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Prescriptions for Rural Mathematics Instruction: Analysis of the Rhetorical Literature

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Very little empirical research has examined mathematics education in rural schools and communities. A modest nonresearch literature does exist, however, and this study analyzed this literature. We found 3 themes describing the prescriptions given to rural educators: (a) mathematics education in rural schools needs to be fixed; (b) good things happen in some rural schools; and (c) fixing mathematics instruction requires certain practices. These practices include providing challenging curriculum, undertaking professional development efforts, making use of distance-learning options, and engaging local support. In general, the prescriptions given in this literature loosely reflect conventional wisdom in their support of the National Council of Teachers of Mathematics standards and the exigencies of the various state-level accountability schemes. The nonresearch literature only rarely tied its prescriptions to any relevant empirical research (either general or rurally focused). In an extended discussion, we critique the influence of deficiency theory on the themes evident in this literature. We conclude that a strong need for a rurally focused empirical work exists and recommend that it be informed by a critical reading of mathematics education practice in rural places. Issues surrounding the rural lifeworld, especially in the context of globalization, would have much to contribute toward the development of such a literature.

This article is a critical review of the existing literature in rural mathematics education. The peculiarity of this literature is that it does not comprise, nor is it based on, empirical research about rural mathematics education. Instead, this literature takes understandings and commitments prevalent in mathematics education generally and, through logic and rhetoric, translates or interprets them for professional audiences working in rural schools. In short, we find that the general is applied to the particular without a particular empirical grounding.

By "rhetorical" we do not mean nonsubstantive, inconsequential, dismissive, illogical, or devious in attempts to persuade. Logic and rhetoric were combined in a single subject domain in the classical curriculum, with "rhetoric" referring to the persuasive use of discourse. That is the sense in which we use this term. Rhetoric is a necessary practice for all those who attempt to use language for public purposes. That a literature is "rhetorical" does not automatically, or even necessarily, render it inapt. Quite the opposite: Good rhetoric renders language very apt. The aptness can be questioned, and that is what this review intends.

This literature, we claim, is largely devoted to persuasion, and persuasion, as the great English novelist Jane Austen understood (in a novel with that title), is a slippery slope. According to Austen, a good warrant—composed of logic and evidence, and argued by oneself—is the best persuasion. We agree; this is why we value reading and writing and thinking—and research.

We are, therefore, concerned with the implications of a questionable empirical grounding in and for this literature, and our critique will center on the lack of engagement in most of this literature—with several notable exceptions—with the logic of rural life as well as the facts of rural life.

Research and Rhetoric

At issue here is what research is, who may do it, the circumstances under which it may be done, and—most importantly for this discussion—what research does after it is done. Where, in particular, does persuasion come in?

The persuasion turns on questions of what is to be done—on some cadre's recommendations for decent prac-

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tice, based on that cadre's understanding of the purposes of education. One common view is that educational research exists not only to inform practice but actually to improve it. Many readers may find that this view recommends itself unexceptionally—improvement is the obvious point of educational research.

But how research ought to fulfill this mission is not clear. Merely completing a research project cannot on its own inform, much less improve, any educational practice; particular interpretations of the findings must be argued in the name of persuasion. These interpretations generally support particular claims about particular improvements.

Such interpretations are necessary because the world outside the site of research-production (i.e., laboratory, university, or scholar's pen) is unlikely to engage the difficult products of research without persuasion. Indeed, the extent to which practitioners and citizens actually can engage these difficult products is quite limited. Instead of directly engaging the products of research, they more likely will be persuaded to attend to the findings of research through one or another interpretations of them—and this method of persuasion (quite different from Austen's approach) is the typical form of persuasion.

In these interpretations, such findings will be most commonly presented without the strictures, caveats, limitations, and other ambiguities and contingencies that prevailed during their creation. Indeed, "the findings of research" is a phrase always to be footnoted, "buyer beware." Great policy missteps have been founded on slipshod interpretations of the findings of brain research, small-schools research, reading research, and, perhaps, mathematics education research as well. The interpretation of research findings is an art form that is little appreciated even among researchers (Bruner, 1996).

The State of Empirical Work in Rural Mathematics Education

Scholars have only recently begun to empirically investigate mathematics education in rural schools, with the advent in 2001 of the Center with which the authors are associated: the Appalachian Collaborative Center for Learning, Assessment, and Instruction Mathematics (ACCLAIM). A review of the ERIC database and of Dissertation Abstracts International from 1985 to 2001 disclosed fewer than 25 studies indexed with the relevant descriptors and identified (in ERIC) as "document type 143—research reports."[1] However, these studies:

- provided scant descriptions (if any) of the rural settings;
- conceptualized questions without referencing rural context in any way;
- embedded no rural issues, questions, or methods;
- reported no findings connected to the rural settings of the studies; and
- drew no conclusions relevant to rural practice, policy, or research.

The findings, implications, and recommendations of this empirical work all concerned mathematics education generally without noting rural context, issues, or dilemmas. Nearly all the studies had been identified as "rural" simply because rural places had supplied the subjects for investigating a question of general interest in mathematics education. This fact will surprise no one who conducts research in rural education.

In short, as ACCLAIM began its work, no specifically relevant empirical literature could be said to exist that addressed rural mathematics education. ACCLAIM was quite clearly broaching a new realm of empirical work. Since 2001, ACCLAIM has begun to publish mathematics education studies that do pose rurally relevant questions and do develop rurally relevant findings and implications. ACCLAIM has, at the date of this writing, posted 22 working papers on its website, of which 6 can be cataloged as empirical research. The other 16 constitute literature reviews, theoretical formulations, or background essays. It is not our intention here to review these works, much less to position them as the proper empirical foundation for rural mathematics education.

The new attention to empirical issues in rural mathematics education, according to some observers, is warranted because rural locations entail variations in lifeways, cultures, and political economies that sharply distinguish the rural experience from the suburban and urban experiences. These differences turn on the historic change from a national political economy centered on agriculture (through approximately 1920) to an industrial political economy (predominating by 1950) to the emerging postindustrial economy (DeYoung, 1995, 2003). Moreover, schooling in rural locations is not a marginal enterprise: 30.3% of students, 40.9% of schools, and 63.7% of districts are located in rural areas or small towns (Hoffman, 2002; National Center for Education Statistics, 2002).

Will this new field of research produce works that will eventually turn out to improve practice? A large debate about the utility of educational research persists, and we cannot address that debate here. Our own view is that a body of research needs to mature as the active project of a scholarly community working with practitioners and lo-

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[1]ERIC catalogs three main sorts of "reports": evaluation reports, research reports, and descriptive reports. The categories are not mutually exclusive. Research reports need not appear in journals; journal-published research reports would be cataloged with an additional code. On inspection some items cataloged as both "research reports" and "evaluation reports" would more properly be cataloged as evaluation reports only.

cal community members, before it can hope to exert much influence in rural schools and communities. ACCLAIM is attempting to cultivate this capacity through its doctoral program, its research, and its engagement in schools. It is very much a work in progress; it will likely produce some results and some disappointments—but its prospects are not the subject of this study.

The Problematic of Prescriptions for Rural Mathematics Education

Readers must recognize that any conception of "rural mathematics education" seems doubtful to mathematics educators in general. The reasons are easily enumerated: (a) good teaching is believed to be much the same everywhere; (b) of all curricular content, mathematics is thought most to transcend issues of place; and (c) student learning is regarded as the natural focus of effort (and not the demands of context, nor, least of all, a role in supporting the continued existence of rural communities). This view is well documented in education (e.g., Arons, 1997; DeYoung, 1995) and it is thoroughly lodged in mathematics education (e.g., Hackenberg & Mewborn, 2004; Moses & Cobb, 2001). The "ruralness" of mathematics education is bound to seem discordant to many mathematics teachers and to many mathematics teacher educators.

As some observers have noted (Arons, 1997; Silver & DeYoung, 1986), these differences point to overarching conflicts over the ultimate aims of education. Based on such understandings, this article examines the comparatively extensive nonresearch literature within mathematics education that has been specifically directed at rural educators.

Mathematics education enjoys a remarkable position in the culture and in the school curriculum as (a) a difficult subject that frightens students and the public alike as it simultaneously compels respect (Smith, 2002), (b) a required course sequence in all high schools and colleges, and (c) one that, with natural science, has figured for half a century as a national security issue (Barlage, 1982). In prominent policy documents mathematics, along with natural science, is commonly affirmed as the knowledge of most worth, and funding for its efforts is impressive.

However, there is ample cause for skepticism about the place of mathematics in the culture at large and in schooling in particular. Briefly, the reasons entail the dubious role of mathematics as cultural capital[2] (e.g., Bourdieu, 1997; Moses & Cobb, 2001), the global damage arguably done by mathematics in the hands of multinational corporations[3] (Apple, 1992), and the arguably equal importance of other knowledge (Smith, 2002). Whether or not such objections are accepted, the prevailing lack of skepticism means that mathematics education researchers have never questioned the prescriptions given to rural mathematics educators (Silver, 2003). Continued skepticism, however, allows us to interrogate the accumulated rhetorical literature about mathematics education addressed to rural school leaders and educators from the mathematics education community. Our assessment is useful partly as a baseline for ACCLAIM's efforts, but more importantly as a description of current expectations for rural schools.

Methods

We focused our search on recent literature covering a 10-year period (1993-2002) and not cataloged by ERIC as being a "research report." This choice intentionally positions this review before the advent of published work from ACCLAIM. The literature base is comparatively meager, and ACCLAIM's nearly 30 publications that are not empirical studies (10 occasional papers and 16 nonempirical working papers) would have distorted the analysis and introduced too directly our own enacted commitments into the literature we sought to characterize. It would also have ruined the effort to establish a baseline assessment of the rhetorical literature prior to the advent of ACCLAIM.

Literature identification. We consulted the Thesaurus of ERIC Descriptors to create a search strategy sufficient to cover the available literature in mathematics education pertinent to rural areas. The actual search strategy follows:

> Set #1: *mathematics curriculum or mathematics education or mathematics achievement or mathematics instruction or mathematics activities or mathematics assessment or mathematics materials* (11,347 items)
>
> Set #2: *rural education or rural areas or rural urban differences or rural schools or rural youth* (5,701 items)

We limited the intersection of these two sets to exclude records indexed with the descriptors *foreign countries* or *developing nations* and to exclude records cataloged as "research reports" (i.e., document type 143). That is, we wanted to focus on literature relevant to the 50 U.S. states and to exclude works cataloged as research. As noted previously, we call this the "rhetorical literature" because it is intended to persuade readers about practical matters.

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[2]For instance, as "gatekeeper" to further study—particularly when the gatekeeping function is not substantively connected as prerequisite knowledge. Algebra plays this role in high school, and calculus plays the role in undergraduate and graduate programs.

[3]The practice of mathematics and science figures prominently in the process of capital accumulation in multinational firms. In a sense, the practice of mathematics and science is owned by these companies, and this is particularly the case when proprietary knowledge is involved.

The justification for focusing on this nonresearch literature entails a two-step logic. First, previous work indicates that the body of research substantively engaging rural mathematics education is small and inadequate. The best work focuses on rural mathematics achievement, and that very small literature (three studies) has recently been described and set in historical and theoretical context (Howley & Gunn, 2003). Second, given the absence of particular research in this field and in light of the recently completed reform work of the Rural Systemic Initiatives, examination of this literature for its themes—and, quite likely, its recommendations for practice—becomes particularly interesting.

Certainly, this is a peculiar literature to examine in a research context. However, if research in this field is to appear and if it is to make a meaningful and helpful contribution to practice, the need to characterize currently prevalent thinking seems evident. The prevailing conception of issues of practice influences not only practice, but future research efforts. A critical reading of this literature seems crucial for the future of the emerging field.

Literature selection. This search strategy yielded a final set of 58 ERIC documents prospectively available for analysis for the time period under consideration. Thirty records were cataloged as "project descriptions" (document type 141), 11 were cataloged as "evaluation reports" (document type 142), 9 as "information analyses" (document type 071 or 072), 7 as "guides" (document types 052 or 055), and 1 as a "viewpoint" (document type 120).

ERIC cataloging, as one of the authors knows from having directed an ERIC clearinghouse, is more art than science. Furthermore, works are usually cataloged with multiple document types. Particularly problematic are collections (e.g., conference proceedings, anthologies). There were two collections in this set; within one of the collections (a rural education anthology), only one item was relevant (Johnson, 1992) and was separately retrieved. The other collection was a proceedings document from the NSF conference, *Building the System*, and it yielded seven documents that were subsequently analyzed separately.

Inspection of the documents revealed six as nonsubstantive in that they contained only minor relevance to rural education or to mathematics education. In addition, four works were principally research efforts not identified as such by the ERIC cataloging—and two of these were also represented by duplicate records in the ERIC database. Two records related to early reports of the UCAN Rural Systemic Initiative were dropped because they presented the same information that appeared in two later reports (Llamas, 1999a, 1999b) that were analyzed. Finally, one item was dropped because it was a videotape and one because of an indexing error (it had not been indexed as pertaining to schooling in a foreign nation, even though it did).

In short, from the 58 original documents, 8 additional documents were discovered, 16 were eliminated as indicated in the preceding paragraph, and 2 were the collections from which the 8 additional documents were taken. The relevant adjustments yielded a pool of 48 nonresearch works for analysis (these are listed in the Appendix).

Analysis. To analyze the themes embedded in this diverse literature, we first prepared the data set by abstracting major points from each document, developing a database of annotated bibliography entries. We used consistent terminology throughout the process of building the annotated bibliography in anticipation of the need to perform multiple electronic searches of the information. Because the database enabled the researchers to identify the relevant points made in each of the documents, the process represented our method of data coding.

Next, using the recurrent terminology from the annotated bibliography in our search, we tallied frequencies of the occurrence of each term and used the highest frequencies to narrow our search for possible categories of related terms and to identify documents suited to illustrate each category. In an iterative process, we re-read the documents in overlapping clusters representing each of the high frequency terms (i.e., categories) and developed statements of possible themes that would make sense of the ideas embedded in related categories. We then reread the articles to see which set of thematic statements fit best with the ideas presented in the body of literature as a whole. Finally, to make certain that the themes we selected characterized the literature, we reread each document and developed a chart to show whether one or more of the themes was represented (either explicitly or by implication). Tallies derived from this procedure were used to calculate the percentages provided in the discussion of our results.

Results

Three integrated themes emerged from this analysis: (a) Mathematics education in rural schools needs to be fixed, (b) good things happen in some rural schools, and (c) fixing mathematics instruction relies on certain practices. The following discussion describes each of these themes, including two or more sub-themes in each case.

First Theme: Mathematics Education in Rural Schools Needs to be Fixed

Perhaps the most prominent theme revealed in the rhetorical literature was the focus on deficiencies in mathematics education in many rural schools. This theme was stated explicitly in 54% of the documents and was strongly implied in another 35%. Commentators provided a variety of explanations for these deficiencies, most of which pointed to the poverty, isolation, and backwardness of rural schools and the communities in which they are located. For example, Royster (1994) explained:

> Systemically reforming mathematics, science, and technology education in rural schools in high poverty areas requires addressing critical barriers. The list of local barriers is extensive and includes lack of resources, low tax base, geographical and cultural isolation, low socioeconomic status, low value placed on education, low self-esteem perpetuated by a welfare system, low expectations for students' educational achievements due to parents' life experiences and regional values, dysfunctional families, lack of awareness of role of education in students' future, lack of role models and professionals in the community to provide community leadership, lack of awareness of how to obtain supplemental funding through grants in many cases, inadequate facilities to attract more talented teachers, insufficient staff development and distance to training sites, and in-service professional development often lacking in quality and content. (p. 70)

Other writers concentrated more on weaknesses in the curriculum, instructional methods, and professional development used in rural schools. For example, Harrison (1993, p. 10) asserted that the "traditional" textbook curriculum and instructional methods employed by rural educators have resulted in "unequal opportunities" for learning mathematics. According to Harrison, standards-based curriculum delivered in a cooperative environment increases students' understanding of mathematics.

Change rural curriculum from traditional to standards-based. From the perspective of some writers, rural schools have had problems with mathematics instruction for a long time, but only with the advent of state accountability mechanisms has the problem been viewed as sufficiently serious to warrant attention. For example, Smith (1999-2000) notes that

> low student performance in mathematics and science has long been a factor known by Appalachian educators and community leaders, but was not seen as a problem sufficient to cause disequilibrium. . . . State emphasis on accountability has changed the school system environment, escalating the visibility of school and district test data and attaching real consequences to low performing schools. Problems can no longer be ignored, and the system must respond to the disequilibrium. (p. 3)

Others have discussed the value of developing and implementing standards-based mathematics activities in rural schools (e.g., Childers & Howley, 1993; Howley & Boren, 1993; Madden, Slavin, & Simons, 1997). Van Boening (1999), for instance, argued that students learn "more mathematics better in this environment" (p. 32), become better writers and problem solvers than in the past, and learn to think mathematically. The repetitive review incorporated into traditional curricular materials is no longer needed, according to Van Boening.

Change pedagogy from "traditional" to constructivist. Schifter (1996) noted that "traditional" beliefs about learning dominate most classrooms: "that people acquire concepts by receiving information from other people who know more; that, if students listen to what their teachers say, they will learn what their teachers say, they will know; and that the presence of other students is incidental to learning" (p. 494). "Conventional wisdom" (Knapp [1995] as cited in Campbell & Silver, 1999, p. 11) assumes that students are deficient and that the curriculum should follow a fixed sequence of lessons emphasizing practice on basic through more advanced skills, never addressing reasoning or problem solving.

According to Schifter (1996), the salient difference between such traditional and constructivist environments is that, in the traditional mathematics classroom, the teacher tells the class exactly how to perform a task, but in the constructivist classroom the teacher poses a problem and expects students to develop and argue a solution. Students engage in spontaneous, unscripted, teacher-guided discussions about their perplexities and discoveries.

Second Theme: Good Things Happen in Some Rural Schools

Counterbalancing the deficit model apparent in the most prominent theme, a second somewhat less commonly evidenced theme is organized around assertions that good things happen in some rural schools. Texts representing this theme assert strengths associated with rural schools that can support teachers and students in the pursuit of mathematical understanding. The theme was explicitly represented in 10% of the documents and implied in another 13%.

Strengths in some rural schools. Acknowledging that studies have often focused on reputed deficiencies (or challenges) of rural schools and communities, Royster (1994) noted that such views are not uniformly held by those living in rural areas. Local people believe there are strengths in rural schools, where opportunity to learn is allegedly supported by stronger community ties and schools of smaller size. "They also feel their students are better improvisers and have learned to do more with less" (Royster, 1994, p. 72). Salyer, Curran, and Thyfault (2002) asserted that more cohesive groups of parents, teachers, and community members constitute an advantage for rural educators. Baldwin (1998c, p. 12) reported the assertion of one principal working in an impoverished rural community: "Our children don't go to museums and factories. But we're trying to prepare them to cope with the world. We don't have much in terms of money . . . [or] technology. But we do have people who want to see change." Others have asserted that frugal habits permit

poorly funded rural schools to keep up with the mandates of the standards movement and improve accountability results (Breckon, 1997; Harrison, 1993; Murphy, 1994).

Connections for place-based mathematics pedagogy. Place-based pedagogy is thought by some writers to exploit the available strengths of rural life by drawing upon the human and material resources of rural communities. For example, Carter, Cohen, Keyes, Kusimo, and Lunsford (2000) and Barnhardt (1999, p. 10), suggest that curricula (including "standards-based" curricula) should be grounded in local culture as the "main catalyst" for improving the formal education system of rural schools. According to Hill, Kawagley, and Barnhardt (2000), a place-based approach that

> foster[s] connectivity and complementarity between the formal education system and the indigenous communities being served in rural Alaska . . . continues to produce an increase in student achievement scores, a decrease in the dropout rate, an increase in the number of rural students attending college, and an increase in the number of Native students choosing to pursue studies in fields of science, math and engineering. (p. 13)

Llamas (1999a) also described a similar approach involving the use of curriculum units designed by teachers and students. These units reportedly gave students opportunities to identify and solve problems relevant to their rural community.

In recommendations focusing on place-based pedagogy, connections to the business community figure prominently. Carter and colleagues (1999), Baldwin (1998b), and Enterprise State Junior College and MacArthur State Technical College (1992a, 1992b) all recommend the involvement of local business people in the development and delivery of locally responsive curricula.

Certain Practices Must Be Adopted to Fix Rural Mathematics Education

This literature prescribed a familiar set of practices to fix mathematics instruction in rural schools:

1. building capacity of teachers and administrators through long-term professional development;
2. developing challenging mathematics curriculum;
3. employing available distance-learning technologies to equalize access to information, resources, and materials; and
4. engaging the local area through sustained community involvement.

Perhaps surprisingly, every one of the documents examined asserted this theme explicitly. The most common recommendations were for standards-based curriculum (recommended in 75% of the documents) and professional development (recommended in 71% of the documents). More surprising was the comparative rarity of the distance education recommendation (17% of the documents). Community engagement was advised in 40% of the documents.

Professional development. One of the most persistent recommendations in this literature concerned the need to effect reform in mathematics instruction through improvement of rural teachers' knowledge and skills (e.g., Batey & Hart-Landsberg, 1993; Cauley, Van de Walle, & Hoyt, 1993). For instance, Cauley et al. claimed that rural teachers are in "serious need" of support and professional development to grasp what the mathematics standards are "actually saying" (p. 40).

According to much of this literature, regional consortia should be used for demonstrating "best" practices, coaching for the improvement of teaching, and supporting the development of standards-based curricula. For example, Hoffman (1999, p. 30) claimed that the Challenger Learning Center of eastern Kentucky fostered the "wholesale reinvigoration of [mathematics and science] teachers."

Other writers focused on the importance of promoting coordinated efforts among the various entities (e.g., local curriculum developers, teacher education programs) that provide professional development to rural teachers (Schatzman, 1995). Taking yet a different tack, some commentators extolled the benefits for rural schools of grassroots approaches such as peer-coaching (e.g., Baldwin, 1998a).

Challenging curriculum. Many sources insisted that rural curriculum and instruction should be "more challenging." For instance, Hill et al. (2000) asserted that current and future employment conditions required more knowledge about mathematics, including algebra, geometry, and calculus. This claim represents one of the rare instances in this literature of a connection to actual research. Campbell and Silver (1999), citing empirical work and also asserting this need, claimed that rural high school students were less likely to be enrolled in advanced algebra, analytic geometry, trigonometry, or calculus than suburban students. One source (University of Alaska, 1998, p. 19) argued the connection between community and challenging curricula: "As students see greater relevance for linking the study of math and science to the needs of their communities, their level of expressed interest has increased" such that several Alaskan districts had developed higher level course offerings. And one rural teacher's report of her own practice in a heterogeneously grouped mathematics classroom (Harrison, 1993) identified several practices thought to contribute to a challenging program of study: high heterogeneous-group standards, flexible within-class grouping, improved whole

class instruction, varied use of class time, and varied structures to support revising assignments.

Distance-learning technologies. Some sources pointed to improvement in rural mathematics education that might result from the use of various distance-learning technologies. This recommendation tended to accompany descriptions or evaluations of rural telecommunication projects (e.g., Baldwin, 1998b; Barker & Dickson, 1993; Schatzman, 1995; Schmidt, Sullivan, & Hardy, 1994). Harmon and Blanton (1997) described the Internet as an "equitable link" (p. 7) for rural schools to access curriculum resources, professional development, sharing of ideas among colleagues, and expert assistance.

According to Rogan (1996), use of the Internet to augment instruction in rural classrooms improved mathematics learning for several reasons. First, it reportedly affected how lessons were taught: "A major difference in the way in which lessons are taught appears to be the use of resources not previously available. . . . Teachers . . . cited the data collected and distributed by other schools as an important resource" (p. 23). Second, the Internet reportedly worked to counter the professional isolation often cited as a difficulty encountered by teachers in rural schools: "A second emerging theme describes personal growth, or, more specifically, the ability to overcome isolation and to incorporate more diversity in lessons taught" (p. 24). Finally, the use of Internet resources reportedly contributed to changes in teaching practice. According to Rogan, "some teachers reported a major change taking place in their teaching style. Lessons were becoming more student-centered and less teacher directed" (p. 24).

Community involvement. The final prominently recommended practice associated with this theme concerned the purported benefits to schools of engaging community members in decision-making about mathematics curriculum and instruction. According to Smith (1999-2000, p. 3), for example, "community involvement and stakeholder support [are] necessary to sustain long-term educational improvements."

As a part of rural systemic reform, several consortia promoted community involvement through partnerships with families and communities and among groups of schools (Appalachian Regional Commission, Appalachia Educational Lab, Kentucky Science and Education Council, 1998; Barnhardt, 1999; Llamas, 1999a; Smith, 1999-2000; University of Alaska, 1998). Connections with a somewhat broader set of community partners were recommended as well. For instance, Duval and Mark (1994) and Hoffman (1993) for instance discussed the benefits for rural schools of forging connections with institutions of higher education.

Summary of findings. We identified three themes describing the prescriptions given to rural mathematics educators. The first theme is "Mathematics education in rural schools needs to be fixed." This theme was stated explicitly or implied in 89% of the documents. Curriculum and pedagogy were both characterized in this literature as objects of needed change: Standards-based curriculum change was advised, as was a move from "traditional" to constructivist pedagogy. The second theme is "Good things happen in some rural schools," explicitly stated or implied in 23% of the documents. On one hand, the good was seen as (a) comprising local strengths having little to do with schooling, such as frugality or ability to improvise, and on the other hand, as (b) concerning curriculum and pedagogy that exhibited connections to local communities. The third theme is "Fixing mathematics instruction requires certain practices," and this theme was explicitly stated in all documents. These practices notably included (a) providing challenging curriculum, (b) undertaking professional development efforts, (c) making use of distance-learning options, and (d) engaging local support.

Critical Discussion

In this section we are at some pains to interpret the themes, as a whole, in a critical framework. The critique is particularly necessary if this fledgling research field is to engage what many rural educators view as central to rural education: rural community life and purposes.

The good news is that this rhetorical literature shows evidence of such engagement. The second theme acknowledges some strengths in rural communities, and at least one group in Alaska is actively working to sustain rural communities through the sort of mathematics and science education provided to Alaskan children and youth.

The bad news is that the recommendations in this literature seem much more strongly to encourage rural practitioners to embrace general conclusions of current thinking about reform in mathematics education (i.e., deploying challenging curriculum, standards, constructivist notions of learning, professional development, and use of technology) than to imagine the development of a rural sort of mathematics education. Whatever else it might do or be, the alternative project would engage rural community not merely on behalf of student success, but as a prospective field in which such success would be necessarily applied in rural communities. In other words, school mathematics in rural places would principally benefit those places and not principally other places as is now the case (Theobald, 1997). Engagement with this alternative project is limited to the two Native American Rural Systemic Initiative projects (e.g., Llamas, 1999a, Barnhardt, 1999), in which cultural prerogatives increasingly enjoy a prima facie, but still challenged, legitimacy.

In the critique that follows, we first establish, empirically, the absence of reasonable warrant to the claims made in the documents in this literature by examining the use of references in them. Second, we link this disengagement to an underlying perspective latent in this literature (deficiency

theory). Via that perspective, we then suggest that these failures serve an educational agenda that is arguably not healthy for rural communities, which we call the "cosmopolitan educational agenda." As noted previously, there are a few exceptions to this charge in the works examined.

Empirical Warrant and Citation Patterns

As noted earlier, the recommendations given in this literature rest on an apparently inadequate empirical base; and where rural issues are concerned, in any case, such a literature barely exists and has only recently appeared. Therefore, the applicable empirical base would be the generic one that might apply, for instance, to the national mathematics education standards as a whole or to mathematics instruction generally (Kilpatrick, Martin, & Schifter, 2003).

Our claim that the literature studied offers little empirical warrant for its claims is substantiated by an inspection of the reference lists included in the documents examined. More than half of these works (54%) provide no references at all. The lack of citations, moreover, is apparently not a function of the brevity of many of these works: The correlation between length and number of citations is not statistically significant ($r = .17$; works varied from 3 to 77 pages). Of course, this is not surprising in one sense: This body of work is not a peer-reviewed research literature. It is a decidedly professional literature, however, making broad and specific recommendations about professional practice. In this sense, then, the lack of warrant is quite surprising, and perhaps disturbing. Reading this literature, one can perhaps also appreciate the conservatives' call for evidence-based practice.

This measure of the engagement of these works with the professional literature suggests a tendency for those framing recommendations to rely on their own judgment or perhaps on a broad reading of empirical literature in mathematics education. To pursue this issue a little further, we therefore examined the reference lists of the works that included such lists (46% of the total), looking for the frequency with which empirical studies from peer-reviewed research journals had been cited. Fully 65% of these works—those with at least one reference cited—contained no citations to research in peer-reviewed journals.[4]

The rhetorical literature thus asks a wide audience to act on received wisdom, rather than to reflect on evidence in consideration of problematic issues—and thereby reach independent judgments. Is this uncommon or unreasonable? We do not think it uncommon, but we do find it unreasonable. If teachers and school leaders are to be thoughtful practitioners (practical intellectuals), then the field needs to cultivate their capacity to assess evidence and to think independently. This is surely a logical position to take in a constructivist frame of reference (e.g., Jacobsen, Clifford, & Friesen, 2002).

This familiar tendency has particularly disturbing implications in the case of mathematics education for rural places, as we consider next. Not only is the rhetorical literature inattentive to empirical findings, it also tends to construct the rural circumstance as deficient.

The Influence of Deficiency Theory

Much of the rhetorical literature is concerned with rural poverty, and practical work with impoverished populations often starts with the presumption that poverty embeds deficiency. As noted, there are a few remarkable exceptions, especially Barnhardt, 1999; Hill et al., 2000; and University of Alaska, 1998. In fact, the perspectives of deficiency theory are so common, and fit so neatly with professional tendencies in education, that many educators remain unaware of the pitfalls. A brief background, therefore, may be helpful to readers.

Deficit theory explains poverty, particularly urban poverty, as the creation of those who have been impoverished. The urbanizing poor, on this view, perpetuate their poverty from one generation to the next via a culture of poverty, a term introduced by anthropologist Oscar Lewis (1959). Some observers consider this explanation to "blame the victim." Still others object to the construction of the poor as victims. Whatever the objection, deficit theory rules out the possibility that impoverishment is caused by something other than the poor themselves. Of course, such a theory also constructs poverty as an undoubted problem; the possibility that virtue and poverty might sometimes coincide is not entertained—for instance, vows of poverty, contentment with modest means, and, more socially than individually, rejection of greedy accumulation as a cultural project.

In deficit theory, formal education is seen to be the most effective means by which individual poor people might be snatched from an inadequate life. "Education is the way out" is a mantra for many educators, including many who have come from impoverished backgrounds. Ruby Payne is lucratively promoting deficit theory in schools across the nation, including many rural schools, on just these terms. Her formula is that poor children need to simulate middle class cultural norms in order to succeed in school and life (Payne, 1998).

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[4]Three works contained the maximum number of such citations (six citations to peer-reviewed research studies): Campbell & Silver (1999); Harmon & Blanton (1997); and Madden et al. (1997). The two works in this literature co-authored by the first author of the present study (Childers & Howley, 1993; Howley & Boren, 1993) also included no connections to the peer-reviewed empirical literature. Of some interest, perhaps, is the finding that the number of peer-reviewed research citations in a reference list correlated strongly and significantly with the number of citations overall ($r = .74$, $p < .001$). That is, the tendency to use citations was strongly associated with the tendency to cite empirical research.

The works reviewed, with few exceptions, embrace deficiency rather heartily. Danek, Calbret, and Chubin (1994, p. 52), for instance, maintain that

> because rural schools are embedded in communities and local economies, their failure reflects the conditions of the environment. The environment is often gripped by disadvantages. Many minority [sic] male dropouts end up in jail, while many of their female counterparts become young mothers. It is not uncommon for the child of a 14-year-old eighth-grade dropout to enter kindergarten with minimal preschool educational experiences before her mother reaches 20 years old.

The difficulty with this explanation for poverty is that it tends, at least as practiced in education, to banish competing, possibly stronger explanations for poverty, and with their banishment, sidelines more interesting constructions of the purposes of education. The stronger explanations for poverty include, most notably, economic theories (e.g., class conflict, structural changes in markets, urbanization, globalization). But the alternatives also include free will (personal choice), cultural legitimacy and competence (e.g., many local cultures are vibrant, despite their divergence from middle-class North American lifeways), and religion (e.g., the Amish remain poor by North American standards because of their view of God's will). Among the more interesting educational purposes, one might include self-actualization and liberation (e.g., Moses & Cobb, 2001), as well as the quest for an ethical life and for thoughtful action (e.g., Hill et al., 2000), for intellectual growth and cultural understanding (Stigler & Hiebert, 1999), and for community in the ideal and in the actual (e.g., Haas & Nachtigal, 1998).

Fulfilling the Cosmopolitan Educational Agenda

This brief overview of deficiency theory includes its rural connections in order to suggest the links, argued in the following paragraphs, between deficiency theories in education and a cosmopolitan educational agenda.

To what do we refer with this phrase? What we call "the cosmopolitan educational agenda" has been characterized by many other writers (DeYoung, 1995; Gruenewald, 2003; Theobald & Alsmeyer, 1993). Whatever it is called, it concerns the separation of people from place, in the name of creating a fluid workforce highly skilled in the "new knowledge" presumed to underwrite economic activity in the decades to come. The emphasis is on individual success to the detriment of the well-being of particular communities and to the project of community itself. We have appropriated the term "cosmopolitan" from Raymond Williams (1973, 1989) in appreciation of the cultural and economic importance of what Williams has called "the World City."

In Williams's work, the World City is the cultural and economic institution that enforces alienation, high modernism, and placelessness as universal values. Economic arrangements in the marketplace and cultural arrangements in the media—and in education—reinforce the prerogatives of the World City (see Johnson & Howley [2000] for an extended consideration of the implications of Williams's work for rural education in North America). In the view of many rural educators, the prerogatives are not working well for rural places (see Kannapel & Deyoung, 1999). Observing this dysfunction during his lifetime led Williams (1989) to call for action to reclaim projects abandoned during the twentieth century—in particular, the projects of community, local cultural creations, and rural lifeways. These are indeed the sorts of projects identified by rural educators as needed in rural places. Kannapel and DeYoung observe that

> the Rural School Problem today . . . is that rural schools have endured 100 years of assault from outside reformers in search of the "one best system" and that this assault continues to this day. Not only are rural schools faced with trying to piece together and capitalize on the remnants of their remaining uniqueness, but they must do so under a barrage of ongoing reforms that seek to integrate rural schools into a national system of schooling. At issue is the complex question of whom the schools should serve—the local community, the larger society, or some combination of both? (p. 70)

In short, the prescriptions for rural mathematics education can be examined in order to determine the extent to which they attend to life circumstances that prevail in rural places—including those features of the lifeworld that rural people prize. Such work is important because the lifeworlds inhabited by rural people differ sharply from those experienced by the residents of suburbs and cities, and such circumstances are known to exert profound influences on schooling (Haas & Nachtigal, 1998). Representing the exceptions in this literature, Hill et al. (2000) do take up this challenge. They assert,

> The whole thrust of the [Alaska Rural Systemic Initiative] has been to build bridges between the vastly different worlds the students are caught between, so when they come to school they don't have to deny who they are, but rather can build on the knowledge, traditions, world view, and ways of knowing they bring with them. Then the western knowledge and ways of knowing (as reflected in the study of math and science, for example) can be learned in a value-added way, and not detract from what they and their ancestors already know. (p. 22)

With the notable exception of documents from the Alaska Rural Systemic Initiative (e.g., Barnhardt, 1999; Hill et al., 2000; University of Alaska, 1998), most of the documents represented here do not take exception with the view that rural lifeways embed serious impediments to good education. The more generous and inclusive perspective—that curriculum and instruction ought to be supportive of rural versions of the "good life"—is an idea seldom entertained in this literature.

The construction of a future for rural youth perhaps constitutes the most poignant site for the ongoing contest between local and professional versions of the good life. For many rural families, adult life within the community represents the best possible future for young people. Professional educators, by contrast, typically maintain the view that success in the wider world is preferable. As Campbell and Silver (1999, p. 16) aptly note, "schooling that promotes individual achievement as necessary for economic success seems in many cases to undercut the importance of a sense of place and the kinship bonds of rural families."

Moreover, mathematics education supports this apparent subversion of rural community in an instrumental way, primarily because it stands as gatekeeper to tertiary education. And in the conventional wisdom, tertiary education represents the most likely route to economic—and, therefore, life—success. Indeed, economic difficulties confronting many rural communities seem to reinforce the view that young adults have no other reasonable option than to abandon the rural communities in which they grew up. Johnson (1992, p. 134), like others in this literature, accepts this proposition, observing that students from rural areas are "being forced to leave their rural environments, learn an entirely new set of job-related skills, and compete on a national rather than local basis." The statement serves, in this case as in so many others, both as a prompt for educators to embrace the cosmopolitan agenda and as a way to distract them from consideration of alternatives to it. Before turning to those alternatives, our discussion first interprets the need for decent mathematics education in light of the role of local influence.

Decent Mathematics Education and Local Construction

The shortcomings of mathematics education have been suggested quite strongly (Ma, 1999; Smith, 2002; Stigler & Hiebert, 1999) and with ample evidence. In particular, Stigler and Hiebert note that American instruction in mathematics is grounded in definitions, rules, and computation, whereas instruction in other nations tends to ground instruction more in concepts and understanding. Heaton (2000, p. 2) characterizes the typical American practice as follows: "Whether I was the learner or the teacher, the routine was the same: memorizing rules and procedures, computing problems in silence, and checking answers with the teacher's guide."

If Frank Smith (2002) is right—the work of mathematics concerns the relationships between numbers—then the concepts that characterize those relationships become the focus of instruction. If this is the case, then the progressive mathematics educators and the reformers (most prominently represented by the National Council of Teachers of Mathematics) have a relevant point: Decent instruction in school mathematics should more strongly engage the project of mathematical understanding. The Council, of course, has published a series of statements that amount to "national standards" for school mathematics (e.g., NCTM, 1989, 2000).

The application of such standards remains problematic, however, and must necessarily remain so in the view of some scholars (e.g., Tyack & Cuban, 1995). Why? First, the American conception of reform itself remains dubious. According to Stigler and Hiebert's (1999) account of Japanese "reform," the improvement of mathematics teaching and learning is not achieved there by self-conscious and inconstant reformism, but by a steady grassroots professional development, with teachers playing the leading role. In contrast, the American route to improvement is inconstant, misdirected, and predictably ineffectual (Stigler & Hiebert).

Second, the history of reform efforts in the U.S. shows a massive record of incompletion and abandonment, with perpetually disappointing results (Gibboney, 1994; Tyack & Cuban, 1995). The staying power of the NCTM standards is not merely at risk; opposition has been strong and vocal from the beginning (e.g., Steen, 1990).

Third, struggle over pedagogy and curriculum is inevitable (e.g., Arons, 1997; Kliebard, 1986). Indeed, for some, such contest is not only inevitable, it is essential to the sustainability of American democracy. Arons, for instance, argues that attempts to impose a single curriculum—a single set of standards—constitute an unconstitutional and dangerous imposition of official knowledge (see also Apple, 2000).[5]

Rural educators and allied cultural workers (e.g., educational researchers, evaluators, and developers) can take up alternatives to a straightforward imposition of national standards onto rural schools and communities. In fact, the work of the Alaska Rural Systemic Initiative might be read as a prominent demonstration that such negotiation is intellectually and culturally productive. We conclude this section

[5]The phrase "official knowledge" refers to doctrines or beliefs imposed by law or regulation on public schooling. The phrase has constitutional resonance relating to the exercise of individual conscience, because of its 1943 use in *West Virginia v. Barnette*, which ruled that requiring public-school students to pledge their allegiance to the flag violated the U.S. Constitution. Observers like Arons (1997) and Apple (1992) view the adoption of state and national standards as attempts by the State (and, with Apple in particular, business) to circumvent or disable independent thought.

with a consideration of alternatives to the cosmopolitan agenda or to the rote application of national standards.

Alternative Themes

Although they receive scant attention in the literature we have analyzed here, three other perspectives may promote a more harmonious relationship between mathematics education and rural life than is possible from the vantage of the cosmopolitan agenda: (a) place-based pedagogy, (b) acceptability of extant practice, and (c) local choice in emphasizing mathematics learning over other learning.

"Place-based pedagogy" is most often presented in the literature examined simply as a palatable way to "ruralize" standards-based mathematics. In this formulation, local knowledge is drawn upon as a method for grounding students' learning in familiar places and customs. However, the ultimate purpose of these linkages is to harness the power of place in service of cosmopolitan ends (see Williams, 1973, 1989).

This version of place-based education is a contested one, however. A stronger articulation of "place-based pedagogy" privileges both locally defined educational aims and locally grounded curriculum and instruction. The Alaska Rural Systemic Initiative provides the clearest example of this approach in the literature we reviewed. The purpose of the initiative is to "systematically document the indigenous knowledge systems of Alaska Native people and develop pedagogical practices that appropriately integrate indigenous knowledge and ways of knowing into all aspects of education" (Barnhardt, 1999, p. 9). Self-sufficiency of indigenous communities, rather than preparation of native youth for jobs in the cosmopolitan marketplace, is its ultimate aim.

A second perspective acknowledges the relative success of rural schools in promoting mathematics achievement and, as a consequence, construes the curriculum and instructional practices of most such schools as acceptable. Because (from this perspective) rural locale does not by itself imply deficiency, rural mathematics education need not be seen systematically to require improvement. Hence the traditional curricula and didactic practices adopted in many rural schools are—on this view—perfectly acceptable; and the rhetorical literature directed toward reforming those educational approaches is, in general, misdirected.

Finally, a perspective that may be especially difficult for mathematics educators to accept nevertheless provides another alternative to the cosmopolitan agenda. From this perspective, rural communities have the right to decide the extent to which mathematics represents valuable knowledge. Determinations about the utility of knowledge, then, come from rural understandings of what constitutes the good life, rather than from cosmopolitan or (what is much the same thing) professional conceptions. This perspective allows for the possibility that rural communities might refuse to devote much attention to mathematics education.[6]

Moreover, this unsettling perspective (unsettling, at least, to mathematics educators) need not be viewed as a refusal to accept a manifest benefit. A radical version of this point of view would argue that such refusals sometimes represent an informed political stance. For example, if school mathematics is used systematically to lure rural students away from their communities or to impose diminished identity constructions on rural children and youth, then resisting such education may indeed be in the best interest of families and communities.

Two Conclusions

Our analysis harbors two disturbing conclusions—one practical and one theoretical—for those interested in rural mathematics education. Practically speaking, the relative absence of concern in this literature for connections to empirical research ought to trouble thoughtful educators and policymakers. With a few exceptions (e.g., Campbell & Silver, 1998), the recommendations and prescriptions given exhibit no logically adequate connection to empirical studies—not to the generic mathematics education literature, not to rural education research in general, and certainly not to the extremely thin empirical literature on rural mathematics education. In fact, not one text noted the need for research about mathematics education specifically focused on the issues inherent in rural context.

The recommendations made seem to represent a default position: the need to implement standards-based "best practice" in rural schools and to address the varied state-level mandates to raise test scores. The best practices identified in the analysis (e.g., professional development, challenging curriculum, community engagement, and distance-learning technologies) are positioned in nearly every case to support the conventional wisdom of rural deficiency—without empirical support, theoretical depth, or much appreciation (with a few notable exceptions) of the problematic nature of decent practice (e.g., see Heaton, 2000). It is telling that all the documents recommended certain "best practices." This is a great success from one vantage (encouraging reforms widely), but a great failure from another (attending to local circumstances and purposes).

The second disturbing conclusion concerns the lack of theoretical depth in this literature, particularly with respect to ideas that have played some role in problematizing educational practices in other fields (see Walkerdine, 1988, for an example in mathematics education). Whereas ideas about social context, which tend to be associated with criti-

[6]We might not want to live in such a community, and we are not necessarily indicating our own preferences in formulating these alternatives.

cal theory and critical pedagogy, have had a pronounced influence on professional discussions about English education and social studies education, they have had almost no influence on discussions about mathematics education. A keyword search of the ERIC database using *mathematics* and *critical pedagogy* yielded a search set including only one document. A parallel search using *social studies* and *critical pedagogy* yielded a search set of 12. Furthermore, critical pedagogy is connected to concepts such as multicultural education that have influenced English and social studies education far more than mathematics education. Notable in some fields, for example, is a literature critiquing educational practices that treat certain groups as "other" by dismissing their rights to self-definition and self-determination. This lack can be attributed here, in part, to the evident influence of deficiency theory.

In our view, the fact that the rhetoric about rural mathematics education does tend to treat rural people as "other" demonstrates the need for a critical literature of mathematics education (see Gutstein, 2003, for a recent example of such work in mathematics education). Analyses of issues in the rural lifeworld—including empirical investigations—could contribute prominently to such a literature (Hackenberg & Mewborn, 2004). Moreover, local initiatives to develop versions of mathematics education that serve the interests of rural communities might form part of a wider effort to free mathematics itself from an unfortunate tendency to serve the cosmopolitan agenda of global economic competitiveness (see Walkerdine, 1998). Such wider effort would position mathematics itself as a potential source of meaning available to all social groups and mathematics education as a set of practices enabling individuals and communities to incorporate mathematics into the lifeways that already make sense to them.

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