculty members were math instructors. Through a purposive sampling process guided by CDKC administrators and faculty, we recruited 9 students, 2 administrators, and

5 faculty members involved with the CDKC remedial math and STEM programs (10 females and 6 males). The inclusion of faculty and administrator participants in this study were critical to addressing our inquiry as they were all involved in the redesign of the remedial math curriculum and understand the circumstances that bear on students' achievement in school. The students we interviewed had all placed into remedial math and were at various stages in the program. Our campus contact described the students in our sample this way:

> The students . . . are probably not truly representative of the normal students that come through. For two reasons, number one it's the end of the semester. At the end of the semester the majority of the students have left. The ones that are left are essentially the dedicated ones. So they're already not perfect representation of our ordinary students. Secondly, I had to choose students that I could ask to be here at a particular time and have some reasonable assurance that they would try to be here and that sets them apart as well. Other than that, other than those two factors, . . . these are students who did what was asked of them.

Consistent with our conceptual framework, we assumed that these participants understand what was involved in participating in CDKC college-math classes and from their various positions are able to talk about what activities successful remedial math students engaged in and, in turn, what educational practices supported them in taking up that activity.

Data Collection Procedures

After studying institutional documents, we met with program staff at a national convening in the summer of 2011. Prior to our campus visit, we reviewed a decade's worth of reports and articles on STEM initiatives at CDKC. We designed an interview protocol to guide data collection across the stakeholder groups (Bogdan & Biklen, 2007) and, at the same time, to create spaces in which participants could give voice to their unique experiences and interpretations of their experiences. The following questions guided our inquiry: What definition(s) of student success guides a) learning and teaching at CDKC and b) in CDKC remedial math classes? What challenges led to this programs being redesigned? As the program was redesigned, what challenges emerged over time that needed to be addressed? In each interview, follow-up questions focused on opportunities for participation and practices (patterns of participation) across stakeholder groups that contributed to student persistence and learning. Over the course of three days, we conducted a series of interviews in which we presented ourselves not as "invisible" observers but as participants in a conversation—though our participants did most of the talking (Conrad et al., 1993). Interview questions focused on student experiences as well as faculty and staff experiences with students. Follow-

up questions probed participants' perspectives regarding why the CDKC program was having a positive influence on student achievement. Interviews took place on campus in private settings that were familiar to participants and adjacent to the classrooms in which remedial math classes are taught. Interviews lasted from 45 to 75 minutes. All interviews were transcribed.

Data Analysis

Given the exploratory nature of this study, we adopted an open coding approach to our review of the interview transcripts, which were the primary source of data used to develop our findings (Charmaz, 2006). We also added observation notes and public documents to an Nvivo database to triangulate our interview data. We proceeded with two iterative rounds of coding. In an initial analysis, we identified passages that described what successful CDKC remedial math students do and, using a mix of process codes and in vivo codes, named different kinds of activity. Researchers compared their results and agreed on just over a dozen distinct kinds of activity. In a second round of coding, we returned to labeled incidents to do focused coding, comparing participants' explanations of what successful students do and why these activities matter. After several passes through labeled incidents, researchers compared focused codes and arrived at four broad activities that "summon" remedial math students to be college-level math students. These four general kinds of activity led to additional coding and the development of a series of narrative statements about the definition of remedial math students in the CDKC program (Strauss & Corbin, 1990).

Throughout the study, we took several measures to ensure the validity of the findings. This was a critical stage in our process as we wanted to ensure that we were capturing the realities of our participants (Charmaz, 2006) and how their sense of the academic Discourse was altered due to this redesign of remedial math. First, the principal investigators engaged in frequent conversation in the field during and after the interviews to sense and tease out potential and personal biases (Conrad et al., 1993). Memos developed in the field became part of our database. Second, every member of the team spent a substantial amount of time reviewing and evaluating the data to determine coding categories and themes, thereby improving inter-rater reliability (Yin, 2009). Third, as we analyzed transcripts, we held regular team meetings to share codes we had developed individually. In these meetings, we tested one another's codes and emerging themes against transcripts and one another's interpretations. Finally, we collected documents from several sources that were used to triangulate data collected through our interviews. This step enabled us to use institutional research from CDKC to validate our findings.

Findings

Our analysis suggests that students, staff, and faculty view successful remedial math students not so much by placement score or level, but by the practices they take up in order to move through classes and programs. In turn, the college supports students in getting through college not so much by offering classes as by establishing relevant classroom spaces, instruction, and curriculum. With the support of their tribal college, these students are "summoned" by the Discourses of college math and are making do, developing strategies to link the Discourses of college math with the Discourses they already value and those they hope to take up once they complete college.

Therefore, our findings are organized under two sections. First, in "College-Ready Practices of Remedial Math Students," we discuss three dimensions that capture the ways in which students are college ready. Second, in "Making Math 'matter' to Students," we demonstrate how faculty employ their own practices to strengthen students' perception of the relevancy and value of math, which ultimately provides the conditions to improve students' engagement with the material. But before we elaborate on what we have learned at CDKC about the practices of successful underprepared math students, we offer a brief description of the program itself.

A Portrait of the Changing Role of Remedial Math at CDKC

Remedial math education plays a central role at CDKC. Most CDKC students start college as remedial math learners. The Test for Adult Basic Education (TABE) typically places more than three-quarters of incoming first-year CDKC students in developmental math classes. In 2002, less than one-third of the students who placed into remedial education went on to complete any of the CDKC lecture-based three-credit remedial math courses—Basic Mathematics, Introductory Algebra, Intermediate Algebra (Madsen, Hodgson, & Ward, 2006). Less than one-tenth of students who started in remedial math completed a degree or certificate. Many of those who passed remedial math classes could not use the math that they learned in college-level STEM courses.

While the CDKC remedial math program has historically functioned like many remedial programs, a decade ago the program adopted a common, computer-based math learning system that supports a mastery approach to advancement in remedial math classes—students advance from one math topic to the next only after they can answer 80 percent of the questions on a computer-based assessment correctly. The learning system serves as both textbook and practice space. When students log in on campus or at home, online or offline, they encounter a table of contents that tracks their progress. They see what chapters, lessons, and assessments they have completed as well as what comes next. As they read the textbook, they are able to toggle

between descriptions of mathematical concepts and processes and practice problems. As they move through material, they are able to "jump" back and forth among topics and "certify" competence by passing a criterion-referenced assessment at least the 80 percent level. Practicing in the system triggers feedback on solutions that track right and wrong answers and also provide hints about likely missteps. For more detailed feedback, students can confer with the computerized "tutor" whenever and wherever they practice. Put simply, this system turns remedial math study into an ongoing opportunity to solve new kinds of problems as fast as students certify mastery of the concepts that underlie new problems.

The same common computer-based curriculum at CDKC has been delivered in three distinctly different course structures: a traditional sequence of three three-credit lecture-based courses; three-credit self-paced courses organized in topical "seminars;" and one-credit or two-credit courses offered in a math emporium. Students have the option to accelerate their learning, signing up for a set number of credits during a semester with the option to complete additional remedial math credits during that semester for no extra charge.

What makes this single case a useful instrumental case is the outcome of this program innovation. By 2005, more than one-half of students were mastering the content in the remedial math courses in which they enrolled. More than 70 percent viewed classes and faculty positively; more than one-half reported feeling confident in approaching instructors and talking about math. Institutional data indicates that more students who start the remedial math sequence remain "active" to the end of the term. These students consistently rack up "certifications," proof that they have mastered at least part of the remedial math curriculum. To be sure, faculty are quick to point out both that many students still struggle with math and also that with minimal increases in overall enrollment, enrollments in College Algebra and Pre-Calculus are growing. Yet, because of this program, underprepared students are becoming ready to take college-ready math courses.

College-Ready Practices of Remedial Math Students

The CDKC students, staff, and faculty that we interviewed do not see a dichotomy between what remedial students and what college-ready students do in college. When remedial math students described what they were prepared to do in college, they often spoke about what they planned to make of college and not what classes they were taking. In fact, the students we interviewed were more likely to talk about the math concepts they were studying and the math that was required for their intended degree than the course names and numbers associated with the remedial math content they were learning. Similarly, the staff and faculty responsible for designing and teaching remedial math education at CDKC were disinterested in distinguishing

between separating remedial and college-ready students. That distinction, an administrator asserted, is irrelevant for "an open enrollment institution, particularly one serving a specific closed population that needs . . . remediation for the foreseeable future." CDKC, she added, does not "have the option of saying that 'developmental ed' doesn't work."

Faculty shrugged and even bristled at the idea that students were progressing through classes solely to attain the status of college-level math student. One instructor put it this way:

> Personally, this is probably a terrible thing to say, but personally I couldn't care less about whether or not they get through the class. What matters is what they learn and that it makes a difference and is going to continue to make a difference for the rest of their lives. They can see it. It's so much a part of who I am and how I approach the material and how I work with the students that they cannot help but see that. That makes [math] important to them as well.

Overall, students, staff, and faculty assume that CDKC students "are ready" for college math based on what they are prepared to do in college math classes. Over the course of our interviews, we identified three widely-shared practices for navigating college and remedial math classes.

"Managing college." In reflecting on his experiences with CKDC students who made it through remedial math and went on to STEM degree programs, a long-time instructor reflected on the importance of seeing them smile as math problems were worked out in class. Smiles indicated to him that students "are discovering" both that being a doer of math is important to them and that "math isn't this big demon that I've got to someday slay. 'I'm managing to do it right now.'" Across our interviews, we learned that students who are moving through remedial math and pursuing their educational goals are able to explain in concrete terms what they are doing and must do in college to succeed. "Managing to do remedial math right now" includes developing a critical awareness of education and a plan for why and how long they will stay in school and what uses they will make of remedial math.

Our student interviews were interspersed with instances in which students recounted "realizing things." Asked about challenges they and their peers face in getting a college education, they spoke frankly about becoming aware of the ways in which their high school education and their own behaviors did and did not prepare them for college. They know what they and their peers are "good at" and where their gaps are. One student, for example, described being astonished at a friend's high school math assignments: "I'm like, 'You really don't know this? You've really never seen this before?' . . . It's kind of crazy. I think that's where a lot of it stems from, a lot of it; most of it." Though she placed into remedial math herself, she spoke fluently about what she needs to do as a college math student. Other students emphasized

the teachers and experiences that made math "a lot easier" and the habits that they "had to get away from" in order to succeed as CDKC college math students. One reflected on the implications of a high school curriculum that required only two units of math, and another student on the debilitating effects of fear and frustration.

All the students we interviewed talked openly and reflectively about their educational journey—including the development of a plan for college. An administrator we interviewed noted that many CDKC students have a limited view of college: "I need to get an education because that's how I'll improve my life and the life of my children; and that's it." Faculty told us that few students know the limitations on "Pell money" or what uses a college degree has on the Northern Cheyenne Reservation. In contrast, the students we interviewed had detailed plans for "finishing up" college and making use of their education. Dropping out of the remedial math sequence was not an option for them because they understood that "eventually students have to take College Algebra."[5] As she talked about her educational goals, one student described the math "requirements" at three different four-year colleges and her rationale for transferring to one of them. Others explained strategies for "working and going to school" or balancing getting an education with fulfilling commitments to traditional Native American families or taking time off before moving off the reservation for more education. Far from an ambiguous path to a better life, successful CDKC remedial math students talk about college as "requirements" and "work" that lead to specific opportunities and come with specific costs.

"Going somewhere" through STEM classes. Prepared CDKC math students approach math classes as means to progressing on a life plan and not, a long-time administrator mused, to become math majors. That is, they go about completing classes as part of what one student called "going somewhere from here." This traditional-aged student recognized the remedial math success of an older classmate this way:

> I always looked up to her and I was like, man, even though she has kids, she has an all right life, and she still wants to do more and still wants to learn. I was like . . . I think a lot of people need to realize is that you can go somewhere from here. So many people think you can't. I see so many people start here and then they just never come back and they think you can't go anywhere from here but you really can.

[5]Students used formal course names to talk about college-level courses since these names functioned as requirements. They habitually referred to their remedial courses by the specific concepts they were learning. Often, they were uncertain about course numbers though never about mastering the content.

CDKC college-math students complete math classes, our participants told us, as steps on the way to becoming a nurse on the reservation or getting off the reservation or understanding traditional practices for caring for the land more deeply. For one student, "going back" to college and completing remedial math classes is part of a new "habit" that leads away from "struggling monthly, monthly" in a way of life "I can't be doing." For this student, a math class—he made no distinctions between remedial and college-level math classes—is a means to a bachelor's degree. For others, math classes are paths to an associate's degree or simply to confidence and hope.

The activity "going somewhere from here" involves using classroom activities, knowledge, and tools to work to a next level of competence. Faculty explained this practice in different ways. For one, it meant "looking at a sequence [of mathematical concepts] and saying, 'Oh, yes. I know how to do that and then demonstrating that [you] can.'" Others defined the activity in terms of staying "on track" with concepts or assignments or staying "in school" or staying "engaged" in the classroom or staying engaged in doing math. For students, this practice has its roots in home, school, or college. One recounted hearing a teacher say, "You should go into Math and all this. . . . And I said, 'yes,' and just kept continuing." For her, continuing in remedial math classes is a process of encountering new material, determining whether she can solve a problem and then "pass" a test of competency in order to move on. Others described the practice as "refreshing" their abilities to work discrete mathematical procedures and progress in a class or to master an analytical process—calculating percentages in order to cut a budget or measure the effect of a filter on water purity—for use outside of class.

More than simply consistent problem-solving, "going somewhere from here" is anchored in three consistent activities. First, while these students begin their college education with different levels of preparation and different educational goals and proceed at different rates, they determine their own pace. More specifically, they explain their progress as a function of prior experience with math, their current threshold of understanding, and their goals. Two students who were completing the remedial math program at the same time illustrate the practice. Each readily recounted her starting point. One, a non-traditional student who is preparing to teach elementary education on the reservation, recounted her starting point this way:

> So I had forgotten pretty much all of my math because I haven't used it in 20 years. So I had to start from the basics. I couldn't remember anything really except for multiplication facts. I could remember that and that's about it. So I had to start out from the very basics.

The other, a traditional aged student interested in an associate's degree, was in remedial math not because she didn't know mathematical concepts but

because she "hated math" and so "whipped through the placement test and landed in [remedial math]." In the stories of these students and others, the practice of recounting a history with math serves both to determine where to start as a remedial math student and also to acknowledge past shame and fear.

Closely linked to claiming a history with math is articulating an approach to classroom activities. Based on their assessment of where they start the sequence, CDKC students determine whether they are "relearning" or "refreshing" or "confirming" their math skills. The non-traditional student who started from the basics was "relearning," and so she spent a year moving through the sequence. Her instructor observed that she may have not needed to start at the very beginning of the sequence, but she chose to go slowly, "relearning stuff that she had once learned." Her goal was "finishing up" an education that would enable her to help her own children complete their math education and ultimately to teach other children. She "loves math." Her traditional-aged peer, from the perspective of the same faculty member, moved much more quickly, "looking at the sequence and saying, 'oh yes, I know how to do that,' and then demonstrating that she could." This younger student described her pace as "independent," a mix of what faculty and other students called "refreshing math skills" and "confirming" competence. She explained, somewhat to her surprise, that her academic preparation made remedial math "easy" and so enabled her to pursue her goal of "whipping through" college to gain the skills to open a business. She no longer "hates" or "dreads" math, though she doesn't like it. Every student in our sample recognized that the "option" to work at their own pace contributed to their success in the sequence.

Second, the practice of "going somewhere from here" includes recognizing successes and seeking out the next challenges. An administrator described the critical role of success for CDKC remedial students:

> They have to have success. They've maybe never had academic success, see. It's nothing but anxiety causing and so what brings them here, what gets them in the door is . . . and this is when you think of all that anxiety, confusion, and frustration that they've got to overcome to even walk in the door and then into the classroom, they have at least bought that education might be something good. Even at that point they're overriding everything in them that's saying run in the other direction. Now that you have them in that classroom you've got some pretty fragile students right off the bat.

Two of the students we interviewed confirmed that they and their peers struggled with "getting frustrated." One added that becoming aware of this challenge led her to "change" what she did in math class, keeping track of what she had completed and "pushing herself" to "do all the math." In order to take up the position of college-level math students, CDKC remedial math students routinely name their successes and leverage them. They describe

"finishing out" problems, class units, and classes. They are accustomed, one student explained, to "accomplish something, even it if is in math, you get a good feeling from it . . . . Like, you're more motivated, 'I can do this, I can get further.'" Asked whether she was "good at math," a student who started her CDKC career in Math 071—the first course in the CDKC remedial math sequence—confidently stated:

> Yes. I had the program on my computer at home so I was just doing it at home too, because like . . . I started math in high school, and then when I took a break from college, I didn't do math for a long time, so when I started again, I just kept doing it. And I finished it in two semesters, and I went on to College Algebra. I got a Merit Award for College Algebra.

In rapid-fire sentences she went on to list three college-level classes she had already completed since then while noting how her frustration had subsided.

Finally, the practice of "going somewhere from here" includes what students called "being serious" about classes. For one student, progressing through remedial math classes had to fit seamlessly into a long-term commitment to "going to school and working:" "I know it's going to be a lot more work." For another, progress meant no longer "expecting to skate through [school] doing well . . . that class is just there to skate through." Faculty and staff noted that frustration and life on the reservation has led many students to "fall of the face of the earth" and just stop coming. Remedial math students who were recognizably "going somewhere" come to classes knowing, in a faculty member's words, "it's really hard because you're going to make us think every day when we come in here." They distinguish, he went on to explain, between the lives that they lead off campus and the "expectations" of the classroom so as to make use of college.

Taking advantage of safe spaces to practice STEM. What CDKC remedial math students do to successfully navigate college is clearly an expression of their individual style and creativity as students and, at the same time, their adoption of characteristic and historically recognizable ways of getting an education. Like anyone acquiring a secondary Discourse, these students are engaging in established social practices through the frameworks of their home Discourses. Because most CDKC students are Northern Cheyenne, they are negotiating very different and frequently conflicting mainstream models, settings, and practices for learning and being. When it comes to math, many CDKC students arrive at the college unprepared and afraid to be a student. A one-credit math class, one instructor observed, "has most students just trembling." In a group interview, one student seemed to capture the experience of starting:

> I don't know about you guys when you started your math . . . I was afraid of math. I did not like math. And a lot of that was a combination of past instruc-

> tors and the way that I've always learned math. . . . You know, if you weren't right, you got a crack with the stick. . . . It wasn't a real stick, but you had this teacher saying, "You're wrong. Sit down."

This fear—what several faculty called "math shame"—is complicated at CDKC by Cheyenne educational traditions. Within Northern Cheyenne tradition, two faculty members explained, learners do not ask questions (see also Montana State Department of Public Instruction, 1980). They have been socialized to learn new practices by watching experts and then practicing on their own until they are ready to perform the practice as a member of the community. "It kind of goes against their cultural background to question an authority," one faculty member observed. Another elaborated as follows:

> They're not supposed to ask questions and say, "Do that again, or how did you do that." They're supposed to watch and let it sink in. But [remedial] math is something where if all you do is watch and let it sink in . . . we don't have time because we're trying to cram so much in, so they don't have time to just sit and let it sink in. They have to ask a question if they're stuck; otherwise, they're going to be stuck in that same spot for a long time.

To progress in remedial math classes, these students—with support from their tribal college—have come to trust college as a safe place to learn math. They sometimes seem to take for granted that remedial math is taught in rooms that gather together computers, "the software" that supports the common computer-based curriculum, one-on-one faculty support, occasional peer support, and access to a nearby learning center. They assume that remedial math students have access to spaces in which to learn math whenever they are able to "come over here and get on a computer" or talk to a math instructor or tutor.

In these safe spaces, the students we interviewed described being motivated by progress rather than grades. They presume that they will have constant access to formative feedback about their math performance through a common, computer-based curriculum. An administrator described the "classroom dynamic" this way:

> In traditional classroom, the students are like we've got to get by what this teacher is trying to do and things like that, and they're kind of working not necessarily with you and trying to get through what you are imposing on them, so to speak, whereas the dynamic changed with the computer-based. . . . Now all of a sudden we're working together to overcome certain obstacles in the form of the problems that we're trying to solve and work over, that we're being presented by the computer.

Another faculty described the dynamic as "working against some online rubric from the university, but they have a coach." Students focus on solving

problems in order to build the knowledge and skills they need where they are going next. They work with faculty and one another to "keep the door to STEM" open. The "requirements" that students must meet have been set by gatekeepers off campus—such as transfer schools or future employers. As one student put it, whether the instructor is lecturing or working with students one on one, when "I asked a question about something I didn't understand, he just explains it without making you feel stupid." Another offered more simply, "he makes me . . . say, 'Oh my gosh, I can do math.'"

Making Math "matter" to Students

The CDKC community believes that students are supported by a curriculum that is designed for them.[6] The college is willing, one administrator observed, "to do something different than what we were doing in order to provide some of our students with a little more success." Our data suggest that what they are doing is relentlessly emphasizing mathematical problem-solving practices over discrete courses or math procedures. In active collaborations between these leaders and faculty, CDKC remedial math classes are continually redesigned to keep CDKC students engaged in problem-solving. Faculty and administrators described the process of redistributing content from three-credit courses into one-credit blocks focused on specific mathematical concepts.[7] An administrator and instructor who have played a central role in designing the current curriculum described "pulling off" pieces of the traditional curriculum to make it more manageable for CDKC math students.

Faculty described linking mathematical problem-solving to students' lives and their educational aspirations. One recounted finding funding to support the development of a series of inquiry-based lessons for her Basic Mathematics students. Her students learn fractions and percentages by calculating what they can buy from a sales rack or the largest tribal presence in local towns off the reservation or the amount of medication needed by a sick child; they

[6]Form the points of view of students, staff, and faculty, CDKC remedial math instruction is designed to engage CDKC students in doing the kind of math they need to do to get where they are going. The remedial math curriculum and assessments are designed to align with college curricula in the state of Montana and the nation, but remedial math instruction is designed for CDKC students.

[7]As the instructor explained, student reactions to curriculum led him to design stand alone courses for number theory and graphing linear equations. Three years later the same sort of data led him to integrate number theory back into existing courses. Throughout this time, faculty and staff varied the extent to which three- and then one-credit courses were self-paced and the role that groups played in them. One described experimenting with having students leapfrogging some concepts in the traditional sequence to solving increasingly complex linear equations on the assumption that this approach was more coherent for CDKC students.

learn area by determining the extent of an invasive species problem or the cost of replacing flooring in a house.[8] Students described remedial math instruction as "different." One student felt that her instructor was pushing her to learn "different shortcuts and different ways to come up with the equations," ultimately to get past her tendency to focus on filling in blanks.

Instructors voiced a widely-shared reason for tying problem-solving to students' lives. Remedial math students, as one instructor explained, need somewhere to "hang" the concepts they encounter. Many of these students have learned the concepts before but fruitlessly. If their CDKC experience is to be different, they need answers to questions like: "Why do I need a polynomial equation to describe this? Why would I need this complex description of a graph or of how something traveled in space? What do we use that for?" CDKC remedial math instruction begins with helping students think about why they need "to learn that stuff" now, another instructor explained, so that students begin to see math as problem solving rather than calculating, so that they "have to think everyday" and, according to another instructor, "think in ways they haven't thought before."

Rather than organizational members who own the curriculum, CDKC faculty are part of the curriculum. They are curricular designers who, an administrator observed, "sit down beside the student, right there having the conversation and engaging one-on-one." Their teaching load, she explained, can no longer be calculated based on how many three-credit courses they teach. Their work is measured in "face-to-face time" or "lab time." They are becoming accustomed to teaching in an emporium where two or three faculty might work with the same students. These faculty members have "the math skills"—both administrators and science faculty assured us—to teach college calculus classes to students who "hold their own" when they transfer. But in CDKC remedial math classes, what counts as a "qualified instructor" is evolving. Among their most critical teaching practices, instructors listed the ability to see when a student gets "stuck" in a problem and the ability to call together an "organically forming cohort" so as to help remedial math students support one another's learning. Perhaps more importantly, three different instructors described the importance of learning how to make math "matter" to CDKC students who have learned to "fear" it.[9]

[8]This same process is used in a "science seminar" that introduces STEM students with remedial math placements to the math of science. For example, these students learn exponents in order to do scientific notation and area in order to take measurements.

[9]Students who are completing this alternative curriculum describe a remedial math career that focuses on what they need to learn rather than what is included in a course. They progress at their own pace, and, to their surprise, they often complete more math content than that covered by the course for which they registered—some students complete the equivalent of 9 credits in a one-credit semester long course. For them, the work of remedial math appears to be the use of a set of integrated tools. They observe and interact with computers, peers, instructors, and tutors to learn the math that they need to get where they are going.

Discussion and Implications

Recognizing Successful Remedial Math Practice

Students who start college unprepared to do college math face substantial challenges in attaining their educational goals—this is no less true at Chief Dull Knife College. In the CDKC remedial math program, a growing number of students who start college unprepared to do college math are adopting and adapting ways of speaking, listening, acting, reading and writing, thinking, feeling, believing, and valuing that identify them as college math students. That is, they are taking on the identities and practices of college math students within an institutional setting that scaffolds that process.

As a point of departure, our findings suggest what activities keep the door to college open for students who begin college unready to take college math. To begin, this case raises significant questions about the utility of drawing a bright line between prepared and underprepared college students. Clearly, CDKC can use placement tests to draw such a line. Yet, in a context where placement tests deem a supermajority of students unready, individuals who need a college education are faced with starting college expecting to be unready to do college-level math. In this context, policies separating remedial and college-ready students do little either to motivate students or to make more effective use of the educational resources available in the community. Such a distinction is all but irrelevant at CDKC and other colleges that do and will continue to serve "specific closed populations that need remediation."

This case redefines the practices of *remedial* math students as the practices of *college* math students. The students we interviewed, whatever their placement scores, aim at completing an education rather than discrete classes, and they appear to view math and science classes as means to their personal ends. These students seek out and take advantage of practice spaces so as to make the process of learning math more manageable. They take pleasure in "getting it;" some come to "love math;" others, no longer to hate it. Despite beginning college unready for math, most students are moving steadily toward college algebra and degree programs, both cognitively and non-cognitively. Our findings suggest that the way CDKC structures its remedial math program allows its students to reconcile the difference between their home Discourse and the dominant Discourse in higher education, which can be at odds with communities of color.

Overall, the image of CDKC remedial math students that emerges in this case study shares much with the image of remedial students that is emerging in a growing body of research on the educational experiences of community college students. This cohort of students starts college with mixed motives (Bahr, 2011a; Deil-Amen, 2011b, 2011c) and limited information (Bahr, 2008a; Rosenbaum et al., 2006) in the leakiest part of the college pipeline.

Many are marginally prepared and so attain degrees slowly if at all (Bahr, 2010a; Wang, 2009). These students appear to be adopting a new college going norm. Rather than joining a campus community, these students use college as they see fit; they often have limited desire to form a social community on campus but form a network with faculty and staff and other students who support them in making sense of their situation (Bahr, 2011a, 2013b; Deil-Amen, 2011b; Santiago, 2007, 2008). While their levels of academic preparation and performance are clearly related to their progress in college, many of these students begin college aware of their lack of preparation (Cox, 2009c). These students view course practices and activities that support learning differently than researchers or most instructors, and unlike students at elite institutions (Horowitz, 1988; Nathan, 2006; Pope, 2003), they may choose not to adopt the instructor's view in order to become part of the academic community (Cox, 2009c; Grubb & Cox, 2005).

Parallel to this view of the practices of community college students, our study suggests that the progress of these students is explained in part by their aspirations, expectations, and internal locus of control (Wang, 2009, 2012), characteristics that are related to their willingness to acquire the academic skills they need in order to attain degrees and also to cope with the stress of being in an academic environment for which they are not prepared (Cox, 2009b). These students largely view college as a space in which to complete requirements by completing classes, but they are more likely to be able to use college to their ends if their classes are spaces where it is safe to ask questions and access assistance—especially assistance from a teacher (D. Cole, 2007; Deil-Amen, 2011b; Grubb, 2010; Grubb & Cox, 2005).

This study emphasizes three activities engaged in by underprepared students who get started in college. First, while our findings confirm that remedial education students at CDKC see college as a means to an end, the case also suggests that these students may not be narrow "vocationalists" (Grubb & Cox, 2005). The students in our study come to college with few academic and economic resources and express an interest in completing their education efficiently. But these students describe their participation in remedial math classes in terms of more long-term benefits and resist defining those benefits in strictly economic terms. Contrary to findings in some studies, these students have quite detailed plans for their education. They talk fluently about how a college education fits into their life plans and how they use conversations with faculty and other community members to determine what degrees and "requirements" they will need to achieve their life goals. They are not so much "getting it over" (Cox, 2009a) as "getting somewhere from here." Many of these students view the end of college as developing the capacity to contribute to the welfare of an extended family, a tribe, and a reservation.

Second, our findings illuminate the learning practices of underprepared students. Rather than learning to make grades (Cox, 2009a), these students explain their academic goals in terms of developing competence and progressing toward educational goals. Consistent with the findings of Grubb and Cox (2005), these students do not view college as "fun." Yet as they describe what they do, several observe, at times to their own surprise, that they enjoy math or science or at least no longer "dread" it; moreover, they describe finding considerable pleasure in understanding the relevance of math in their worlds.

Third, while the students in our purposeful sample are adopting the habitus of college (Callahan & Chumney, 2009), they adopt them in a critical fashion. Educational success is for them as much defined by their home communities as by the social institution of higher education. Their persistence is and will continue to be determined less by what happens on campus than by what happens off campus. Ultimately, they view succeeding in remedial math as proceeding "at my own pace." With Bahr (2013b) and Grubb (2010), we suspect that this notion of success fits uncomfortably within the frameworks generally used to measure student success.

Theoretical Implications

This case expands upon the notions of New Literacy Studies as it relates to understanding how non-dominant groups conceive of topics and spaces—math and higher education, respectively—commonly dominated and constructed by those outside their own communities. While our participants' talk about "math shame" confirms that some remedial students may be at risk for delaying or stopping out in part due to their tendency to have negative perceptions of themselves as math students (Hadden, 2000), the students in our sample seemed both of aware of and resistant to the stigma of being a remedial math student. For them, the more salient challenge is pace. They are, to use the words of a CDKC administrator, college students who are often caught between being "over challenged and frustrated" and "wasting their time." Confronted with problems or classes they do not understand, these students recalled stalling; they had little patience for wading at someone else's pace through content they had already mastered. Completing even a single credit of remedial education at their own pace confirmed and amplified their belief that managing school was possible. Being able to choose their own pace, for these students, transforms remedial education into an opportunity to find ways to "make do" in STEM, to get academic Discourses without having to be assimilated into the cultures that sponsor those Discourses.

CDKC students have a complicated relationship with academic Discourses. There are few jobs on the Northern Cheyenne Indian Reservation for traditional college graduates. As importantly, one participant described the tension between becoming a biologist and sustaining relationships with his more traditional family members and his Tribe's knowledge of local ecosystems. It

may be that for CDKC students, failing a remedial math course means more than not knowing the required content and skill. It suggests to these students that making do in college as an American Indian is not possible, reinforcing yet again the widely-shared myth that "Indians can't do math." Our findings give way to the belief that this academic Discourse can be altered and redefined so that the pathway to degree becomes a more viable means to helping students reach their professional goals. In other words, although the concept of Discourse dichotomizes how minority students conceive the broader society as spaces of belonging (home) and exclusion (public, dominant spaces), this instrumental case study suggests that underprepared students are ready to be college students and that readiness is an organizational construct which is not permanently bounded within the academic (dominant) Discourse. Institutions that embody their minority serving institution identity are in a position to help students alter this construct (Gasman, Baez, & Turner, 2008).

If administrators, faculty, staff, and students themselves are prepared to document and acknowledge the real-life situations of underprepared math students, there can be space for them at the center of a college education. Traditional college curricula and instruction do not, our participants indicate, scaffold college student practices for underprepared students. To be transparent, this instrumental case calls attention to the promise of accelerating remedial education through fast-tracked and modularized courses as well as to the value of contextualized-learning opportunities and highly customized student support for remedial math students (Zachry & Schneider, 2010). But at CDKC, these interventions appear to be effective because they are embedded in an institution that has redefined what it means to teach and assess remedial math students. The underprepared students we interviewed were able to take up the activities of college students because remedial math education is located at the center of a CDKC education.[10] We offer several implications for practice.

[10]This case in part narrates the efforts of one campus to address the institutional influences that Grubb (2010) has found to inhibit effective instruction for remedial students: professional development of faculty and instructional leaders; static course structures; "batch processing" of students in courses; and general misalignments of curricula, funding, and assessment between remedial and college-level courses. Remedial math classes at CDKC are college classes. An administrator described "braiding funding" so that every student who entered the college with remedial math needs—whether they are preparing to take the GED exam or to begin a STEM degree—gets access to "the same curriculum with the same method" in a centrally located classrooms. The remedial math curriculum and assessments are designed to align with college curricula in the state of Montana and the nation. Funding for the technology in CDKC remedial math classrooms is on par with funding for technology in science labs.

Implications

The first implication we draw from this study is that institutions can redefine the participation of remedial students in college by hiring and developing faculty to teach remedial math students. This means, as two administrators explained, selecting instructors who have appropriate academic credentials and also know the local context and the "whole" math curriculum. CDKC remedial math instructors have the math chops to explain the same concept "ten different ways," and because they know the Reservation, they are "comfortable" with teaching as handing a room "one person at a time." At CDKC, teaching remedial math is a process of observing students—in real time or by way of data in their computer-based curriculum—and then crafting "mini-lectures" or "pulling aside" an "organically forming cohort" that guides students to work on concepts at the edge of their grasp. In CDKC remedial math classrooms, two faculty members often circulate in the same classroom among the same 40 students. They serve as resources that get to students when they are "stuck"—often before students have to raise their hands. CDKC students describe the experience of being in class as a mash-up of watching faculty work problems, getting feedback on their own work, and asking questions without feeling like they are challenging an authority. It is likely that instructional needs of remedial math students vary by context. These students can be defined as college students if college faculty members are hired to meet those needs.

The CDKC case also has implications for the assessment of remedial math students as well. In the CDKC remedial math program, assessment is a process of gathering information about the ways in which learners are meeting explicit expectations for math performance. The educational needs of students rather than institutional or statewide policy drives the selection of assessment tools. To that end, CDKC has adopted a placement test that provides detailed information about remedial math needs and supplements that placement with a computer-based test that is part of the common curriculum in the math program. As students get their first glimpse of college math expectations, they also begin talking about their educational goals with faculty who believe that their students can learn math. Across STEM classes, faculty talk frankly with students about how much math they will need to learn given their academic preparation and goals and how long their learning is likely to take. It seems unlikely to us that the suite of tools adopted at CDKC are the right tools for every context. The view of assessment as gathering information about the math performance of students relative to their educational goals rather than as setting reliable cut scores does seem transferable.

Still another implication of this case study is that redefining underprepared students as college students appears to rest on an institutional commitment

to accepting rather than selecting students into an incoming cohort. During interviews with administrators and staff, we often wondered aloud about the seemingly endless willingness of CDKC stakeholders to experiment with remedial math instruction until every student prepared to "get somewhere from here" does. The response to these queries was consistent and straightforward. Chief Dull Knife, our participants explained, is a tribal college. Remediation—whether it is conceived as institutional policy and practice or educational activity—is inextricably linked to the mission of a tribal college and to that of Minority-Serving institutions (MSIs) more broadly. Colleges and universities that set out to serve minority students in the United States build student bodies from populations of students that are increasing their share of college enrollments but historically are less likely to be academically prepared or to enroll as a traditional college student, as a first-time, full-time student at a four-year institution (Aud, Fox, & Kewal Ramani, 2010; Li & Carroll, 2007; Swail, Redd, & Perna, 2003). Stakeholders at MSIs understand remediation to have long served underprepared minority students as a "means of intervention to resolve academic deficiencies" (Davis & Palmer, 2010, p. 512). Studies of MSIs—Historically Black Colleges and Universities, Tribal Colleges and Universities, Hispanic-Serving Institutions, and Asian American and Native American Pacific Islander-Serving Institutions—emphasize their shared commitment to providing an educational opportunity to students who "face a variety of unique challenges in attaining a postsecondary degree" (Merisotis & McCarthy, 2005, p. 47; see also Baez, Gasman, & Turner, 2008). To a great extent, CDKC's experiment with remedial math is a product of the college's identity as a tribal college.

The centrality of serving underprepared students to MSIs notwithstanding, little research looks directly at remedial education in MSIs. Palmer and a series of collaborators have looked at the experience of underprepared Black males in HBCUs, largely confirming that characteristics of HBCUs are perceived as supportive by underprepared students (Davis & Palmer, 2010; Palmer, Davis, & Hilton, 2009; Palmer, Davis, & Maramba, 2010; Palmer & Gasman, 2008). Studies of remedial writing classes at MSIs suggest that at these institutions, students may be encouraged to draw on and understand their prior literacy expertise as a scaffold from which to acquire and make use of new literacies and programs that document the success of underprepared students (Jaffe, 2007; Kynard & Eddy, 2009; Lamos, 2012; McCurrie, 2009; Merisotis & McCarthy, 2005). Building on this study, further research is needed to explore what can be learned from MSIs about providing remedial education for underprepared students.

In conclusion, we suggest that thinking differently about remedial math students means thinking about students who get an education in a place for a purpose. Research on how underprepared students progress through col-

lege needs to be supplemented by research on what unprepared students do with their access to college; that is, we need to understand why these students exhibit the enrollment behaviors that they do (Bahr, 2013a, 2013b). This research will have to conceive of the progress of underprepared students—and students more generally—not only as behavior but also as intentional and situated activity aimed at becoming recognized as able to talk, listen, read, write, act, interact, believe, value, and use tools and objects as college students. In completing the MSI Models Study, we became increasingly aware of the situated nature of what individuals and institutions do. Consider the case of CDKC. For many CDKC students, our participants told us, starting and progressing through college is part of a process of finding a place in the world relative to the Northern Cheyenne Indian Reservation and Tribe, even if that place is on another continent. We suspect that student progress at many campuses that educate underprepared students—students who come to college even though they are not yet ready—is similarly situated. Research focused on what works for underprepared students in the aggregate may miss what works for students who begin college at a particular campus in a particular place with a particular purpose and also happen to be academically underprepared.

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