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Community and Place in
Mathematics Instruction in
Selected Rural Schools



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The teaching of mathematics, which arguably is so abstract as to transcend place and community and even culture (according at least to a Platonic view of mathematics), will seem to some observers particularly ill-suited to instruction in place- or community- or culture-based approaches.

Nevertheless, current thinking in mathematics education, with its emphasis on the construction of meaning and the application of problem solving to “real-world” situations, might logically be interpreted as supporting these varied approaches to instruction. Because both rural education and math education scholars collaborated in conducting this study, the project did indeed have its eye as much on the *community purposes of mathematics instruction* as on the *mathematical purposes of community engagement*. The related complexities are legion—and, we find, interesting.



This report begins by stating the study questions quite simply (the simplicity is deceptive), then considering the significance of the study in a very wide context, and then, before turning to the reports of the seven sites studied, carefully distinguishing “place-based education” from its close, and valued, cousins. The beginning of the report, then, provides theoretical frameworks necessary for readers to understand the intentions and purposes of the study. The empirical work is objectively conducted on such a basis.

One point, it seems, needs to be made clear at the very outset. A life-long commitment of the two lead authors, and most of the co-authors, is to rural places. Hence, mathematics instruction that makes connections to rural places interests us (but we also understand mathematics as beautiful, useful, and interesting, just like our colleagues in mathematics education). In this light, although the two lead authors are recognized supporters of place-based education, they are not active promoters of it; they are neither directly engaged in establishing place-based education programs nor in improving existing ones. Though this report does perhaps end by championing some related ideas, it is selling no product. The team, and the study as designed and conducted, are, as will be seen, far more interested in the nature of the struggle to do the work described by interviewees than in making assertions about the value of particular ways of doing such work. Indeed, from the vantage of both scholars and struggling practitioners, the fact that anyone will do such work seems remarkable, even miraculous. The reasons for such an assessment will become clearer in the discussion that follows the statement of study questions.

Study Questions

The present study provides an analysis of rural place-based mathematics education in seven schools that reputedly had embraced this approach (the selected sites were among many that had been recommended by nationally known figures in place-based education and mathematics education; details are provided in a subsequent section). It addresses two broad research questions:

- 1 :: How do rural schools connect mathematics education to local communities and places?
- 2 :: What conditions enable and constrain their efforts?

In fact, the study was framed around the struggle to make these connections, rather than to identify “best practice” in this sort of work. A form of schooling conducted in the name of particular places, in fact, hardly lends itself to the development of a set of practices that would be best everywhere. Indeed, the lead authors regard the construct of best practice quite skeptically overall (see, e.g., Howley & Howley, 2007; Howley, Howley, & Burgess, 2006).

Significance of the Study

A substantial research base describes the long-term decline of rural communities in the U.S. and the troubling contribution of schooling to such decline (e.g., Carr & Kefalas, 2009; Corbett, 2007; Lyson, 2002; Theobald, 1997). How is it that the operation of schooling in rural places should so actively assist this devolution? The significance of the study lies in the difficult answer to this question, but with the engagement of mathematics education and community of central interest.

The issue of such engagement is particularly important to rural communities, in part, because of the long-continuing challenges to their very existence, an issue of commentary and concern since at least 1900 (Carr & Kefalas, 2009; DeYoung, 1995; Theobald, 1991). In mathematics education, however, evidence of the difficulty of making such connections, even in the otherwise effective reformist efforts, shows very little success. In Irving’s study of student evaluations of National Board Certified high school mathematics teachers (2004, Table 35, p. 224), negligible effect sizes were estimated for *involvement with family and community* ($d=.07$, nonsignificant) and *relating mathematics to the real world* ($d=.14$; $p<.01$). By comparison, the effect size of overall quality of the teaching of these teachers was much higher ($d=.41$; $p<.001$).¹

¹Hattie’s (2009) synthesis demonstrates that studies of nearly all innovations show positive effect sizes, with two important caveats. First, effect sizes of $.10 < d < .20$ harbor possible practical value depending on circumstances (e.g., some innovations with weak effect sizes can be easily adopted because they cost little or nothing). Second, Hattie’s discussions tend to treat innovations displaying effect sizes of $d < .10$ as not practically different from 0. A third caveat is probably in order, as well: variation exists around all effect-size averages. Further, not all effects reported by Hattie (2009) are derived from studies of innovations. Most usefully, perhaps, Hattie (2009) reports that year-to-year teacher effects on student achievement typically vary from $.20 < d < .40$, and he seems to adopt $d=.40$ as the hinge-point of effectiveness on this basis—that is, the effects obtained by a year of good to excellent ordinary teaching become the standard for judging effectiveness. (The average across 800 meta-analyses of effectiveness was also about $d=.40$). On this basis, at any rate, a durable challenge seems to prevail for the attempts of even good to excellent high school math teachers to connect mathematics curriculum with community and “the real world.”

Urban and Rural in the Doubtful Future

As the planet becomes increasingly urbanized, it does seem to many observers that the rural population can be “left behind” (cf. Yeller, 1967). Indeed, rural realities can be left so far behind as to be dismissed from consideration when national issues are at stake. After all, the common outlook on rural existence is that it is inherently backward (Herzog & Pittman, 1995). In recent decades rural writers observed that “rednecks” remain the only group in America that can still be demeaned publicly without reproach (e.g., Bageant, 2007; Goad, 1997; Herzog & Pittman, 1995). The aspersions are, in fact, politically correct, endemic and widespread outside of rural populations. Of course, rural populations—like black, Hispanic, and Indian populations—do learn of their reputed inferiority from the popular media, and like those others they struggle against embracing the bogus reputation (Bageant, 2007).

In fact, perhaps surprisingly, the *number* of Americans living in rural places has remained rather stable over the past century (U.S. Bureau of the Census, 2010b). The decline is proportional, not absolute, so that now approximately 80% of the U.S. population resides in metropolitan zones; and, as of the 2000 census, more than half live in metropolitan areas of more than a million persons (U.S. Bureau of the Census, 2000). The trend is global, and more than half the world’s population now lives in cities (United Nations, 2006).

The urbanized future of the planet, however, is far more problematic than once imagined. Daunting challenges loom larger for urban residence with each passing year: the carrying capacity of the planet has, moreover, been seriously overshot with the development of megacities; fossil fuel sources that power the economy of the megacity are in limited supply and the oil has begun its predicted global decline; industrial, fossil-fueled pollution is melting glaciers fast, already threatening the sustainability of some megacities. Global megacities of more than 15 million inhabitants have *already* become among the most squalid and dangerous habitations ever seen on earth according to some observers (e.g., Davis, 2009; Kunstler, 2005; Orr, 1995). What is the outlook? According to the United Nations (2006), world population will not stabilize until about 2100, at 10 billion, at which time over 90% of the global population is predicted to live in just such dangerous urban environments *outside* the currently affluent “first-world.”

The sustainability of urban life at the present scale and on the present economic basis is doubtful not only because of the extremes of poverty and dislocation entailed, but also because the industrial model on which urbanization rests so evidently threatens the durability of a planet capable of sustaining humanity. The logical implication is that if humans do not collectively act better and differently, catastrophe will overtake the species, just as it has already overtaken many other species (Davis, 2009). At present, of course, such evidence, argument, and projections might be regarded as but dire predictions. The threat, though, seems clear enough, even if the

exact future, as always, remains uncertain. Most discussions of such matters, perhaps because of the uncertainty, and perhaps because of the common disregard, ignore the future significance of sustainable rural places. How can what has been dismissed as insignificant prove significant again?

The Future Significance of Sustainable Rural Places

All of this is old news, in fact, even if the related implications for rural, rather than urban, places remain so little appreciated. One must ask why the position of rural places with respect to global-cosmopolitan tragedy should be so roundly ignored. Why? The answer is a matter of speculation, of course, rather than empirical research, at least so far, but the answer is arguably tied to the modernist view of attachment to rural place, which is regarded as decidedly backward.

By contrast, and quite understandably, continuing affection surrounds the “wonders of the modern world,” at least the wonders of the modern *developed world*: the automobile, the airplane, effective pharmaceuticals; and cheap energy, food, clothing, and shelter. Schooling secures perhaps less overt affection, but certainly more and more people seek as much formal credentiation as they or their nations can afford (Green, 1980). The modernist outlook is deeply inscribed in the institution of schooling, and the implication of this claim is that even in rural places, schooling functions consistently with the commitments of modernism (Scott, 1998; Theobald, 2009). Among these commitments is the view that attachment to rural place is an impediment to modern ways of living and to modern aspirations. On these terms, attachment to rural place, especially in those who continue actually to live in the rural places where they were born, symbolizes attachment to tradition and repudiation of the modernist project of perpetual change and personal reinvention. Rural place, in short, can easily be seen as the enemy of a cosmopolitan worldview that prizes multiculturalism, individualism, and personal ambition.

On one hand, people may not realize the extent to which the availability of these undoubted modernist goods may already be jeopardized, but on the other hand, they likely look to the systems that created such wonders to save the industrial system and the planet itself. Under such a scenario, rural places would persist as irrelevant and backward. Some of the observers already cited regard such hopes as fond illusions (Bageant, 2007; Davis, 2009; Kunstler, 2005; Orr, 1995; Theobald, 1995, 2009). Time will tell if the concerns of such authors are justified. In the meantime, the threat to the sustainability of urbanization and many of its attendant commitments persists, and concern seems, at present, to be mounting.

At present, prevalent modernist commitments would still seem to deflect the popular imagination (a famously manipulated popular imagination, cf. Mander, 1978) from entertaining the possibilities of a more, not less, rural

future. Notably among educators, David Orr (1995) argued *15 years ago* that the exercise of such popular imagination, indeed, “re-ruralizing” education itself, was at that time long overdue. With equal force and logic, Victor Hanson (1995) explained what farming and an agrarian land ethic have meant for the institution of democracy. He argued that care for a rural place creates a citizenry with interests and ideas worth articulating, debating, and defending. The point is educationally relevant. Many educators are concerned with the evident collapse of democratic engagement and access to power in the U.S. (see Lasch, 1995, for a sociological description of the problem). According to Hanson, a classics scholar and farmer, the reason the United States is becoming an oligarchy is that the connection of the citizenry to the land has been severed by industrial culture. The task of recovery along rural lines is apparently so daunting that only a few hardy intellectuals can even imagine the necessity, let alone think about it in any focused manner.

Anthropologist Wade Davis (2009), whose work is as concerned about the loss of cultures world wide as environmental activists and biologists are about the loss of plant and animal species, is among the few who have had such recurring thoughts. In his telling, the modern era finds it so easy to destroy rural places, and the planet as a whole, precisely because it regards every place as real estate. As real estate, rural places are especially attractive because the common heritage located there can be appropriated for dramatic private gain (see Theobald, 1991, for historical precedents). The panic of national emergency (energy insufficiency, foreign energy dependence, imbalance of trade, and so forth) renders the appropriation much easier, in fact. In Davis’s account, the homelands of indigenous peoples are violated because oil or trees or coal are to be found there. As always, these homelands are regarded as “empty” because population densities are so low by the standards of urbanization.

Put somewhat differently from how Davis might frame the issue, this move is enabled by the substitution of the value-in-trade of the land for its value-in-use. In trade, land is available to the highest bidder. The notion of a sacred homeplace, on such terms, appears laughable. But Davis, the anthropologist, speaks to the kind of value-in-use that would seem to concern anyone who thought culture was important:

The triumph of secular materialism became the conceit of modernity. The notion that land could have anima, that the flight of a hawk might have meaning, that beliefs of the spirit could have true resonance, was ridiculed, dismissed as ridiculous. (Davis, 2009, p. 120)

Under the scheme identified in this passage as “the triumph of secular materialism,” any attachment to the land is reformed as economically counterproductive—and economics trumps all other purpose. Attachment to place can be dismissed as sentimentalism, as foolish, and indeed “ridiculous.” Not only does the land (the entire earth, actually) lack everyday use in this scheme, it lacks meaningfulness, which is a much more serious

problem in Davis’s view. A meaningless world, he finds, is one that is easy to dispense with. The notion—common to societies the world over—that the land is sacred is thus easy to mock in the modernist frame of mind as backward. As the forgoing discussion shows, this mockery is still successful, not only as applied to indigenous people (aborigines, Indians, Polynesians), but to ordinary farmers and “rednecks” of all stripes and hues in the developed world, but perhaps especially in the U.S.

Mathematics Knowledge for Rural Places

This is the daunting context and scheme into which the struggle for place-based education—as distinct from culture- and community-based education—enters. Couched in such terms, the nature and fact of the struggle should now be evident to readers. Further, those who struggle in this work are merely teachers, and in this study, they are teachers of mathematics. The irony is that mathematics is perhaps the intellectual discipline most widely acknowledged to have enabled the work of modernist science, technology, and engineering from the seventeenth century to the present. From the vantage of the critics, at least, educators may need to ask which side their version of mathematics is on: rapacious exploitation or common purpose.

The significance of this study, then, lies in the significance of a redirection of mathematics education to rural purposes. As suggested above, however, such purposes are even difficult to see, and logically, therefore, they are even more difficult to realize.

If global catastrophe can be avoided—or perhaps even if it cannot be avoided—a more rurally conscious future would, at least in the view of the critics, would entail cultural construction with practical implications for community, politics, economics, and ethics. The work of place-based mathematics, under either scenario, would be valuable not only to rural places, but to a more sustainable, and one might hope, a more humane future.

Despite such high-mindedness, however, the economic and cultural practicalities are seemingly obvious: “green” approaches to energy, a more secure and better food supply chain, and a more appropriate population dispersion. According to the critics, such developments depend on rural places and, most particularly, on a land ethic. They seem to agree that the world will need to use its land far more wisely in the future. Notably, the land that is being talked about is nearly all in rural places, places that have the affection of those who live there. Rural people, and the many others likely to be interested in rural issues, are going to need to know math better and differently for such applications. As readers will see, the issue of the application of mathematics looms large in the words and thoughts of those with whom the research team spoke.

CULTURE, COMMUNITY, AND PLACE:
understanding “place”

▶ According to advocates, culture-based, community-based, and place-based approaches to instruction are valuable for a variety of reasons. They reputedly provide students with opportunities for learning in authentic ways (SARKAR & FRAZIER, 2008), and they connect new learning experiences to students’ prior lived experiences (G. SMITH, 2002). Moreover, while supporting critical linkages between schools and the local communities they serve (WOODHOUSE & KNAPP, 2000), such approaches actively engage students in making sense of what they are learning (G. SMITH, 2002; SOBEL, 2004).



Despite their purported value and their particular relevance to schools in rural locales, however, rural schools and teachers often do not make use of these approaches (Howley, 2003). Like other “progressive” pedagogies, culture-based, community-based, and place-based approaches are difficult to plan, implement, and sustain (Cuban, 1993; Howley, 2003). The few case studies describing instruction that links school learning to community and place demonstrate how much effort is needed to establish and sustain these initiatives (Gruenewald & Smith, 2008). Further, educators seem to deploy these approaches to teach some subjects, notably science, social studies, and writing, much more often than to teach other subjects, such as foreign language and math.

One may as well distinguish among these three approaches (culture-, community-, and place-based schemes) at the outset. Think of them as a nested set, with *culture* the most inclusive set, containing *community*, containing *place*. Since the overall approach is, after all cultural, the point is not so much the material reality, but the immanent social (or political or educational) aims of the particular approach. In particular, the urban origins of what is now called “culture-based” (or “culturally responsive”) education lie with particular concern for the ordinary lives of black and brown students attending city schools (e.g., Ladson-Billings’s “culturally relevant pedagogy”), though quite arguably education everywhere is founded on an existing culture of some sort. What is at issue, perhaps, is whose culture is foundational.

Community, in particular, may or may not be engaged by practitioners of culture-based education. The ACCLAIM leadership, however, has honored *ordinary rural life* as an abiding interest since the inception of the Center, and this abiding interest has led to its interest in place-based education (and pedagogy). To put it bluntly: *place is rural*, and place-based education

(or pedagogy) is an almost exclusively rural phenomenon, as documented by the historical record of its writings. This is a provocative position, as it turns out, and therefore requires some unpacking. A brief explanation, at least, is in order.²

Culture

Let’s start with the most inclusive category, culture. Education must be inherently responsive to some culture, otherwise knowledge itself is rendered nonsense: knowledge requires *cultivation* (e.g., Bruner, 1996). That is, living and growing knowledge is at least imbued with culture to start with, unless one takes the dubious Platonic view that knowledge is eternal. The Platonic view is that humans discover knowledge rather than make it. The position has some merit, but seems overall short-sighted to many thinkers (Bruner, 1996; Ernest, 1998). To separate knowing from human agency and to disconnect it from the social traditions of the imperfect knowledge that humans possess at any historical moment abstracts knowledge from its only possible origins (outside Divine intervention, that is). Humans are *homo sapiens*—people who know—not by virtue of knowledge per se but by the always doubtful act of knowing, the act that results in tentative knowledge. The tentativeness of knowledge is cultural, the result of doubt and of the capacity of *homo sapiens* to ask questions and to examine them reflexively. Among the human achievements, mathematics is admirably logical; but it is certainly reflexive, and inventiveness is very clearly evident.

If knowledge, then, is conceived as lifeless (bereft of a living culture and of the living and dubious process of knowing), schooling, if not education itself, arguably becomes a game of nonsense, compliance rituals, headtrips

²Many others, wanting to avoid the charge of exclusiveness, argue that place-based education can be practiced anywhere (e.g., Hutchison, Smith 2002; Sobel, 2004). This move may perhaps be regarded as generous, but the lead authors, at any rate, find it illogical and even misleading about the role of land ethic, where the meaningfulness of place resides.

centered on status differentials, and actual miseducation. Mathematics and mathematics education are famously subject to what the outlook of this project might call the “Platonic error” (e.g., Charalambous, Philippou, & Kyriakides, 2002; Ernest, 1998). This difficulty should sound even more familiar in general than with mathematics. Which and whose culture should schools elect to cultivate as harboring legitimate knowledge? It’s a disturbing question, but a tremendously practical one for teachers. Once they grasp the question and the implications of the possible answers, their teaching is unlikely to remain the same. Because of the usefulness of mathematics, such questions exist for mathematics as well as for literature and history. For what purpose and to what objects should one apply mathematics? The question is at present almost as irrelevant to school mathematics as the social implications of scientific knowledge once were in school science.

This is the issue that makes “culturally responsive schooling” (e.g., Ladson-Billings, 1995) controversial, and the one that causes the headtrips centered on status differentials to come so ferociously into play, at least according to the critical theorists and the social reproduction theorists (e.g., Anyon, 2005; Apple, 2000; Bowles & Gintis, 1976; Freire, 1970; Giroux, 1983). Culture, whether an example of low status (e.g., African-American, rural) or high (e.g., Harvard-yard, Manhattan-elite), remains comparatively abstract—a set of practices conceived as common to some rather large, even diasporic, collectivity. Culturally responsive schooling, even the inventive schooling justly responsive to the low-status culture of its patrons, might thus respond with activities entirely conducted in the classroom. Community-based education, by contrast, takes the issues beyond the classroom.

Community

On this view, then, community-based education could be understood as the next step in culturally responsive education: real-time connection to local culture predominating *outside the school*.³ Taking this step is obviously messy, difficult, and possibly dangerous; nearly always it is construed as impractical (e.g., in conflict with the adopted program, contrary to administrative directives, too taxing of available resources, inefficient and ineffective from the standpoint of accountability testing). One cannot be sure what will happen when one collaborates with laymen—though the same observation applies to students (Cohen, 1988)! In any case, “the community” in this sense is everything local outside the walls of the school, and every school has an outside to be accessed for this purpose.

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³One needs to be careful with the jargon of education; “community-based education” is quite different from “community education.” The ERIC Thesaurus (2010) scope note for “community education” follows: *Extending existing educational resources (including those of schools, colleges, and local organizations) into the community to serve all age groups and special target groups not ordinarily served by regular educational programs (Note: Do not confuse with community-focused place-based education, for which use the Identifier “Place Based Education,” coordinated as appropriate with a second Identifier “Sense of Community”).* Community-based education by contrast is about bringing community concerns and struggles into the curriculum and into instruction that takes place both outside of school and within school.

CULTURE, COMMUNITY, AND PLACE: *understanding “place”*

Place

The next step in this application (from culture to community) is where the *rural* comes in. How might place relate to community? Those who fret about offending possible urban and suburban collaborators happily conflate community and place. Every community is a place! There’s no difference! Why bother with place-based education at that rate? It would be synonymous with community-based education. Rural educators, however, invented the term and their interest cannot be so easily dismissed. Readers should note well, though, that the dismissal is consonant with the overall judgment of irrelevance accorded rural life and the alternatives rural life might harbor for the future.

Place, no doubt, could be construed as a set of geographical coordinates, such that if one exists on the planet, one occupies a place. This sentence is being written at 39°15 02.62 N by 82°16 20.73 W but might have been written by a somewhat younger author at 40°50 11.06 N by 73°56 53.68 W, and in that sense of “place” each set of coordinates is indeed a geographic location. Further, by such a formulation, locations on the moon and within galaxies in the universe are “places.” But clearly, one is not speaking of a form of education based on geographic coordinates. No approachable content is associated with a point, a mathematically famous object with no length or breadth. The only content is position. *Place* is something very different, it would seem, from *position* or *location*. Neither position nor location includes community or culture, though place does. But it includes more.

Rural educators have in fact invented and developed the construct of place-based education and its variants (see, e.g., Annenberg Rural Challenge, 1995; Barnhardt, 1980; Theobald, 1997).⁴ But this is not what renders place-based education rural.

Logic applies here because of what “place” *means* in contrast to how it might be *located*. Place, in this sense, refers to the nexus of culture and the interaction of local communities with *local land*: stewarding

the land, cultivating the land, and inhabiting the land—investing it with and accessing its already-existing complex meanings and varied usages (Theobald, 1997; Gruenewald, 2006).

Perhaps one might find an urban or suburban community interacting with the *land* in this way, but the circumstance is at present extremely rare.⁵ In suburbia and in cities, intense trade in land renders sets of geographic coordinates as real estate, and the land—with its other sustaining usages and meanings—is abandoned, submerged, and obliterated by buildings on a gargantuan scale. In World Cities like New York, Hong Kong, Tokyo, London, and Paris, the land and its watersheds are actually buried. The mantra of this cosmopolitan real-estate culture is the familiar “location, location, location.” The value-in-trade of minutely plotted geographic coordinates that demarcate small parcels suppresses any value-in-use of the land.

In brief, a valuable piece of real estate on these terms is by no means a *place*. For the time being (pending global environmental and economic collapse, and perhaps for long afterward), place will remain a rural phenomenon. Possibly, with severely altered circumstances, the land in the suburbs and even in some cities could in the future become productive and sustaining once again (see footnote 4). It seems dubious, though.

Place-based education, then, engages much that culture- and community-based approaches do. It’s a comrade in such work. But because of its concern for the land and an ethos bound up with the land, it approaches such work with a rural consciousness, and perhaps a rural conscience. In the seven reports that follow, the study generally found that the rural patrons of these rural schools did appreciate the work done by the educators whose voices grace this report. Possibly, teachers in cities and suburbs could embrace a rural consciousness and conscience, strange as it might seem to those around them. Such an approach would seem necessary, at least according to David Orr’s (1995) prescriptions for “re-ruralizing” education in its entirety. It seems to the lead authors, at any rate, too much to anticipate for the reasons given above.

⁴ERIC added the descriptor “Place Based Education” in 2003 (ERIC Thesaurus, 2010) and indexed earlier documents with the new descriptor (standard practice when creating new indexing terms). At this writing, 191 documents bear the descriptor, nearly all of them also either carrying a rural descriptor or revealing (by inspection) a strong rural connection—as with the earliest in the set (Barnhardt, 1980). The Alaskan context that has always concerned Barnhardt is rural, but in Alaska the cultural theme predominates because of the immanent cultural conflict between Native Alaskan communities and urbanized white Alaska. That conflict, in the eyes of many, trumps but by no means submerges the rural character of the Native Alaskan ethos. For such reasons, for instance, a team of Native Alaskans that produced mathematics materials (see, e.g., Lipka & Adams, 2004) insists that their concern is culture-based, not place-based. Community connections remain important for this project, as do rural connections—and the development of the activities have manifested all these connections.

⁵Thirteen years ago, two of the lead authors did visit Blende, a suburb of Pueblo, Colorado, which was still served by an agricultural irrigation system developed for the area before it had suburbanized—but much to our surprise, the suburban residents were raising animals, alfalfa, and large gardens; it was wondrous to see. We’ve not seen this suburban manifestation of a land ethic anyplace else, and the memory remains for us an image of an interestingly ruralized suburbia. Urban agriculture programs exist today to grow crops on abandoned lots in many cities, including New York City (McMillan, 2010), and the involvement of young people in these projects is clear.



Drawing on ACCLAIM's active relationships with scholars in rural education and mathematics education, the research team developed a list of initial contacts in mathematics education, science education, experiential education, outdoor education, and rural education.

In fact, the list of nominators reached 81, of whom the study team was eventually able to contact 58. The researchers asked these individuals to nominate sites in which mathematics educators were using community- or place-based approaches to instruction. Altogether, those who provided nominations recommended 61 rural sites, which the team contacted by telephone, eventually selecting seven sites (see Table 1) to provide variety by geographic location, education level, and extensiveness of engagement with community- and place-based pedagogies.

Activities and Responsibilities

At each site (in this report all names of places and persons are pseudonyms), during the 2007-2008 school year, a member of the research team interviewed teachers, students, parents, administrators, and non-parent community members. Additionally, each investigator observed mathematics lessons of various sorts, taught by self-contained classroom teachers at the elementary school, and at the secondary level by math teachers, vocational agriculture teachers, science teachers, and in a few instances, by community members. The investigator at each site also collected relevant documents such as instructional materials, newspaper articles, and examples of students' work. He or she also accompanied teachers, students, and community members to various activities and recorded information about those activities in field notes. The numbers, by site, of interviews, classroom observations, and activities recorded in field notes are provided in Table 1.

As data were collected, interviews were transcribed verbatim and relevant artifacts were scanned and organized. Analysis of data from each site began with the interview transcripts, which represented the primary source of data. Report authors were not necessarily researchers, and the lead authors (C. and A. Howley) edited drafts of study reports as seemed to them necessary (see Table 2 for the disposition of team member's involvement across the study).

Data Analysis

Data analysis for this report was carried out by report authors and analysts (see Table 2), on similar but not exactly the same terms. Teams in which Aimee Howley was involved took a "Straussian" approach to data analysis (more analytic, more systematic), using two levels of coding—inductive (i.e., open) codes closely tied to the data and then axial codes (e.g., Strauss & Corbin, 1998) with more categorical significance. Studies in which Craig Howley and

TABLE 1 :: *Interviews and Observations by Site*

| Site | Interviews | Classroom Observation | Field Notes |
|--------------------------------------|------------|-----------------------|-------------|
| South Valley OH | 14 | 5 | 2 |
| Magnolia AL | 8 | 3 | 3 |
| Lafayette KY | 11 | 2 | 2 |
| Confluence District Collaborative NE | 22 | 6 | 6 |
| Green Mountain School VT | 3 | 4 | 3 |
| Eastcove ME | 16 | 2 | 7 |
| Meriwether Lewis WA | 11 | 5 | 7 |
| Totals | 85 | 27 | 30 |

TABLE 2 :: *Disposition of Team Members' Involvement Across Sites*

| Site | Authors/Analysts | Data Collection |
|--------------------------------------|---------------------------------|----------------------|
| South Valley OH | Clonch, A. Howley | Pendarvis, Foley |
| Magnolia AL | C. Howley, A. Howley | C. Howley, A. Howley |
| Lafayette KY | C. Howley | Klein |
| Confluence District Collaborative NE | M. & A. Howley, Tusay, Miyafusa | Belcher |
| Green Mountain School VT | C. Howley | Jimerson |
| Eastcove ME | A. Howley, M. Howley | Perko |
| Meriwether Lewis WA | Klein | Klein |

Robert Klein served as principal analysts and authors took a more "Glaserian" approach to data analysis (more synthetic, more impressionistic). In both approaches, researchers focused on multiple readings of transcripts and coding of data for emergent themes that seemed to work best in explaining the ways place and community were integrated into mathematics education at the site.

For the most complex sites (i.e., Eastcove Island and the Confluence Collaborative), a second analyst reviewed the observation data, field notes, and documents to determine the extent to which these sources of evidence appeared to confirm or disconfirm the suggested themes. The second analyst added memos to the data set, making a more nuanced understanding accessible to the authors.

METHODS

For the less complex cases, the team member who gathered the data reviewed drafts of the reports to help ensure that the written story told reflected on-the-ground experience at the site. The final drafts reflected data from all sources and thereby depict both the character of the work undertaken at each site to integrate place and community into mathematics instruction and the challenges that this work confronted.

Limitations and Delimitations

This report is characterized by a set of limitations typical of qualitative investigations, as well as by delimitations particular to this presentation and peculiar to this study. Both together constitute caveats for the reader. For additional caveats (which include recommendations), see the concluding section of the report.

Limitations

This report presents findings from a multi-site qualitative study. Findings cannot be “generalized” to other sites, nor to any set of other schools or communities. Indeed, the enumerable facts related to engaging communities and schools jointly in mathematics education are not the focus of this study. Instead, the focus of interest and investigation is on the relevant issues that manifest themselves at the study sites. Such a focus explains why adducing themes figures as the key work of the study. The themes articulate issues, and though issues in this report are unique to sites, each such unique issue relates to more prevalent conditions that are the focus on an ongoing cross-case analysis (see delimitations for further details). Additionally, a quantitative survey is now being planned with a view to producing more conventionally generalizable findings about enumerable facts, a further step that the study team believes must draw upon such an effort as the present one given the current absence of a body of relevant research.

A complex project like this also presents issues for management and these issues embed likely limitations. Different research team members visited the sites; only Robert Klein visited two sites. Site researchers *were* briefed and guided, and they *did* consult study leaders from their sites. But access clearly varied across sites, and such differences in access likely had something to do with team members’ methods of engagement at the sites and the nature and extent of data gathered. Were seven sites too many or too few? One cannot say with much certainty, except that overall the study elicited something like data redundancy across sites—though such a judgment will be subject to better specification in the forthcoming cross-site analysis.

Delimitations

Across the study we talked only to local people about their varied projects. Precisely how these projects articulated with the reformist intentions of state or federal agencies, or national professional groups was not the concern of the study. Interviewees, however, did express such concerns and the study did analyze the related data, but not with the intentions of those other entities as a touchstone for interpretation. Over the decades, too many studies of rural education have been biased by such intentions (Coladarci, 2007; Louisiana Department of Education, 2003; see also Scott, 1998).

The study also did not investigate rural private schools, though several were nominated. The Green Mountain site is something of an exception, though as noted there, this private school was included in the study because it enrolls some public school students on a tuition basis from local districts that do not maintain middle schools. This arrangement is especially common in New England.

Readers should also be aware that the site reports deliver their insights in the voices of particular authors and with somewhat variable intellectual outlooks. Some authors, for instance, chose to include more testing data, and some more sociological data. Editing by the lead authors and by a professional copyeditor did not aim to render each case in the same voice or with precisely the same elements. Despite the familial differences, the study’s overall intentions should be clear. The overall format is, also, one hopes, sufficiently consistent (i.e., background, themes, discussion) that readers can perceive a cousinly kinship across the site reports.

The seven site reports given here, moreover, do not constitute and were not at this juncture intended to constitute, a formal cross-case analysis. On that basis this monograph shares a work still very much in progress, though this evolution has been ongoing since 2006. For that reason the study leaders do not regard this report as premature. At this writing (April 2010), several related papers and a symposium have been submitted to conferences and journals. The quantitative survey mentioned previously is also in progress, as well as the *de novo* cross-case analysis planned for summer 2010. Findings from either work (the survey or the cross-case analysis) cannot be surely anticipated, of course. But the concluding section nonetheless speculates on issues that, pending ongoing rigorous analysis, offer themselves as possible overall concerns manifest in the following seven site reports.



The next seven large sub-sections of this report present findings at each site. For each site report, we first present information about the school and district, then turn to a consideration of salient themes, and then consider reflections or implications about the findings. Readers may consider each sub-section of the report a case, but the research team is still pondering the question of what constitutes the “case” at each site. The team believes that identification of the “case” must await further developments in the team’s ongoing engagement with the data.

A brief synopsis of the relevant work at each site should help readers develop a feel for the scope and scale of the work across all seven sites. Following this presentation, we provide the full-length site reports—in the order evident in the brief synopses. Again, all sites and all persons are identified by pseudonyms. Additionally, references to specific websites or sections of websites that would disclose the identity of sites have also been suppressed.

South Valley Local School District is a small district located in rural Ohio. Ms. Ball graduated from South Valley High School and now teaches sixth-grade mathematics at South Valley Elementary. She engages students in a range of community-inspired mathematics projects throughout the year, including St. Jude’s math-athon, Relay for Life, Pi Day, and a stained-glass project that focuses on geometry and measurement in creating artwork. For the Relay for Life project, students collect and track money, time “laps,” and graph results.

Magnolia City School District is located in a rural southern Alabama county where 56% of students receive free or reduced-price lunches. Magnolia City students participate in an aquaculture program and actively maintain the fish environments (monitoring pH, population size, health), track and foster fish growth, and eventually sell the fish at a community fish fry that generates funds to sustain the program.

Located in a mountainous region of Washington, *Meriwether Lewis Junior-Senior High School* enrolled about 250 students in grades 7-12 in 2007-2008. Ms. Jay is the only middle-school mathematics teacher and invites community members to her classes to describe the mathematics they use in their daily work. This has included a local fiber artist, a bicycle shop owner, and a video game designer. For “Math Communities,” parents lead small groups of students through multi-step word problems every two or three weeks.

Eastcove Community School has a student body (pre-K to 12) of just 71 students and is located on a small island off of the coast of Maine (so small that the town’s website lists the name of all residents). The principal

and some teachers have instituted numerous place-based initiatives, most notably including the design and construction of pea-pod boats and an all-electric vehicle that was demonstrated in Washington, D.C.

Green Mountain School is a non-profit rural private school in Vermont, enrolling “tuitioned” public-school students among its nearly 130 students (2007-2008). Students there engage in “tree plot math,” a six-week project related to the local industry of timbering. They are assigned plots of land—often triangles, circles, or quadrilaterals—and they gather data about the trees in their plots, graph the results, calculate the worth of their trees, visit the sawmills, and occasionally present their findings to the schools’ board of trustees (e.g., to help the trustees decide whether or not to log the entire tract owned by the school).

The Confluence District Collaborative brings four rural Nebraska school districts into one administrative unit under the leadership of a single superintendent and central office staff. Survival of the individual schools and districts involves significant sharing of resources, including teachers traveling between schools. In many ways this site was a counter-example, or perhaps represented a set of practices in decline, given that most teachers in the study tended to view place-based approaches as appropriate only for lower-level students or unsuited to the distance-learning technologies being used to address concerns about itinerant teaching. For this reason, for a lengthy history, and for organizational scale of the relevant projects and the collaborative itself, this site is the one offering the richest and most complex set of data across all seven sites.

Lafayette County High School is a comparatively large school (over 1,000 students in grades 9-12) in rural Kentucky. Because of the initiative of a math teacher and a vocational agriculture teacher, the school operates a “lutherie” class in which students craft ukuleles and other stringed instruments from raw lumber over the course of the year. Each student makes two instruments: one to keep and one to sell at a community show for funds to sustain the program. Measurement, scale geometry, and trigonometry are emphasized connections.

South Valley Elementary School

The South Valley Local School District is a small district located in a rural Ohio county. The district has two school buildings located on the same campus: South Valley Elementary School and South Valley High School. The 98,000-square-foot elementary school was completed in 1993. It serves approximately 550 students in Kindergarten through grade 8.

In Tables 3 and 4 we report Local Report Card data for South Valley Elementary School for the 2006-2007 and 2007-2008 school years (Ohio Department of Education, 2008). Table 2 provides a summary of the information used to establish the school's performance rating. Table 3 reports the proficiency levels on achievement tests administered in 2006-2007 and 2007-2008.

TABLE 3 :: Local Report Card Profile

| Report Card Summary | 2006 // 2007 | 2007 // 2008 |
|--------------------------------|-------------------|---------------------------|
| School Designation | Effective | Effective |
| Number of State Indicators Met | 15 out of 19 | 15 out of 19 |
| Performance Index Score | 95.9 | 94.8 |
| Adequate Yaerly Progress | Not Met | Met |
| School Improvement Status | Improvement Yr. 1 | Improvement Yr. 1 (delay) |
| Value Added Measure | N/A | Met |

TABLE 4 :: Percentage of Students at and above the Proficient Level

| Site Indicator | 2006 // 2007 | 2007 // 2008 | 2007 // 2008 State |
|--------------------------|--------------|--------------|--------------------|
| 3rd Grade Reading | 73.7% | 75.9% | 77.4% |
| 3rd Grade Mathematics | 84.2% | 64.8% | 79.3% |
| 4th Grade Reading | 90.3% | 86.4% | 81.1% |
| 4th Grade Mathematics | 88.7% | 76.3% | 74.6% |
| 4th Grade Writing | 93.5% | 79.7% | 81.7% |
| 5th Grade Reading | 87.3% | 85.2% | 72.7% |
| 5th Grade Mathematics | 67.3% | 68.9% | 61.8% |
| 5th Grade Science | 96.4% | 86.9% | 66.4% |
| 5th Grade Social Studies | 76.4% | 86.9% | 64.8% |
| 6th Grade Reading | 76.4% | 86.3% | 79.7% |
| 6th Grade Mathematics | 93.1% | 94.1% | 76.6% |
| 7th Grade Reading | 76.6% | 77.9% | 77.3% |
| 7th Grade Mathematics | 83.3% | 85.3% | 68.8% |
| 7th Grade Writing | 76.3% | 85.3% | 85.7% |
| 8th Grade Reading | 76.1% | 79.3% | 79.4% |
| 8th Grade Mathematics | 78.9% | 84.5% | 72.8% |
| 8th Grade Science | 67.6% | 60.3% | 62.2% |
| 8th Grade Social Studies | 53.5% | 62.1% | 53.5% |
| Attendance | 95.4% | 95.6% | 94.2% |

Results above the state standard of 75% for academic indicators and 93% for attendance are shown in bold.

The 2007-2008 local report card data show that the South Valley Elementary School met the state standard for mathematics achievement on four of the seven indicators and exceeded the state's average proficiency rate on six of the seven mathematics indicators. In the sixth, seventh, and eighth grades the South Valley Elementary, mathematics proficiency rates were considerably above the state averages. The sixth-grade scores exceeded the state average by 17.5 percentage points, the seventh-grade scores by 16.5 points, and the eighth-grade scores by 11.7 points.

As these data suggest, many students at South Valley Elementary are achieving grade-level competence in mathematics. Part of their learning, moreover, rests on the engagement of community and place in the teaching of mathematics. The dynamics of place- and community-based mathematics education are elucidated in four emergent themes: teacher leadership, community connections, use of mathematics in real life, and support for the mathematics program.

Teacher Leadership

The story of the unusual mathematics program at South Valley Elementary School is inseparable from the story of an extraordinary teacher, Ms. Ball. Ms. Ball graduated from South Valley High School and returned to the school district as a teacher of mathematics and physical education. In her role teaching math to sixth-graders, she has been the driving force behind changes in the mathematics curriculum. Her aim has been to provide students with a high-quality program that expands their engagement with mathematics by showing them its applications to community life. Ms. Ball expressed the belief that mathematics represents an important skill both in terms of its contribution to everyday life and in terms of its role in helping students create better lives for themselves. She talked about her hope that the students would "make a mark in life" and that they would grow up to be "giving people."

Comments from various members of the school staff at South Valley indicated that Ms. Ball has been at the forefront of the development of the mathematics program. She has exercised leadership in promoting various mathematics projects such as the math lab, the stained glass project, the St. Jude's math-athon, Relay for Life, and Pi Day; and she has also kept her own knowledge and skills up to date by participating in a variety of professional development programs. A board member described the qualities that make Ms. Ball an effective leader in the school: "She's enthusiastic. She's organized. She takes control; and once she does something, it's not just half way." He also spoke of her as a team player who gets other people involved in the programs that she is promoting.

Not only has Ms. Ball actively pursued professional development activities, she also has encouraged colleagues to take advantage of such opportunities. Moreover, she has provided professional development to other teachers. Ms. Ball indicated that department meetings at South Valley represent one form of professional development and that math network meetings involving teachers from nearby districts provide another form. According to staff members, Ms. Ball has taken a leadership role both within the district and within the wider math network. She also has provided professional development to colleagues



Ms. Ball's efforts to link mathematics education to the community took place in a context in which such connections were already valued. For example, more than half of the people interviewed described themselves as having multiple connections to the community. Five of the teachers who participated in the study mentioned that they themselves had been students at South Valley.

by mentoring entry-year teachers, supervising student teachers, and presenting at state and national conferences. The school principal described Ms. Ball's engagement with professional development:

Of course, Ball has been part of the in crowd on all of that. She desired to go to the national meeting because she knew the people and of course she's been on the agenda for some of the programs and some of the conventions and workshops.

He also commented that, over the past several years, Ms. Ball has decided to decline invitations to national and state conferences because of limited resources in the district. As a result of her willingness to forgo such opportunities, other teachers in the district have been able to participate in these kinds of professional development activities.

Participants viewed Ms. Ball as an enthusiastic teacher—someone always working to find ways to captivate and motivate students. According to participants, moreover, she has also catalyzed the efforts of other teachers at the school. Overall, the data portray Ms. Ball as an outspoken champion for math education at the school. Participants described, for example, how she approached administrators in order to get equipment and materials for providing hands-on mathematics instruction of the sort that she saw as relevant to her students' lives. Perhaps her most notable accomplishment was the addition of a second math class—a math lab—to the elementary school schedule. Each day sixth-grade students now receive didactic instruction during one class period and experiential instruction during another.

Community Connections

Another theme that was evident in the data from South Valley concerned the depth and quality of the connections between the school and the community. Ms. Ball worked to establish and maintain these connections by involving parents and community organizations in classroom and school projects. The superintendent mentioned her connection to the community: "She is a good community person. And ... there's a generation or two that know her—came through her classroom." Another staff member described her connections to the community in a bit more detail:

She's always been a great teacher. But, she became more involved—involved in little leagues and 4-H's and our basketball programs and things like that... She's got a large family here in the community. And as time passed, she's become a community leader around here. People really respect what she says and does.

Ms. Ball's efforts to link mathematics education to the community took place in a context in which such connections were already valued. For example, more than half of the people interviewed described themselves as having multiple connections to the community. Five of the teachers who participated in the study mentioned that they themselves had been students at South Valley. Some of these teachers had left the area to attend college or find work; when they returned, they were committed to expanding the horizons of the South Valley students. According to one teacher,

We take our kids, for example, on a field trip every year or every nine weeks for an incentive.... We took them to the mall, and I honestly had kids last year that had never been to a mall before. And ... I had one last year that was so sheltered he didn't know what corn on the cob was. And he was from the country. That blew me away.

Other teachers in addition to Ms. Ball used connections with families and the community as a basis for some instruction in their classrooms. One science teacher commented that being from the community helped him connect science and mathematics content to students' lives:

We talk about animals that we take to the fair; most of our students here, at least 50% or more are in 4-H. They take animals to the fair. They know about raising animals. They have to be able to measure the feed, talk about the percentages of protein and other things in that food so they understand those kinds of things... Many of them have gas wells and oil wells on their property, which definitely is related to our science standards in 6th grade, so a lot of them know the process of how an oil well or gas well is drilled.

Many teachers also invited parents and community members into their classrooms as volunteers. One parent indicated that she worked in the school as a volunteer approximately three days a week. Her work in the school

entailed a number of activities, including providing an orientation program to other parent volunteers, helping with the lunch program, and substituting for teachers who were absent. She also played a role in the various community-based math projects provided by the school, such as the Relay for Life, the 24 contest, and the development of house plans.

Using Mathematics in Real Life

Another theme characterizing mathematics instruction at South Valley was the importance that teachers placed on using mathematics in everyday life. Some teachers talked about their passion for the subject and how they wanted to communicate their enthusiasm to the students in their classrooms. As a fourth-grade teacher put it,

I love teaching math. Math has always been my passion and I want to share that passion with children; I want them to learn to love math. My goal is to try to show them how to use it in their everyday life and why they need math.

The commitment to linking mathematics to practical matters was perhaps best exemplified by the inclusion in the curriculum of a math lab. All sixth-graders at South Valley enrolled in two math classes—a traditional math class and the math lab class. In the traditional math class, students focused on the concept of the day, completed practice problems with the daily math concepts, and discussed the processes used to calculate solutions. In the math lab they explored ways that the concept was connected to everyday life. In Ms. Ball's characterization, "The theme of the lab is 'What's the use of learning math if you can't use it?'"

Two major school-wide projects that teachers saw as ways to connect mathematics to everyday life were the stained glass project and Relay for Life. In the stained glass project, students used geometry and measurement skills as the basis for designing artwork. Students also used mathematics skills in others parts of the project—for example, in determining how much the glass would cost and how much profit they had made at the auction.

What we did is: the kids team up and they designed the scaling of it, the mass scale. Then we make a trip to Franklin Art Glass in Columbus and they give us a tour. They get to pick out the glass, and the grant paid for that. We spent ten weeks designing...Then we have an auction and we call in the media and the kids.

As part of the Relay for Life project, students were responsible for setting goals, getting sponsors, timing the laps, collecting and counting money, and graphing the results. After the relay, the students compared the results for each grade level and compared actual performance to performance goals.

Members of the South Valley Elementary community also described several other mathematics projects that focused on ways mathematics can be used in everyday life. The Hundredth Day of School involved young children in using the calendar and counting the days.

We do different activities with our calendar with that because that goes in with keeping track of the days of the year. We talk about days we're not here and how many days we're here in the month. And there are patterns, and we do odd and even. ... This is something they do at home with their family and they bring in a hundred items or something they've made that displays a hundred.

Other projects involving math included a math day, with booths for buying items and making change, using banana splits to teach fractions, graphing the beats from songs, starting savings accounts, and making house plans.

Support for the Mathematics Program

Many interviewees spoke about the high levels of support that the community gives to South Valley Elementary School and its various programs and projects. One administrator described the scene at the Halloween festivities one year:

The first time I was here, cars were all over the place...the bleachers were so full that I had to stand the kids up against the wall for the parade. ... Our kids can't sit down, that's how crowded it is.

He also added the comment that parents support the educational program as well as extracurricular and social programs.

Teachers also indicated that they receive support from the school administration. Ms. Ball, for example, spoke about the long-term relationship she has had with her principal and his support for her and for other teachers:

He's a very, very teacher supporting man. He's very supportive, and he'll say, "Ball, if it's good for the students, let's do it." And it's nice to have that because some people don't have that privilege. He's very supportive that they're doing what's good for kids.

Other South Valley staff commented that they felt support from parents, community members, the principal, the superintendent, and members of the board of education. Teachers at the Elementary School mentioned that the board and administration have honored their requests for resources such as technology, instructional materials, and hands-on labs.

Summary

Study participants described South Valley Elementary School as the literal and figurative center of community life for the residents of the district. With so much support, teachers at the school have been able to connect instruction to practical activities in the community. The math lab, the stained glass project, and the Relay for Life project exemplify the use of this approach to engage students in the learning of mathematics.

Magnolia City Schools

The Magnolia City School District is located in one of the rural counties of southern Alabama. The city of Magnolia itself has a population of approximately 2,000 people. As of 1999, 41% of families with related children of 18 years or younger live in poverty status, and 56% of students in Covington County receive free or reduced-price lunch. The Magnolia City Schools are definitely small, rural schools, with 162 students in the high school and 84 students in the middle school.

Magnolia Middle School accomplished 12 of 13 Adequate Yearly Progress (AYP) goals, falling short only in attendance, and Magnolia High School met 5 AYP goals of 5 (Alabama Department of Education, 2008a, 2008b). Magnolia High School received a bronze medal rating from *U.S. News and World Report's* list of America's Best High Schools. On some achievement measures the two schools exceed the performance of the larger district of which they are a part.

Project researchers conducted interviews with the principal of Magnolia Middle, the Magnolia Middle math teacher, the Magnolia Middle science teacher, the Magnolia High science teacher, a former Magnolia High agriculture teacher, the Magnolia High agriculture and turf management teacher, the Magnolia High math and computer science teacher, and a focus group of Magnolia High students. In addition, project researchers met with community members and observed a few classes. The content of the interviews centered on the use of place and community in curriculum involving mathematics. The interviews were later transcribed and coded along research guidelines.

Emphasis on Active Learning

Most of the persons interviewed attributed Magnolia's success to an emphasis on what interviewees called "active learning" (engagement with extended projects, for the most part). The respondents asserted that active learning offered students several benefits that conventional instruction does not, chief among them retention, interest, relevance, clarity, and self-esteem. Some of these benefits were more widely observed than others.

Science teachers of both Magnolia High and Magnolia Middle asserted that greater retention is a result of project-based learning. The Magnolia High agriculture teacher concurred: With active learning, he said, students "learn it instead of temporarily learning it, if that makes sense ... There's a difference in instruction for testing and there's a difference in successful instruction for life."

A Magnolia student from the focus group spoke to the greater degree of interest and engagement students experienced with active learning:

We did a lot of hands on with Coach ... he was like, "Hey, well you come give this a try and mess with the pH," and when we first started doing it, it was just fun ... trying it ourselves.

The Magnolia staff reinforced the ability of project-based learning to hold a student's interest. The Magnolia Middle science teacher reported that her students continually ask when the next lab will be. The principal of Magnolia Middle commented that students "don't want to touch" math by itself because it "has no meaning," but have a keen interest in the aquaculture program. On the matter of relevance, the Magnolia High agriculture teacher reported:

I had science teachers tell me, say, "Man, how did you teach these kids all about pH?" ... it was simply they were taught using pH. That's all they need for it is the relevance.

And the Magnolia Middle science teacher observed that activities with real life applications answer that timeless question, "Why do we need to know this?"

Self-esteem was mentioned in a significant number of the interviews. A student in the focus group reflected the sense of ownership imparted by project-based learning: "We have our own set tanks ... they're like, your fish and you just take care of them. Recently they moved ours out and it was really sad."

Both the Magnolia Middle science teacher and the Magnolia High agriculture teacher agreed that self esteem in one's work in a particular area can lead to better performance in other academic areas as well as at home. The principal of Magnolia Middle also mentioned that students who have a sense of ownership in their work perform better.

Although a seemingly obvious benefit, clarity as a result of project-based instruction surfaced in only one interview—namely, with the math teacher from Magnolia Middle, who described how she used projects to explain concepts that can't be adequately expressed in a textbook, such as surface area.

Magnolia High School does in fact offer many opportunities for students to engage in active learning. The school's most distinctive feature is its aquaculture program. The aquaculture program was started in 1992 by the now-retired Magnolia agriculture teacher, who collaborated in its founding with the director of a highly respected place-based education collaborative. Although aquaculture courses do not exist in the formal curriculum, aquaculture units are used in biology and chemistry and vocational courses as well as for an extra-curricular aquaculture club. In the high school, science classes are divided between those seeking advanced diplomas and those seeking regular diplomas. There is a division of labor concerning upkeep of the aquaculture project among the various classes. For example, according to one science teacher, his senior environmental class (part of the regular-diploma group) has the responsibility of checking the pH, nitrites, and ammonia using a water test kit. Not much "rigorous" math is involved, he notes, just recording numbers, using a table, and some algebra. In other classes, the aquaculture unit is used for specific instructive purposes, such as labs.

Middle school science classes, meanwhile, are separated into A and B groups based upon performance. The Magnolia Middle science teacher reported that, much like the high school, students at the middle school learn graphing by measurement of pH, ammonia, and oxygen. It's worth noting that the middle school still receives the guidance of the retired Magnolia High agriculture teacher concerning the aquaculture program, who visits the school "seven days a week, unless I'm out of town." When speaking of math application in the program, he noted,

These kids routinely put chemicals in the water in parts per million ... They would have to determine how much they had grown, they would have to graph it, chart it, ... figure out the total biomass in that tank ... and then they would have to feed those fish for the next two weeks based on ... two percent of the total biomass ... We actually had books ... called *Math in the Fishery*.

All the Magnolia staff interviewed agreed that aquaculture is a math-intensive subject. Though the math teacher at Magnolia High described herself as a “shut-in math teacher” (a shut-in is a sort of invalid; the teacher was being humorously self-deprecating, it seemed), she nevertheless voiced positive opinions of the aquaculture program and reported that students had routinely brought to class math problems that arose in their aquaculture work.

The turf management program is another feature of Magnolia’s curriculum distinctive for its hands-on approach. This program is evidently Magnolia’s only bona fide vocational program and is headed by Magnolia High’s current agriculture teacher. Students maintain the school’s football and baseball fields, developing skills that will make them better candidates for employment in the turf-management industry. The decision to offer exclusively turf management reflects the growth of Alabama’s golfing and resort industry. The Magnolia High science teacher told interviewers that, because of the South’s favorable climate and soil, he’s known persons to make “six-figure incomes” in the field. Students employ math skills in this program in a variety of ways. They apply ratios to the conversion of various weights and the measurement of fertilizing materials required for specific areas of land and use geometry to figure surface area of different landscapes or the spray radius of sprinkler systems. According to research field notes, however, the Magnolia High agriculture teacher reports students of turf management use less advanced math than students of aquaculture.

Magnolia offers a variety of typical extra-curricular activities: FFA, Beta Club, French Club, and Math Club, for example. But the school also has some less common offerings, some of which may facilitate active learning. For example, as previously mentioned, the aquaculture program is available as an extracurricular activity in addition to being an academic subject. Another such activity is land judging, an extra-curricular counterpart of the turf-management program that, like turf management, is advised by the current agriculture teacher. In land judging, students dig a hole of a certain diameter and explain the soil’s properties. Students throughout Alabama enter and compete in land judging contests. Fieldnotes indicate some difference of vision between the current (turf management) and retired (aquaculture) vo-ag teachers. In part these differences may have, it seemed to interviewers, center on differing assessments of educational purpose, with the current teacher more concerned with employability regardless of place and the former teacher concerned with cultivating local entrepreneurship.

Engagement of Place and Community at Magnolia

While Magnolia offers much in the way of active learning inside and outside the curriculum, the school system’s engagement of place and community now appears to be limited. In the interviews, teachers provided a variety of reasons why place and community might not be engaged to their fullest extent at present. Before examining these reasons, the involvement of place and community that does take place deserves examination.

The retired Magnolia High agriculture teacher’s presence at Magnolia Middle School is the most striking example of involvement of community in the curriculum. His long residency in Magnolia speaks to his investment in the community. In his interview, the retired teacher expressed his belief that education in the classroom should respond to the community’s needs. He claimed that, while a teacher, he tried to foster community-oriented students by teaching them skills they would need in Magnolia:

I can only say while I was here, I really tried to connect community with what we were doing. I tried to teach students what they would need in this community, not what they would need in, you know, Nashville, Tennessee, or New York City, or whatever. And you can look around at my students and see that. You know, they’ve got jobs that are relatively [good] here. They’ve got. . .they realize they can get a job welding here. They can’t get a job welding for somebody else here, they have to start their own little business, you know, or whatever. Or they can build a construction business here, and then they can go down to the coast and build it. You know, so they can do it. That’s just my two cents worth.

The annual Magnolia Fish Fry is another tangible connection between the schools and life in the city of Magnolia. The Fry, held in the middle of town, is a graded activity for students. Students filet fish from the aquaculture units, then prepare and cook it for the public. The principal of Magnolia Middle School viewed this activity as extremely important, as he has the attention of the community for an afternoon. In his interview, he reported that he planned to have students conduct a slide show and presentation about the aquaculture program at the event. Moreover, the researcher’s field notes relate that the principal tried to coordinate the construction of a solar greenhouse with the annual fish fry.

Many teachers came forward with reports of community members and organizations being supportive of the school. The retired agriculture teacher related two anecdotes: one in which a visitor from Florida was recommended by a local barber to visit the aquaculture units and another wherein the community banded together to convince the school administration to keep the aquaculture program when a rumor arose that it would be eliminated. The current agriculture teacher reported that the cost of the school’s co-ed FFA Club, for which he is the advisor, is defrayed by selling fruit to the community. The Magnolia Middle School science teacher mentioned the local newspaper’s willingness to give positive press to the school’s activities, the students’ participation in community service, and the generosity of local businesses in providing materials to the schools. The manager of a nearby fertilizer co-op plant told researchers that the co-op donated material to the schools, and claimed that investment in local schools was important for local businesses. She believed that such involvement was more prevalent in smaller communities like Magnolia than in neighboring communities with larger populations, where, she claimed, more parents were involved in shift work.

Despite these examples of positive relationships between the school and the community, the interviews reveal a limited engagement of place or community in the curriculum per se. For example, the high school science teacher told researchers in early May that he had taken students on nature walks to cover the classification of fungi and plant life “three or four times” since March – in other words, about twice a month. When researchers asked the Magnolia Middle math teacher for an example of place- or community-based learning, she provided a single example: an assignment she gave her students to measure the square footage of the floors of their homes. (Science, as compared to mathematics, is more typically reported in the overall professional literature as sponsoring activities outside the classroom.)

The math teacher at Magnolia High had a few examples of community-based education from her classroom experience. It seems she invited a surveyor to her class a few years ago to talk to the students to: “show how he uses trig . . . the kids really enjoyed that . . .he took us out in the field and we had the strings and the [theodolite].” Another instance involved an aviation engineer,

the father of a student in the Math Club. The teacher reported that the father had visited her class before and that she had planned to take a field trip to his place of work, though the trip had not in the end proved possible. Such illustrations suggest a range of possibilities upon which Magnolia's math teachers might build, but much remains unrealized at present, as researchers heard:

INTERVIEWER:: How about the engagement of the community with the math program?

MATH TEACHER:: Well, there isn't any, to be completely honest with you.

Obstacles to Place and Community-Based Education in Magnolia

In the interviews, all of the Magnolia teachers speak of obstacles to place- and community-based education. The majority of their responses can be divided into three categories: hindrances of standardized testing, withdrawn posture of educators, and limitations of a low-income community.

From the interviews, disagreement prevails among the Magnolia staff as to whether standardized tests are a hindrance to project-based education. Some of the educators, notably the principal at the middle school, believed standardized tests were accurate indicators of performance and that active learning is good test preparation. He believed that "numbers do not lie" and that standardized tests should not be a concern to "responsible teachers." He cited the testimony of the high school principal, who ascribed excellent test scores in math and science to the aquaculture program (researchers also heard this testimony personally from the high school principal). The middle-school science teacher also voiced this claim. She said that her principal supported the aquaculture program because he saw it as contributing to stronger test scores. She agreed with the claim, telling researchers that the labs, activities, and projects in her class are reflected in students' test performance, and she also affirmed a belief that standardized tests accurately measure student learning.

The math teachers at both the middle and high school, however, claimed that standardized testing put unnecessary limitations on their teaching. The high-school teacher told researchers she felt pressed for time even when teaching elementary algebra. The varied demands related to accountability tests were the reported source of the constraints (i.e., covering all the Alabama course requirements, and also preparing students for the state-mandated graduation test across all math topics). The middle-school math teacher, expressing views echoed by both the current and retired high-school agriculture teachers, told researchers that teachers must teach to the tests in rational self-interest, as teachers are state employees and school funding is awarded based on test scores. Interestingly, the science teacher at Magnolia High observed,

Maybe we've gotten so oriented ... [to] getting ready for tests that [we arrive at a prime directive:] *I'm the teacher, I've got to get these kids ready. There's really nothing that you the banker, or you the grocery store owner, or you the drug store owner can do to help me.*

This insight may suggest that a kind of accountability frenzy (see Olsen & Sexton, 2009, for a related example) works to alienate teachers and the curriculum itself from the community. The retired agriculture teacher, a seemingly tireless proponent of connections with the community, also spoke of a perhaps related circumstance affecting school leadership generally: "The

principal especially, [doesn't] want to have to worry about the community; they want to have control over everything that goes on in the school." It's worth noting, at this juncture, that in conversations with the researchers, the current principal spoke admiringly of the aquaculture program and of its related efforts to connect school and community. The passage just quoted from the interview with the retired teacher may have been making a general observation about the dilemmas of community and the professional control of schooling.

Magnolia's economic circumstances entered the discussion several times. The math teacher, when asked about projects in her class, replied that because Magnolia is "a low-income area," she has to "keep my terms where they'll understand" when making lesson plans. The observation suggests, perhaps, a connection between comparative poverty and language facility. The science teacher at Magnolia Middle commented that, because the community is so small, students could not apply what they learn in school in the community, but rather in other communities with greater economic opportunities. The observation seemed to mean that Magnolia offers such limited employment options that most students would need to abandon the community as adults.

Finally, the retired Magnolia High agriculture teacher alone mentioned a lack of community leadership: "The best people are not the people who run this town ... the people who tend to run things are the people who bicker with each other all the time." Possibly, such a circumstance complicates the work of making community connections.

Summary

Magnolia City Schools exhibit accomplishments that are quite rare, at least in the experience of the lead authors working with impoverished rural places. The aquaculture and turf-management programs are math-intensive, hands-on programs to which many students elsewhere lack access. Magnolia City Schools keep students active with projects, field trips, and labs. The project-based approach to education reportedly receives little to no resistance from administration. Evidence exists of interaction with place and community as part of the institutionalized curriculum. Nevertheless, in mathematics classes per se, such interaction is quite limited. The Magnolia Schools' legacy of community engagement, and its on-going efforts, have not yet infiltrated mathematics instruction sufficiently to generate direct engagement with the community. Possible explanations might include the comparatively limited school and community resources for community connections generally, but this explanation is difficult to maintain in light of the many other "active learning" initiatives in play at Magnolia. A more compelling explanation might entertain the argument that a math teacher's role, especially in high school, is inherently inward-looking, introverted, or necessarily narrow. The comments of the Magnolia High math teacher seemed consistent with such an explanation. Another explanation, however, might address the influence of the prevailing accountability regime, and this explanation, too, was advanced by teachers, whom, we infer, feel manipulated and put-upon by its demands. Tellingly, perhaps, one teacher seemed to suggest that fixation on accountability testing increased the separation of community and teachers by making teachers unilaterally responsible for accountability success or failure. If the teacher is right, it may be more difficult than ever to entertain the idea that education might be a joint responsibility of educators and members of any local community. Mathematics, however, seems a particularly thorny case.

Meriwether Lewis Jr. - Sr. High School

Meriwether Lewis Junior Senior High School is located between two Salmon Falls Valley towns along the valley's primary highway (2002 populations were around 1,000 and 400 respectively) and in 2007-2008 educated just over 250 students in grades 7-12 in a Federally designated "rural: remote (43)" locale. In 2007-2008, approximately 31% (vs. 38% statewide) of students were eligible for free or reduced-price lunches. Demographics from the NCES data list 248 White students, 8 Hispanic students, 3 Asian students, 3 Black students, and 2 American Indian/Alaskan students. The eleventh grade contains the largest number of students (55) and the seventh grade, the smallest (39). According to the School's principal, union limits on class sizes mean that each classroom houses about one-half of the total students in that grade. In this case, and in observed classes, this works out to 20-28 students per class, with a published 18.4 students per teacher. Meriwether Lewis graduated 92.1% of its students "on-time," compared with the state's 72.4%.

Meriwether Lewis and the Salmon Falls Valley Elementary School share a campus and are the only schools in the school district. As such, most of the students have known each other since they started school. There is one math teacher for junior high grades and 1.5 math teachers for the senior high grades. It is almost certain that each student in the district has Ms. Jay for grades 7 and 8 math, and Mr. Valeti for 9-12. Teachers come to know students in the district and their families well during the six years they spend at Meriwether Lewis.

The State Test of Achievement (STA—a pseudonym) results from 2007-2008 are shown in Table 5, below, for the 7th, 8th, and 10th grades. Results for both Meriwether Lewis and the State are given. Meriwether Lewis School District had a "100% met" rating for AYP in 2007-2008 across all subjects and grade bands, although this was not disaggregated by race and ethnicity because the school enrolls too few students to provide reliable comparisons.

TABLE 5 || Percent of Students Meeting Indicators (2007-2008)

| Grade | Reading | | Math | |
|------------|------------------|-------|------------------|-------|
| | Meriwether Lewis | State | Meriwether Lewis | State |
| 7th Grade | 93.2% | 62.8% | 72.7% | 50.3% |
| 8th Grade | 70.6% | 65.9% | 64.7% | 51.5% |
| 10th Grade | 92.7% | 81.3% | 69.8% | 49.3% |

The Salmon Falls Valley School District enrolls students from the portion of the Salmon Falls Valley ranging 33 miles and taking just under 1 hour to drive. The spine of the valley map is the Highway, tracing the path of the Salmon Falls River from the Mountain foothills to a major River. From late Fall to early Spring, the northern end of the road and school district becomes "the end of the road," with the highway closed through the mountains because of snowslides that bury the road. Living at the end of the road means, as one resident pointed out, that only those who love living there will. The same could be said of the teachers of the area, who expressed a love for the Valley despite the drawbacks associated with isolation.

Nevertheless, there is a natural and economic gradient apparent in the valley. As a general rule, greater income levels flow in the opposite direction from that of the Salmon Falls River. Home prices tend to be greatest in the north and lowest closer to the major river to the south. Lifelong residents note the explosion of home prices once the Valley was connected to the Internet in the late 1990s. The introduction of high-speed Internet access allowed the affluent, well-paid, and well-educated to reside in the valley while "telecommuting" to work (the nearest large city is about 100 miles distant). During interviews and informal conversations, residents suggested that wealthy technology workers from a major urban center brought money to the valley and caused home prices to rise dramatically. As such, Meriwether Lewis educates sons and daughters of smoke jumpers and software engineers, of those living in trailer homes and those in modern custom houses worthy of the covers of *Sunset Magazine*.

Of all the towns in the Valley, Arbella is unique for its statutory wooden boardwalks and Western façades. The "old west" town is a popular stopping point for summer tourists on their way into or out of Cascades National Park. In the winter, after the major snows, the Valley hosts a steady stream of cross-country skiers who stay in hotels, eat at restaurants, and shop in the general store and other small businesses in the valley. Outside these two periods of activity, the Valley suffers from little to no outside business. During an early-December visit, the researcher was the only resident of a 20+ room hotel, and often the only diner in the restaurants at night. Store clerks seemed confused when the researcher entered their stores "at the end of the road."

What Ms. Jay Does

The focus of the study at Meriwether Lewis was on Ms. Jay's seventh- and eighth-grade mathematics classes. Ms. Jay grew up in the Salmon Falls Valley. She is a veteran teacher who has served as a mathematics coach for the State Superintendent's Office (SSO). As a "coach," she trained teachers on-site in reform-oriented mathematics instruction. Because of this, as well as a general commitment to professional development, her classroom contains a large selection of books and other resources she uses for instruction. Students commented in focus groups that, even though they have an "official textbook," it is just one of the wide variety of resources Ms. Jay uses to teach. Students identified the official textbook as what substitute teachers use when Ms. Jay was absent.

Two prominent features of Ms. Jay's instruction involve the community. First, "Math Communities" are a periodic activity in the seventh and eighth grades and involve pairing a volunteer parent with a group of four students to work on a pre-determined problem over the course of one class period. Ms. Jay also invites members of the Salmon Falls Valley community to describe the ways they use mathematics as part of their work, hobbies, or life outside the school. "Careers in Math" has included a bicycle shop owner, a video-game designer, a weaver, and a smoke jumper. The focus of Careers in Math is communicating relevance of the subject to students' futures, whereas the focus of Math Communities is multi-step problem-solving.

Math Communities

Ms. Jay started Math Communities “a few years” prior to the interview. According to the teacher, this usually involves having

parents come in and I train parents on what they should be doing, working in small groups problem-solving, and then they come in about every other week or so and work with small groups and work with kids solving problems. Sometimes the problem is just a problem we’re going to solve; other times it’s right along with the curriculum I’m teaching at the time.

Ms. Jay prepares multi-step problems appropriate to the age, ability, and structure of the activity. These come from her extensive knowledge and use of a large library of resources, including books, websites, personal files, and resources collected at conferences and professional development seminars to locate these problems. Ms. Jay’s fluency with a wide range of quality resources was notable.

The number of volunteers per class is usually in the range of two to three parents. In the case of my observations, four parents volunteered though only three came. Recent e-mail communications with the teacher (2009) suggest that getting parents to volunteer and then show up is an ongoing challenge. Focus-group participants nonetheless described how welcome the invitation was to come to the middle school in light of their perceptions of decreased parental involvement in their children’s schools as the students age.

Parent volunteers’ experiences and self-reported skills and knowledge in mathematics vary greatly. One informant, Sheila, described her struggle:

[In] the first period group, I can get really stumped, because there’s two kids that kinda know what’s happening, and the other two are somewhat lost, or don’t have confidence in themselves, and I feel like I’m just barely able to do the problems myself, so I don’t feel like I have enough skills to help guide them along. [It’s] almost like we get lost together, and I need to talk to [Ms. Jay] about this more, and I just haven’t talked to her about this.

Her views seemed apparent during Math Communities. She addressed three students in the group after a fourth student managed to solve the problem rather quickly:

SHEILA:: How do we figure it out if we aren’t a brain like [Female Student]?

FEMALE STUDENT:: Sorry.

SHEILA:: That’s okay. Not all of us, like me, are good at math like you are.

Another parent highlights how such feelings may inhibit parents’ volunteering for math communities:

I think, parents, you know, we were talking about labels on themselves, and there are many parents that don’t feel that they’re good enough at math to help in a high school setting (agreement). They just assume there’s no way I could do that.

The other end of the range of parental skills and confidence was exhibited by a parent who works for a software firm performing duties requiring a background in mathematics. Given the influx of telecommuters with the introduction of the Internet in the valley, it is reasonable to assume that some parent volunteers have completed college-level mathematics coursework.

Regardless of mathematical backgrounds, parents need to be aware of the methods and the problems to be used in Math Communities. Ms. Jay provides parent volunteers with support in the form of both training and packets that prepare parents for the upcoming math communities. Parents see examples of good student work, again annotated by Ms. Jay, to help calibrate parents’ expectations of the students with the teachers’ expectations. The packet, sent home several days prior to the math communities, is 5-10 pages in length and includes:

- Statement of the problem.
- Extensions of the problem.
- A detailed four-point scoring rubric assessing the categories: “solution,” “process,” and “support.”
- Sample student work graded according to the rubric and annotated with explanations.
- Sample “four-square” sheets in which students must:
 - Rewrite the question in their own words,
 - Show the mathematics,
 - Create a labeled graph, picture, chart, or diagram, and
 - Explain the “how” and “why” to solving the problem.

The four-square sheets address communication, reasoning, and problem-solving standards covered as part of the State Test of Achievement (STA). At the end of the Math Communities class hour, students must present their solutions to the class.

Ms. Jay explains:

Our STA, our state test, requires kids to explain, you know, what they do. It’s the whole communication page on the standards, and so I think you saw in my four-square problem-solving, I expect them to show me the math, to show a table or graph or something, and to explain it, and so probably on the STA, one of those is sufficient, but I think that kids need to know there’s different representation and that it’s important to be able to give a lot of explanation. I mean, in real life you have to give explanations, you have to be able to communicate, and it’s important.

Still, despite the degree of organization and support displayed by the production of these packets, some parents either don’t or won’t volunteer. Some, like Sheila, volunteer despite their fears and struggle to provide adequate help to students.

Parent focus-group participants were very positive about Math Communities but lamented not being able to “debrief” with the teacher after the communities. The parents would have liked to discuss student performance and concerns they had about what worked well (or not) for some students. Ms. Jay supports this idea but cites the lack of such time between classes. And since Ms. Jay often is covering two or three groups of students, she is not able to circulate and to observe other groups except peripherally. In a recent e-mail message (personal communication, February 13, 2009), Ms. Jay wrote that she has

had high school students suggesting to me that they (instead of adult volunteers) would like to come back and run the Math Communities that you saw. These are former students and remember doing the Math Communities and really enjoyed it. I think I may look into that, as I am having trouble with parents canceling a lot this year, but am not sure how to get the high school students out of class.

This information suggests that Math Communities have a lasting effect that some students saw as valuable and worth supporting.

Math Communities attempt to involve community members, and parents specifically, directly in support of student problem-solving. The program’s continuation is largely attributable to Ms. Jay’s tireless efforts at recruiting parents and preparing them with the extensive set of packet materials. Parent volunteers seem to welcome the opportunity to participate in their children’s school and appreciate having instructional duties. Everyone recognized the continuing challenge and time involved in recruiting and managing volunteers. Administrative support is largely in the form of admiration for Ms. Jay’s work. Fellow teachers similarly admire her work, but they claim that they don’t have the time to structure similar opportunities in their classrooms.

The assessment structure embraces the demands of the STA, and student STA scores likely reflect this. Ms. Jay indicated that her students’ scores in the problem-solving strand had risen 25% in the past three years. Her knowledge of the STA and her ability to prepare students for the test was noted by students, other teachers, administrators, and parents. The student focus group bore out this theme:

STUDENT 1:: And one thing. The STA seemed like she wrote it, because she prepared us like, really, really well for it. It seemed like it was something she wrote for us to do, like, just like a unit test, ‘cause it was like everything that she taught us. She reviewed perfectly for the STA, that was just like...

STUDENT 2:: Yeah, every day she would have a warm-up entry to the STA, so we’d get used to it.

STUDENT 3:: Yeah, like he was saying, on the STA we saw questions that were like, ‘Whoa!’ We had a question almost exactly like that two weeks ago.

The oft-echoed sentiment that the demands of standardized testing rule out the possibility of spending an entire class on one problem never arises in Ms. Jay’s class. Standards and STA preparation seem to be integrated into everyday, from the STA-prep problem that begins every class to the design of the rubric for grading Math Community problems. In a follow-up e-mail, Ms. Jay was asked to give advice to a teacher wanting to enact reform-oriented lessons but struggling to make the time in light of the need to prepare students for state achievement tests. Ms. Jay’s response is quoted at length:

I think the advice that I would give the teacher is to be very intentional in everything she teaches—don’t do it unless it covers a standard or is a skill or concept that is needed to meet the standard or for the next level of mathematics. I do do an “entry” problem at the beginning of each class period and it is directly related to standards that need to be met. Another very freeing thing for me is that I don’t follow the textbook page by page. I think too many teachers follow the text page by page instead of thinking thoughtfully about what they are teaching and the standards that need to be met. I use the standards as a guide to teach the concepts the students need to learn. It requires more work, as I sometimes need to create units from various materials. I have that flexibility, and I am not sure if she would if she works in a bigger district. (personal communication, February 13, 2009)

Careers in Math

The Careers in Math program is both older and newer than the Math Communities. Ms. Jay tried a version of Careers in Math prior to her assignment as coach with the Office of Superintendent for Public Instruction (SSO). The year of the interview with Ms. Jay was the first year of Careers in Math since her return from SSO duties. Her commitment to making the program work is evident from the grant received from the Salmon Falls Education Foundation (SFEF—a pseudonym). The grant allows Ms. Jay to pay speakers a small honorarium to offset the loss from taking time off from work to present to the class.

Ms. Jay describes the two goals:

The number one thing would be that they see *relevance* in what they’re learning and that it’s sort of a *motivational* factor to stay engaged in math and to learn math. Of course, then, the math that’s going on with those people that are in, you know, maybe that they’d learn something—that doesn’t always happen because it’s not a teacher, you know, and maybe not the best instruction or whatever, but that’s definitely secondary and definitely important, I think. My number one reason for doing it was to get, you know, my poster over there, ‘When are we ever going to have to use this?’ And then the community, they want to be involved, they want to be a part, you know, the school is pretty central, when you’re in a rural area, it’s central to our community, and so they just

want to be involved, we have such a rich background of people here, and they have so much to offer, and so, you know, hopefully that they'd just be involved and feel good about what's going on with their kids. I guess that's what I see them getting out of it [emphasis added].

Her enthusiasm for the project seemed evident when, after one of the speakers had finished speaking, she turned to the researcher and indicated that now she knows how to help that person do this next year. She said she believed that next year it was "going to be great." The fieldnotes contain the following observations that help explain what Ms. Jay seems to have meant:

[The visitor] seemed to get better as the day wore on. The mathematics was decidedly over the heads of the students, but there was probably a beneficial "wash of words" over the students. They certainly got the picture of a lot of mathematics underlying computer games and graphics.

During the week of observations, three visitors, in fact, shared the mathematics inherent to their vocations or avocations: a local fiber artist (weaver), a bicycle enthusiast, and a video game designer and programmer. The weaver began her presentation by displaying two towels she had woven, one longer and narrower than the other. She asked the students which one looked more like a towel. Students overwhelmingly chose the one with sides were roughly in proportion to the golden mean (approx. 1:1.68) as opposed to the longer, narrower one with sides in ratio of 1:2. This prompted a brief discussion of the aesthetic history of the golden ratio. Students were then shown a picture from an article in a sewing magazine. The article described the weaving of the Fibonacci sequence (1, 1, 2, 3, 5, 8, ...) into a rug pattern.

Next, students were led through vocabulary terms such as "e.p.i - ends per inch," "loom waste," and "warp." They were given string and some mini- looms made of cardboard and were told how to calculate the amount of thread necessary to weave a small "mug rug" on their looms. The calculations involved percentage loss to shrinkage, density (ends per inch and picks per inch), and measurement skills. The handout listed the following two problems:

- 1:: To make warp for a scarf at 15 ends per inch, and 8 inches wide, how many total ends do I need? If my scarf is to be 62 inches long, how much yarn do I need in inches? In feet? In yards?
- 2:: To make a 4-inch warp for a mug rug on a cardboard loom set at 6 e.p.f. how many total ends do I need? How long does the warp need to be in yards, including 8 inches of loom waste? Don't forget that warp threads go around both sides of the cardboard loom.

The class completed the calculations individually, then as a whole class, at which point the looms and yarn were distributed and students were lost to the craft. Students were observed the following day working on their weaving during Math Communities and at other moments when their attention was demanded elsewhere. Students did not appear to the researcher to have been distracted by such "multi-tasking."

Perhaps predictably, students showed the most interest in the return of a former Meriwether Lewis student, now Art Director and Co-Founder of a video game production company. Mr. Goldsmith graduated from Meriwether Lewis and then attended film school at the University of British Columbia,

afterward launching his company. After setting up a slideware presentation and connecting a gaming console to the overhead projector in the classroom, he began the class by asking students what video games they liked. Students enthusiastically (though somewhat tentatively, as is typical at this age, when one must declare one's likes and dislikes publicly) offered World of Warcraft, Halo, and Fate as favorites.

The principal of the school entered the room and took a seat near the back. Mr. Goldsmith started through a series of slides describing the steps in video game production. He then gave a programmer's perspective on the mathematics involved in video game production, talking about the dissection of the screen objects into triangles and the rating of graphics chips in triangles per second.

Students were asked about the physics represented in video games. As through much of his introduction, students seemed to be challenged by the terminology, suggesting that the perspective or material was well above the knowledge level of most of them. Eventually, terms like "gravity" and "friction" entered the discussion, and Mr. Goldsmith described the ways that triangles could be assigned a set of parameters, describing the physics of each triangle.

After the slide presentation, he turned on the gaming console and showed students the near-final version of the flagship game his company was creating for a major gaming platform. Students seemed captivated by what they saw on the screen, even though the game is a card game quite unlike the first-person shoot-ups mentioned by students as their favorites. After a brief demonstration, Mr. Goldsmith asked for questions but got none.

In terms of the teacher's two goals for the program—communicating relevance and mathematical content—Mr. Goldsmith delivered on the first, but the mathematics underlying his presentation was probably the most advanced presented by the three visitors observed and seemed to challenge most of the listeners. Nonetheless, Goldsmith's status as an alumnus of Meriwether Lewis, combined with an occupation admirable to contemporary high school students, may have given him the power to transgress typical expectations for "developmental appropriateness."

Carl Drais owns the valley's only bicycle shop. Occupying one of the western store fronts, it is a narrow showroom and repair facility run entirely by Mr. Drais. Before coming to the valley, Mr. Drais worked for a research university, where he was assistant director for community-based learning. In that role, and relevant to this study, he worked with professors and teachers to develop multi-disciplinary, community-based strategies and lessons. As such, he was eager to visit Ms. Jay's class to describe the mathematics involved in his business.

He started the class by asking students what mathematics they thought would be applicable to his job. Mr. Drais and the class eventually settled on three major areas of his business that use mathematics: financial aspects of running a business, measuring people for fitting them to a bicycle, and the mechanics of bicycles such as gear ratios. The first and last areas were addressed only briefly.

Mr. Drais called for one male and one female volunteer to be measured for a bicycle. Each student was measured for arm length (both left and right), inseam, and a measurement for height involving the sternal notch. Students in the class kept track of the measurements. Once the measurements were complete, Mr. Drais led them through the calculation of average arm length, explaining that the asymmetry of most people meant that, for the purpose of fitting to a bicycle, the average arm-length was preferred to the measurement of only one arm. This figure, together with the other two, were then used as inputs to a formula he provided to the students. The formula yielded a number that corresponded to a “baseline reach”: the distance between top of the seat post and the top of the stem. The determination of the formula was not discussed, only its use in fitting bicycles.

With the time that remained, Mr. Drais got out two wheels of different diameters and had students compare the distance travelled by each through one revolution. The class ended before these measurements could be used in any meaningful way.

Students appeared engaged in the lesson, and Mr. Drais kept the students active throughout the class period. Bicycles and bicycling seemed to be relevant to the students, and many students knew Mr. Drais already from having purchased a bicycle from him or from his role as cross-country ski coach at the school. Of the three visitors observed, Mr. Drais was the only one with a career in the valley. Unlike the fiber artist and the video game designer, having a storefront operation in the valley may have communicated a kind of relevance-in-place to the students that mathematics is important for those making a living in the valley.

The mathematics involved in the presentation was well within the grasp of the majority of students at the seventh- and eighth-grade level. It involved measurement skills, facility with computing from a formula, and basic geometry relating circumference to diameter (though as far as the presentation went, this was not addressed completely).

Ms. Jay also referred to other visitors she invited to the classroom for Careers in Math presentations. Her response during an interview suggests that she finds confirmation in her belief that mathematics is useful and important to a wide audience:

INTERVIEWER :: What’s been your biggest surprise as far as somebody who’s come in?

MS.JAY :: Personally, I was surprised at how much firefighters use math, you know, for the angle they set their ladder, they have all this stuff, and I was sort of surprised at that.

As she considered this the first year of the program (she downplayed her efforts of several years prior), there were not many examples of visitors, though her ongoing conversations with community members and her provision (through her grant) to compensate visitors for their time suggest that she has in mind other visitors for Careers in Math.

Obstacles

Despite a thorough knowledge of the Valley and its residents, Ms. Jay’s community network doesn’t include other middle school mathematics teachers with whom to share professional discourse. Math Communities and Careers in Math offer ways of addressing this isolation, as Ms. Jay indicated:

INTERVIEWER :: One of the themes that has come up is this issue you’ve expressed before, a sort of isolation in the sense of where are the other teachers that you get to collaborate with or talk with. Is reaching out to the community sort of filling a gap in that isolation, or is that just still a genuine desire to have fellow math teachers in your grade to talk with, or more time to talk with high school math teachers, or ...? How do you see yourself as a professional in a rural school?

MS.JAY :: Well, I do, my best days are the math community days because I get the parents in there and we get to talk about, I love it when we get to talk about a good math problem, you know, so I think that fulfills part of that, but I also think I still want to talk to other math teachers, and I don’t really get that much of a chance to.

In informal conversations with the researcher, Ms. Jay expressed further the wish that she had to be able to share ideas and exchange resources with other teachers at her level, especially while she was pursuing her National Board Certifications. The desire to connect with others seems to spring from a joy in doing and teaching mathematics and the desire to share that joy. Her extensive collection of teaching resources may be an attempt to engage in such a discourse in the absence of other middle school mathematics teachers. Although an obstacle, isolation in this sense does not seem to have a negative impact on the program, and the fact that everyone lives at the “end of the road” probably strengthens Ms. Jay’s ability to generate support for the programs. Hence, the isolation is more of an individual, professional obstacle than an obstacle to the success of the programs.

The unwillingness of parents and community members to volunteer and to show up reliably is a greater threat to the sustainability of the programs. Ms. Jay has expressed concerns about parents not showing up or not volunteering in sufficient numbers, even as she is grateful for the parents who contribute actively to the programs. At this point, the teacher’s enthusiasm and skills for planning, organizing, and administering the programs seems adequate to address this obstacle, viewing this as an unfortunate, but not insurmountable, annoyance. Moreover, as mentioned above, her willingness to find creative solutions and to take risks has led her to consider using high school students (who are conveniently in the same building) to support Math Communities. Hence the sustainability and success of the program depends overwhelmingly on Ms. Jay’s skills and determination.

Support

Support for the work described comes from two principal sources: grants and community. Ms. Jay seeks external support and invites both parents and community members to help with or speak to her classes. These sources of support are considered in the following paragraphs.

Ms. Jay sought and received at least two grants to support her further education and the Careers in Math project. First, she received support from the Salmon Falls Valley Education Foundation (SFVEF—a pseudonym), a non-profit organization created by residents of the Valley to support post-secondary education for its residents. SFVEF provided financial aid that helped Ms. Jay launch her teaching career: “The support from the SFVEF allowed me to complete Associate of Arts and Bachelor of Science degrees. I have since gone on to earn a Masters in Teaching, and now I teach math at Meriwether Lewis Jr./Sr. High School. I am very appreciative of the Foundation’s help with my continuing education (SFVEF Promotional Literature).”

Second, the Salmon Falls Educational Foundation (SFEF) supported Ms. Jay with a grant to compensate Career in Math visitors. She describes her motivation for seeking the grant:

This year I wrote a grant to support the teachers or the parents coming in to speak, if they don’t want to volunteer their time, sort of a small stipend. It’s through a group here called Salmon Falls Educational Foundation, and they raise about 70 or 80 thousand dollars every year, and they really give to our school. The volunteers this year that can’t volunteer their time are going to get reimbursed for their time. People that like the fireman came in they’re like working obviously won’t be reimbursed, but people [such as] small business owners, things like that, or if they’re taking time off their job, they’re definitely going to be. So I’m excited about that, because I feel like their time is valuable.

Both the Careers in Math and Math Communities programs are rooted in the concept of invitation. The programs depend on parents’ and community members’ willingness to accept invitations extended by Ms. Jay; both programs would surely have foundered had they not received minimal levels of participation. A small group of parents have volunteered for Math Communities, though problems with reliability and quality of instruction remain. Most of the parents interviewed for the study described their motivation to volunteer as a way to stay connected with their children’s education. Parents volunteer time despite other demands on their time or, in the case of Sheila, a reluctance bordering on fear of the mathematics.

Community members similarly have been supportive of the Careers in Math program, taking time from their businesses or avocations to create effective presentations and offer them at the school to multiple class sections. Other teachers, the principal, and other school officials support the program through admiration and encouragement. Improvements in sections on the STA confirm the effectiveness of Ms. Jay’s teaching and seem to offer her a license to take the risks inherent in the Math Communities and Careers in Math.

As Ms. Jay labors to recruit volunteer parents and community members, it would be easy to speak of “pleas” more than “invitations” as being at the core of the programs. Two things suggest that the concept of invitation is more appropriate, however. First, parents and community members who volunteer indicated that they wanted to be involved and that the request was a welcome way for them to be a part of Ms. Jay’s instruction. Second, an invitation is only a plea if the inviter issues the invitation from a sense of desperation or need or if the invitees view themselves as “rescuers.” Ms. Jay’s professional success as a mathematics teacher is well recognized, including her selection as a mathematics coach at SSO, where she helped other teachers to improve their practices. As such, the Careers in Math and Math Communities programs are the result of a desire on her part to improve instruction, not a result of any sense of urgent need or despair. Furthermore, all of the parent volunteers contributed to Math Communities with deep admiration for Ms. Jay and her professional abilities.

Summary

Ms. Jay’s professional knowledge, commitment, resourcefulness, motivation, and willingness to take risks are evident. Her projects and the accomplishment of her students are the evident benefits. The invitations offered by Ms. Jay in both efforts represent an opportunity to form connections—among students, the other educators, and the community. Having grown up in the valley, she aims to connect community members with the process of mathematical education and to connect students’ conceptions about and knowledge of mathematics with worlds beyond the classroom.

The planning, organization, and administration of the programs is time-intensive and involves a considerable amount of reaching out to the community and to parents to support the program through their time, funding, or ideas. She displayed relevant skills (which struck the researcher as uncanny) at marshaling a wide array of resources toward a goal, not unlike that of a virtuoso composer or conductor. That she is the only teacher of middle-school mathematics in the valley would make her known to many, but Ms. Jay’s community network is broader than those who have sent their children to Meriwether Lewis, as evidenced by the Bike Shop owner, the firefighters, and those in the community who spoke knowingly of her work at the school, despite not having sent their children through her classes. This claim is tempered somewhat by the realization that most of those with whom the researcher spoke (formally or informally) were from the upper part of the valley, representing the upper end of the economic spectrum in the valley, making them more likely to be involved in or aware of the schools (Jeter-Twilley, Legum, & Norton, 2007). As such, this claim may be overstated for the valley as a whole.

Eastcove Community School

Eastcove Community School District is located on an island off the coast of Maine. The entire student body of 71 students (pre-K to 12) reports to one building, the Eastcove Community School. This new school was completed in 2008. The 22,000 square foot building features solar panels to generate electricity and is designed with two separate wings that meet in the middle, where there are common areas and a kitchen.

At Eastcove Community School, challenges to the community are viewed as intimately tied to the school. This is due in large part to the attitude of its principal, who says that “without the school, the community would disappear.” A sense of personal responsibility for the condition of the island is built into the school’s circumstance since inhabitants live 12 miles out to sea, on an “unbridged” island. Serious issues challenging the island community become opportunities for students to construct solutions. For this reason the themes described in this report are not simply about what supports the connections between community and mathematics education, but also are about the challenges that, confronted and problematized, strengthen those connections and, at this site in particular among all others, the consciously in-play concept of *place-based education*. This site is the one in which place-based *math* education is probably the most appreciated and the most consistently sustained. The nature of the challenges here helps explain how and why, as this report will suggest.

Community Context

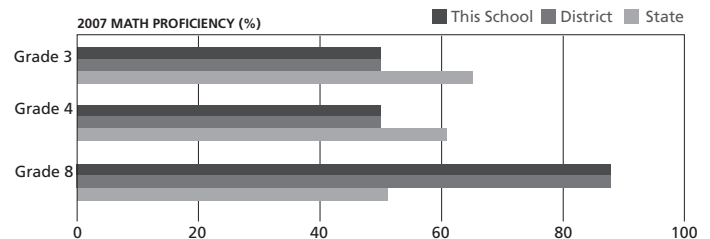
This community is small enough that the town’s informational website lists the name of every baby that lives in the community. The year-round population of the town is between 321 and 350, depending on the source, but in the summer months that number spikes to about 1,500, when people with summer homes on the island return. In addition to the economic vigor brought by seasonal residents, lobster fishing and boat building are major employments in this community. Also, maintenance of the island (it operates a sewage treatment plant, for example) provides jobs for year-round residents. According to the Eastcove Community School website, the school is, however, the island’s biggest employer. The implication of all of this is that, since the summer residents so vastly outnumber year-round residents, the summer people have a reason to support the economy and organizations of the town of Eastcove, even when it is not summer. Without the year-rounders, the seasonal residents would have no *beautiful island community* to contribute to their enjoyment of the island. The support, which is both financial and attitudinal, affects the school district’s ability to implement and sustain place-based education efforts in the areas of math and science. This theme of outside money and local pride will be played out in the body of the case study.

One more community condition must be mentioned. Eastcove is not a classically impoverished rural community. Family incomes as of the 2000 decennial census (Bureau of the Census, 2000) were just 5 percent lower than the state average (the community is *not* affluent), but rather more remarkably, the poverty rate for the 25 percent of residents under the age of 18 was just 2.8 percent. Perhaps these figures reflect the relative equality of the income distribution among the island’s year round residents: 29 percent of the families subsist on incomes of less than \$35,000; 58 percent have incomes from \$35,000 up to \$75,000; and just 13% of families have incomes of \$75,000 or greater. The national distribution (Bureau of Census, 2000) for these cut-points of family income (again, 2000 decennial census) were, respectively, 32.8%, 39.4%, and 27.7%. Eastcove family incomes constitute a distribution arguably more egalitarian than that for the nation as a whole.

Student Academic Performance

On standardized math tests for 2007, the elementary grades exhibit scores lower than state averages, whereas the eighth-grade test results show this school substantially outperforming the state as a whole (see Figure 1):

FIGURE 1 :: Proficiency Scores (2007, Eastcove Island)



Source: <http://www.schooldatairect.org>

A similar trend prevails with regard to reading scores from 2007 tests, with the notable exception that only the third-grade proficiency tests show performance below state averages, and from fourth grade onward, this school outperforms the state average on state reading proficiency tests. No test results were available for grades above grade 8.

The fact that the upper grade students of this school pass math proficiency tests at a rate of 88% when the state average is about 52%, and do so while the school implements and maintains place- and project- based math programs for the upper grades, may have to do with a *sustained* place-based and hands-on math instruction. ⁶

⁶The elementary grades seem to focus on in-class games and a textbook program implemented in 2007.

Data collected

The researcher conducted interviews with two student focus groups (5 students per focus group), one in the fifth and sixth grades, and another for the eighth and ninth grades. Additionally, the researcher conducted interviews with the principal of the K-12 school, all three of the high school math and science teachers, the middle school math and science teacher, the first- and second-grade teacher, the third- and fourth-grade teacher, the fifth- and sixth-grade teacher, the music and drama teacher, and a *place-based educator*⁷ hired by the Island Institute (<http://www.islandinstitute.org/>). In addition to educators, the researcher also interviewed a school board member, a parent, and the school secretary and conducted a joint interview with two community members who engage in fund-raising and management for the school. The researcher also created fieldnotes and gathered relevant artifacts (newspapers, school plans, community documents, and so forth). See the introduction to this report for a description of methods of data analysis.

Themes

The combination of leadership and dialogue seems powerful at this site. Devotion to place within the school, and within mathematics education in particular, survives the inevitable challenges to its existence because the variety of experiences and philosophies among the math teachers generates a culture of flexibility and tolerance. A variety of tensions and struggles also seems to foster place-based math instruction at this school. Differences of opinion are a matter of dialogue here rather than silence, and differences are apparently approved rather than merely tolerated or marked for elimination. A thoughtful principal, having survived a “critical incident” in 1997, has gained the loyalty of faculty, staff, and community.

Such evident conditions strike the researchers as key to the sustainability of the programs and a school culture that supports and promotes the engagement with place and with place-conscious curriculum and pedagogy. The school enjoys a curriculum focused on student inquiry and student choice...and considerable support from the island’s seasonal residents. These conclusions are explored and documented in the discussion of themes in this section.

Because math teachers with different approaches work together and advise one another, because most or all teachers instruct in more than one field and work with more than one grade level, and because the principal values student inquiry in the curriculum, students are unusually free to reflect on and even critique their math education. They exercise this freedom, and to an informed observer their remarks seem evidence of engagement in their own learning. Perhaps such engagement contributes to the high math scores in evidence at this site. It seems likely that educational conditions at the island (an unusual combination of community support, comparative economic equality, small school size, the experience and flexibility of educators, and

the leadership of the principal) facilitate this engagement and the superior achievement. These speculations cannot be answered by this study, of course, but only raised.

The sections that follow describe and explore themes that are implicit in the foregoing account: (1) variety of experience and approach among math teachers, (2) interaction with seasonal residents, (3) principal leadership, and (4) school culture invested in student inquiry. Each theme is, to a degree, entwined with the others, and each theme also points to challenges confronting school and community.

Variety of experience and approach among math teachers. Most of the place-based math instruction in this district occurs with the high school students. For the most part, the elementary and middle school teachers report focusing on “foundational” math, relying on in-class, hands-on activities or games, but not place-based instruction per se. However, all teachers interviewed clearly articulated their preferred approaches and seemed engaged in reflective teaching practices.

The elementary school teachers have the unusual position of teaching two grade levels at once as well as teaching all subjects, whereas other teachers in the middle and the high school levels teach perhaps two grade levels, but only two or three subjects. The fact that all teachers in this school, at all grade levels, are expected to teach more than one subject is partly the result of the small school size.

Both elementary teachers interviewed stated that, although they engage in “activities” (projects, experiments, data-gathering, etc.) and although at least one of them is extraordinarily successful with student-led instructional methods, connecting math to local place has not been a major or a sustained part of their curriculum. The principal reports that the need to teach multiple subjects encourages collaboration and dialogue between teachers. He also reports that he brought the place-based educator from the Island Institute to help teachers develop curriculum plans that take them out of the textbook:

The challenge for him [the Island Institute consultant] has been to work with—particularly the elementary teachers—in showing them that they can get out of the classroom, that they can look to the town for things that connect with their curriculum, whether it’s history...or, you know, to math projects where they see that the town has put out for bids painting the water tower...and realizing, there’s an enormous cylinder.

The principal also notes that elementary school teachers may be trained more to the classroom, and that the “town is very much overcoming their worries about seeing kids outside of the school.” No process of change is without conflict, and it seems that this school has a leader who is sensitive to the views and needs of both the faculty and the community. This sensitivity allows for teachers who are “traditional” and “progressive” to own and engage their beliefs as a part of teaching without concern for toeing a line or following some arbitrary imposition of “best practice.”

⁷Notably, this term (“place-based educator”) is used personally by this employee: “[What] the Island Institute is, it works with the different island communities, and they put different ‘fellows’ on the island...It’s an intern, basically. They are not all at the schools, but the island has to decide what need they want...and [the principal] decided he wanted a place-based educator in the school here.”

The math teacher at the middle school has a self-reportedly “traditional” bent, but a flexible attitude toward tradition. She reports that “math is in everything” and also reports using a direct and teacher-centered method of instruction because, as she says,

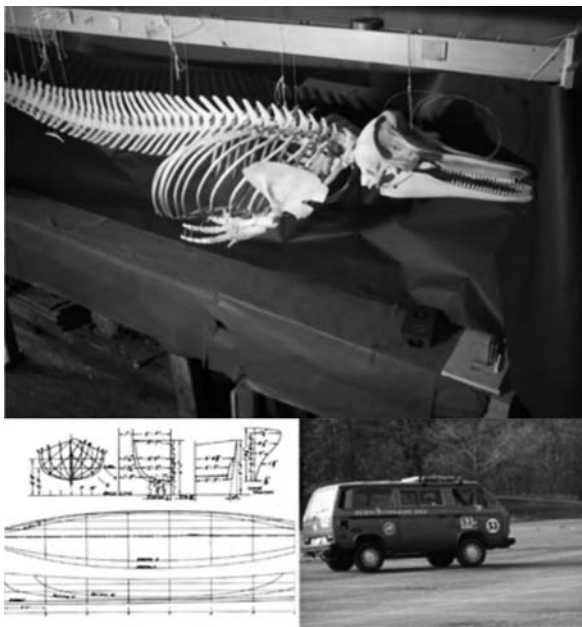
What I hear from kids is that they like...knowing that they're going to come in, they know what's expected of them, and they like that routine. And, they like the nuts and bolts of it.

This teacher also reports telling her students,

What math does is train your brain to problem-solve. It's making you look at a problem in more than one way. Because, with math, there's many, many ways to come up with a solution.

At the high school level, however, teachers use several examples of both project- and place-based math instruction. These include the building of the “pea-pod” boat (see below); units involving graphing and designing rooms for the new school being built next door to what was then the current school; and units involving the building and demonstration at a national competition in Washington, D.C., of an electric vehicle. Figure 2, below, includes a picture, taken from the school's website, showing the electric vehicle; an example taken from the blueprints of the “pea-pod” boat; and a science project in which students re-constructed the skeleton of local marine mammal.

FIGURE 2 :: *Student Skeletal Reconstruction, Pea-Pod Boat, Electric Vehicle*



A community member and fund-raiser says of these projects:

I think that just the process of building the pea-pod boat involves math. It has to involve some geometry, it has to involve some physics and an ability to take that knowledge and apply it, and I think that's huge....So, yeah, I think there's a lot of place-based stuff here. I think watching those

kids put together that Electric Vehicle, that was huge! That was huge, and how much math and science did that involve? ... And, that's applied math and science, as far as I'm concerned.

Additionally, the place-based educator hired through the non-profit Island Institute works with teachers and students at all levels to help involve place-based education into all subjects and grade levels.

A high school math teacher expressed ways in which the variety of teacher approaches to math instruction helps create an environment tolerant of ambiguity and sufficiently flexible to support place-based math education:

So, we all take very different approaches to mathematics.... I think it's great that they have a complete different diversity. Because, let's face the reality: N is much more of a mathematical theorist.... I'm much more into the application of mathematics to the finances or architecture, and M is much more the mathematician in relation to science.... We divvy up the students....So, as a result, they get all of us at least once and some of us twice. And, as a result, they'll see all of the different flavors of the way math is approached.... I have to admit, I'm not a mathematical theorist. I run to N often when I come across these theoretical concepts that are new to me.... But, he comes to me sometimes with the very practical questions. That's helpful, having that camaraderie in math, and I think the students benefit from that.... then [the students] see us having that discourse, and sometimes having contradicting opinions on mathematics, sometimes, too, which is also good to see. So, it's not always harmony.

The high school math teachers each have unique training backgrounds: one studied science and math at an MA program at Antioch New England, in a methods program rooted in place- and project- based ideals; one was an architect; and another was a “traditional” math teacher for most of his career, subsequently took up computer science and programming, then moved to the island after retirement to work in a boatyard. He reports that “somehow I got back into the school business again.” Each of the three high-school teachers evidently possesses a unique and personally meaningful approach to the study of mathematics.

Interaction with seasonal residents. One conflict, or opportunity, facing this community and its school is that every summer thousands of wealthier visitors come to the island to live until fall. While none of these seasonal residents ever attends the school, they support it in various ways, both culturally and monetarily. Summer residents who enjoy this island have an inherent stake in helping sustain a year-round community, and in being aware of the footprint they leave. Fortunately the summer residents seem aware of the inherent stake and have taken steps to care for it.

The fact that these summer residents bring in so much money has a variety of effects upon the school and community, and it may have contributed to the above-mentioned critical event in which the principal was fired not long after he first took the job. (He was subsequently reinstated; the incident is explained in detail below.) On one hand, seeing money flow in and out with such regularity seems to have engendered a “we can do it” sensibility about

fund-raising, both among teachers and students. Also, as a result of one or two very wealthy summer residents, the public school has a scholarship program that gives each student who graduates the opportunity to apply for several thousand dollars towards college tuition. One of the community enrichment programs alone produces about \$100,000 per year for school programs. On the other hand, this community may feel dependent on its wealthy patrons, and with limited property and high demand, the community does experience rising property values—a boon for the school, overall, but a burden for local residents and their children who might seek to remain on the island. Also, culturally speaking, a cultural difference exists among the two populations: islanders are, by and large, people who work with their hands, while the visitors are, by and large, specialized white-collar workers—some of them, according to the principal, quite influential and well-known.⁸ A tension prevails between what residents regard as “good enough [for Eastcove]”, and “too good,” which may be read as “destructive of island pride and culture.” Interestingly enough, this tension may produce an atmosphere more supportive of sustained place-based math education. The islanders and the seasonal residents alike have a vested interest in preserving the unique island culture and environment. Though reasons may differ, the goal is the same. Therefore, while year-round residents may sometimes resent the presence of the summer residents, they are also grateful for the resources and support provided. This support then goes to the school, where it helps sustain place- and project- based math instruction that uses Eastcove’s particular assets. Though some islanders, according to the principal, are wary of education that leaves the classroom, there seems to also be an understanding that, through place-based education, children are taught to appreciate Eastcove as well as the wider world the seasonal residents represent.

School fund-raising efforts on the part of the school and community, have been ongoing since the early 1990’s, and have been encouraged by the principal. A community member who runs a school enrichment program states:

It was [the school enrichment program] funneled into Eastcove Arts Enrichment [which raises about \$100,000 annually]. And, it’s a concept that P [now the principal] started. . . . One of the things that he wanted to encourage at Eastcove was getting people in to talk about a huge variety of subjects. . . . and, he was raising the money on his own. . . . and, it was another [person, a former school board member involved in criticizing the principal during the “critical incident” in 1997] that wanted to, she wanted an accounting of all that money, and she wanted to be able to spend it the way she saw fit. And, that’s when Eastcove Arts Enrichment split off and became its own independent non-profit organization, so that it wasn’t funneled through the school anymore, and nobody else could touch the money. It had to be aligned with the mission statement. . . . Yeah, [we] started our own non-profits. So, now, this non-profit supports my salary. . . . And, and it supports the programs that we bring here.

Here again we see conflict, this time specifically concerning funds, resulting, in the long-term, in programs and attitudes that support place-based methods on a more sustainable basis.

The demand for island property and historically rising real-estate values has prompted one high school math teacher to teach mortgages:

I made them choose a building currently for sale on this island. We go through, and we make an analysis—you know, what it would take to own such a house. We do full mortgage evaluations and decide, you know, what is the minimum earning that a person would have to have, or a couple would have to have, in order to afford that house. They actually end up making tax documents, they end up doing tax returns. . . . They [the students] never realize just what their parents have had to go through to own the houses they own. And, on this island, it’s gotten so expensive to own a house; they come to realize, you know, how difficult it will be for them to get a house on this island.

This math educator uses a local challenge to teach a practical math concept, useful in any setting.

Again, within this theme is a larger thread, persistent through all four themes presented here: conflicts, challenges and tensions are opportunities for growth, occasions to exercise personal agency. Nowhere is this thread stronger than in the history of the principal and his ongoing administration at Eastcove Community School.

Principal leadership. The current principal of Eastcove Community School has been teaching in this community since 1974. All together, he has been at ECS for 34 years. He reports that when he arrived, teacher turnover was quite high, that a feeling in the community—a sort of “*Will-you-stay?*” challenge, led to hostility and to the harassment of teachers—causing many teachers to leave:

I became principal because I was sort of the last man standing. . . . just by virtue of my persistence. . . . by then I’d been here 18 years, you know; I had this institutional memory of what went on.

Soon after he became principal, while raising money for a new enrichment program, in about 1997, he claims, “the community became divided about the school.” Here, he describes this formative critical event:

One side supported the school, the other side did not. And. . . the school board fired me. And, you know, that caused a reaction on the part of the students and a lot of the community members. The students held a sort of a walkout. They walked out of the school. . . . and then they went to Augusta, and they gave a speech on the steps of the capitol about how they valued their school, and that kind of stuff. And, that was sort of a testing moment for the whole community, and the result of it was, that the school board was voted out of office and I was reinstated.

⁸The island may not have a newspaper but it has a comparatively active web-based news source, *Offshore Grit* (a pseudonym), in which appear some of the events related to the lives of the residents, seasonal and year-round.



From the beginning of his term, to develop an education that engaged and excited students was a top priority for the principal. He saw it as a good higher than appealing to the school board. In the short term, this earned him hostility, but in the long term it seems to have affirmed to the community that he cares for the students.

He states that his interest in shaking up school culture helped cause the problems:

When a child comes to school here, they're here for 13 years...in this same building. And so everything becomes very familiar to them....So, understandably, they got bored with it. And, so, I at least interpreted it... was that we had to make the school different. We had to keep it exciting for them. And, one of the ways was to get them out of the building, to take them to places.... And, so, you know, one of the issues surrounding the controversy in the town was field trips.

From the beginning of his term, to develop an education that engaged and excited students was a top priority for the principal. He saw it as a good higher than appealing to the school board. In the short term, this earned him hostility, but in the long term it seems to have affirmed to the community that he cares for the students. One community member, who had a daughter in the graduating class the year the principal was fired says:

One of the things that made me proudest of her was when she went to try to, you know, make a stand in Augusta, which is the state capital. And, she said, 'What I learned at Eastcove, what I got out of Eastcove Community School, was the ability to reason.' ... And, I think that was a very telling comment.

Community members mention that in the community, a lingering sense of hostility remains, a sense that "if it was good enough for me in the thirties, it's good enough for me now," as one interviewee quipped. However, even among such inhabitants, the belief that the principal is the source of this threat reportedly no longer prevails.

The tenor of the principal's account of establishing place- and project- based education in this school suggests that he remains sensitive to teachers' concerns. In the next passage from the interview transcripts, he talks about the implications of a high school teacher's instructional style:

He probably was the first person in the school who sort of, was here, because he was a place-based educator...it was just as natural to him as breathing....He's done a ton of stuff with the community....You know, Q [the Island Institute Place-Based Intern] is here because I just felt I wasn't successful in, you know, really making it a part of the whole school culture. In fact, there were some jealousies. V has been such a successful, popular teacher that other teachers felt a little diminished.... And I realized that it isn't something you just know how to do. It's something you need to be trained at.... You need to shift your awareness.

School culture invested in student inquiry. The researcher at this site conducted two student focus group interviews, and in both, students were not afraid to disagree with one another or voice differing views of the approaches to math instruction in their classrooms. About half of the 10 students interviewed (fifth and sixth grades, and eighth and ninth grades) reported enjoying and benefiting from instruction, in math as well as in other areas, that connected them to the community and the region. One student in the upper grade level interview says:

What I really like is that what we're learning is, is based in the community. Like, last year, I did a whole intensive...like a month [-long] project on cod fishing...and our dad's a fisherman, so when we come home and start talking about cod fishing...he is ecstatic, and talks for hours and hours about it...so when we're learning stuff like that...other people...if we know a little bit about what their lives used to be like, then I think...we have something to talk about and it's better to know our past and some of what the island used to be like...we were talking about how Maine has shaped us.

This student, who has lived on the island since birth, feels that the connection to place and community in the school has been a positive influence. On the other hand, another upper level student says,

I feel like we have somewhat of the basics, but I feel like we need to be pushed more outside of our comfort zone. Because, I feel like Eastcove is, like, one big comfort zone, and everyone uses that to fuel the knowledge, but then it's just knowledge of this place, so when we leave here, how are we going to be knowledgeable about other places?

A similar vein of thought divided the students in the fifth and sixth grade group interview, in which one student reports enjoying the new textbook, saying that it is more "disciplined," and, "like a test almost." In contrast, another student from this interview, talking about math lessons based in lobster fishing, says:

Lobstering is...like, there's a bunch of math, and a bunch of coordinates that, like, you have to follow...and, like, and at least me, I want to be able to go out lobstering when I get older to try to have a way to make money, because we're right on an island and that's a good way to do it.

In both group interviews, all students seem to share this concern about preparation for the future, regardless of which take on math instruction they prefer—textbook- or project-based. Additionally, the fact that in both interviews, students spoke at length and with ease about their projects and their preferences suggests that the principal's (and the school's) focus on student involvement and leadership regarding school care and progress results in more active and participatory feelings about the course of their own educations. For instance, a student delegation visited planning committee sessions for the new school building and "demanded" that the planning committee include a commons area for students only, where they had some privacy. Such a space had existed in the old building, and the students wanted to ensure its existence in the new one.

The principal described his overall beliefs about *leadership*—and he did so without using that over-used term:

I say that we teach responsibility, not obedience, here...because obedience requires constant oversight. Responsibility requires, you know, teaching the kids how to be responsible and then allowing them to be responsible. And, the other [thing] is to learn by discovery rather

than always, you know, [by] explanation. What I—the approach I take [regarding federal and state tests] is that we don't do anything different, you know, to prepare them. We just do what we do. And, my belief is that if what we're doing is what we should be doing, then those tests will be fine.

The island's key educational leader explicitly discussed developing a sense of personal agency and inquiry among the students and faculty, and in all likelihood among the island's inhabitants.

General Observations

At this school of 71 students, a remarkable school culture prevails, partly as an expression of the island's character. This culture accepts and even embraces conflict. The culture sustains an educational environment in which one realization of place-based math education seemingly benefits students, families, and community. This small miracle depends on support from its seasonal residents, from variously engaged math educators, from a seasoned and prescient educational leader, and from an understanding, appreciative, and involved year-round community.

One important caveat seems in order. The intimacy of the school and the community and the peculiar mélange of facilitators make it unlikely that Eastcove can serve as a "model" for "best practice" in place-based education. The experience at this site, however, does suggest the degree to which place-based mathematics education is not simply a professional formula for success, of the sort so common in education. The main point here is perhaps not performance on accountability tests—though educators and community members clearly expect students to learn mathematics. The main point is apparently the cultivation of the community; student engagement and achievement are enacted within this apparent priority at this site. The innovations here are, moreover, arguably not such that they can be "brought to scale" (i.e., tweaked for adoption everywhere, or even only in other rural schools, or even only in other island schools) in any ready-made manner. "Fidelity of implementation," for instance, is arguably not a concept that can be applied to this "innovation." The experience of the island is idiosyncratic, dynamic, and simultaneously fortunate and troubling.

At the same time, one might easily pull some "lessons" from the experience here—but the lessons would be quite abstract: (1) understand the purposes of place-based education; (2) expect controversy; (3) struggle for resources and understand that money is power; (4) enlist the support of and engage the community in the work; (5) limit attention to accountability demands to the peripheral vision of the system...and so forth. Such nostrums are easy to frame and exceedingly difficult to follow. One might observe, however, that the right struggles have led the island to appreciate such matters, to some extent.

The Green Mountain School

Unlike the other schools in this study, The Green Mountain School (TGMS, founded in the 1960s) is a non-profit private school. In the 2007-2008 academic year, TGMS enrolled a total of 127 students in grades PK-8 taught by 15 teachers (National Center for Education Statistics, 2009). The school's student body was 84% White (107 of 127), and (with Magnolia) is among the more ethnically diverse in the study.

New England presents a circumstance unusual in the United States and relevant to this school. Throughout the New England states, many very small towns operate their own elementary school districts; some small town districts, in fact, operate only a single K-6 school. In such circumstances, these very small town districts "tuition" their children to higher grades—they pay other entities to school their children. TGMS accepts such children from two neighboring towns that operate K-6 schools only. To this extent, despite its private-school status, TGMS directly accomplishes a publicly funded purpose in ways that private schools in other regions do not.

Approximately 15% of TGMS students are from the town in which the school is located. The school does operate a local bus for nearby students, and parents drive some students to and from the school. Classes are held in two small buildings (K-6 in one and 7th and 8th grade in the other) about a five-minute walk from one another. According to 2009 school data, 30-40% of families of TGMS students receive financial aid, provisions that are enabled by grants to the school. The campus contains a large woodland tract. Timbering is a major local business, and a paper mill and lumber mill are located nearby.

Although 35% of TGMS students receive scholarships, decennial US Census data for this rural town (locale code 42) show that median household income was about 5% under the national average (for 1999) of \$42,000, and the modal salary range was \$50-75,000, whereas just 8.2% of families with children under the age of 18 existed on incomes below the official poverty line (as of 1999).

The parents are arguably more affluent than average—or perhaps more progressive than average; the teacher describes the founding of the school (in the 1960s) as a progressive alternative to the conservative tenor of local public schools. The school, however, has survived and thrived (between 2006 and 2007, enrollment increased by nearly 20%), and the community has reportedly become less conservative (several major New England colleges and universities are about an hour's drive from town). In any case, both affluent suburban schools and nearly all private schools regard official compliance routines associated with state standards and accountability provisions as irrelevant (e.g., Jones, 2007).

A researcher visited TGMS over three days in September 2007. The researcher observed classroom activities and interviewed the principal of TGMS, the TGMS teacher who originated a relevant program, and a parent of a TGMS student. Transcriptions of interviews, field notes, and observations

were analyzed to extract themes for this report. The comparative thinness of the data may be responsible for the limitation of findings in this case to a single theme, *praxis of "the real."* In addition to this theme, this report considers one possible insight about the climate of the school.

Praxis of "the Real"

What is the case at this site? Nearly all of the available data concern what one interviewee called "Tree Plot Math."

This instructional interlude is a six-week project related to the local industry of timbering. As noted above, the school campus includes a substantial tract of timbered land, and the instructional project involves the students in timber management. The "Tree Plot Math" project was initiated about seven years ago by the TGMS 6th and 7th grade math, science, and geography teacher. The teacher assigns plots within the timber stand to teams of students; the students' task is to gather data about the trees in their team's plot: number, species, height, thickness, density, and so forth. They plot and graph; they calculate measures of central tendency and variability, displayed in histograms. The teacher seems to vary the dimensions and form of the plots from one year to the next: rectangles, circles, triangles. The students calculate the worth of their trees, visit the mills, and host classroom visitors involved in timbering and timber management; additionally, on occasion, classes present their findings to the school's board of trustees (e.g., to decide if the stand should be logged or not).

Arguably the most interesting feature of this case is the teacher's perception of the process of contextualizing mathematics instruction to "reality" for middle-level students. The practice here would certainly merit deeper investigation, but the teacher's reflections are germane to the work of practitioners who may be intrigued by the possibilities of such practice, as well as to mathematics educators who wonder if "real mathematics" can *really* be engaged in this fashion. Elsewhere in this report, for instance, teachers wonder about how to connect the math they teach to everyday life outside the classroom. The Green Mountain teacher seems to address this apparent conundrum in the following extended passage:

For a couple of years, and I was just tutoring math, and I wasn't the homeroom teacher. And I was looking at some math books and at the types of problems for fractions and decimals and percents, and they're just very boring: the seventh grade sells cookies and cakes and makes this much money. And I thought, "You know what? I don't need somebody else's data; we'll get our own." And at the same time I was talking to some other people, working with Valley Ecology Project, and they were going to do a science project here. So their initial thing was tree plots in the woods. And so from some other source, and I can't remember exactly what it was, they had 30-by-30-foot tree plots, and made them into a

coordinate graph. So from there I said, "That will be the basis for my math this fall, but I will also collect data, we'll learn about trees; and the studies of percents, decimals, fractions, graphing, coordinate graphing, histograms. We can all base this on the tree plots and learn about our environment." So that's what I did, and it's grown from there.

This account discloses something akin to an epiphany, an individual insight overtaking one teacher's reflections and prompting action that soon enough (several years) becomes a local institution. Indeed, "tree plot math" is the reputational condition that no doubt led this site to be nominated.

Like any project-based effort, the Tree Plot project requires more planning, more thought, and more tolerance for ambiguity than one typically observes in schools. As the teacher notes,

It's incredibly [hard work], maybe not so much in terms of planning, because I've done it a lot, but it's incredibly busy because, as you saw, taking a bunch of seventh graders out in the woods might not appear like it's the most, efficient way of getting information across.

To explain why the effort is *necessary*, however, this teacher articulates a philosophy: the ideas seem coherent, comprehensive, and nuanced. These arguments and outlook notably pertain to a conception of "the real" and inform a praxis of *the real*. According to the teacher,

What this curriculum does is take a set of skills, and instead of doing problems in the book, relate them to *real-life* problems in the woods.

Interestingly, the teacher describes the project as a curriculum. One might interpret this to indicate that the scope of her thinking is wide—that as she thinks about this work, she sees a range of implications not hampered by standards, or what Apple likes to dub *official knowledge* (Apple, 2000). Her thinking about these matters is arguably more her own than is common in an age of "official knowledge." Reality, on the teacher's terms, also embeds misfortune:

You know this time it was nice, but last year it poured... all the kids wrote things on the tape on the trees, even though it was a sharpie and it all washed off, but that's real life.

Such a claim seems to suggest that "reality" embodies more than the contrast between the phoniness of classroom life (cf. Brown, 1991) and the reputed authenticity of everyday life. Consider, therefore, the following passage:

They're learning a lot of lessons besides just dealing with numbers, and to me that's *really* important, and when people collect data you can lose a week. And sometimes you can't go back and get it. And, when they study geography or anything else, then they start realizing that even though you have this set of numbers that's finite, there might be some mistakes in there. So I'm hoping that they get a perspective, become a little more analytical and questioning [emphasis added].

This feature of reality (*really* important... *realizing*) seems to hint at a process of learning, and not just of teaching, that enforces or evokes reality per se. The preceding passage, indeed, exhibits the same concern for the unpredictable nature of ordinary (rather than written, simulated, or scripted) life. It seems that, in the teacher's view, learning cannot exactly be prescribed in the ways that professional educators so often assume:

Some specific skills they may not retain better from working, or learning, in the woods or learning out of working in a textbook. However, their understanding of how they can use those skills to be in their environment and have it make sense, and actually get something out of it. And, the other things they learn about... their environment, affecting the economy, resources, and trees. Those things they all remember.... It also gives them an understanding of their environment which I think is really important: The woods aren't just *there* but there is actually *something in them* [emphasis added].

One can perhaps infer from this testimony that "real" learning—in exactly the sense to which the interview data attest—is by definition memorable. That is, to qualify for learning, the object of study needs to be memorable. For students of this age (and for all those who do not consider mathematics as any part of their vocation), mathematical objects are not memorable, and so, in a logical sense, do not qualify for learning. This logical inference from the data might strike some observers (especially mathematicians and some mathematics educators) as pedagogical radicalism, or perhaps just romanticism. The "tree plot math" institution at TGMS, however, is an episode in the students' year, and not the entire year. Yet the teacher's view of this episode as a curriculum suggests that the "episode" exerts an influence on her classroom teaching. Due to the short visit, however, the study was unable to examine this possibility.

Favorable Conditions

This section describes an insight that, due in part to want of data, *does not* rise to the level of a theme, but that is suggestive of overall practice at this school, a circumstance that may contribute to the emergence of the *praxis of "the real"* in the teacher-inventor of "tree plot math."

This is a small data set, as noted above. Nonetheless, in *none* of the transcripts, field notes, or observations do the words "standards" or "accountability" ever appear. Educators do not voice worry about testing or "implementing" standards-based instruction. In response to a query about objections to the project, the principal observes that a few parents would rather see their children engaged with textbooks than with the forest:

Those parents... want to spike their kids right along the "math success" continuum. Completing a book—that means success. Let's move them along to the next book.

04

TGMS offers an evidently informal approach. The field notes show that teachers were known by their first names. The seventh and eighth graders had access to a commons area between the two classrooms—and the trendy activity during the September 2007 visit, in which both boys and girls avidly engaged, was knitting.

But he pointedly adds: “*There’s not a lot of those parents here, by the way [emphasis added].*” This remark may indicate that the aims and the reputation of the school deflect parents who might otherwise consider the school as an option for their families. The sole parent interviewed for this site voiced her opinion of the strength of the school (notably using the word “real”):

Parent: What I like about TGMS is that they do a lot to connect learning to the real world. Present “enlivened” perspectives.

Interviewer: What do you mean?

Parent: What’s taught is linked to what is really happening in the world. Like last year we went to Boston on a field trip. Went to a mosque. Met with some Islamic people. Ate in a Mid-Eastern restaurant. All this was part of a study about different cultures.

TGMS offers an evidently informal approach. The field notes show that teachers were known by their first names. The seventh and eighth graders had access to a commons area between the two classrooms—and the trendy activity during the September 2007 visit, in which both boys and girls avidly engaged, was knitting. Some students, in fact, were observed using sharpened pencils to knit. The school has no bell or public address system; and according to field notes, schedules were “loose” and the tenor of the school was “relaxed and informal.” Observed the researcher: “Lots of people were coming and going.”

As elsewhere, a reputedly excellent innovation by one teacher, though clearly “institutionalized” does not seem to animate the entire school. Elsewhere in the transcript, this teacher is asked about support for this work, as follows:

Interviewer: Do you feel supported by the administration?

Respondent: Um...not unsupported, but I mean, I guess theoretically supported, but I do it. I do everything. It’s not like I have somebody else who is helping me do it.

The study, however, is interested in what enabled the teacher’s epiphany. The teacher acts with power to implement an innovation; in conventional terms she is “empowered” to teach adventurously (cf. Cohen, 1988). What empowers her here, however, is perhaps the culture of teaching and learning that prevails at this private school with a hook to the small, local public systems it also serves.

Faculty members at the school seemingly come from compatible backgrounds. Indeed, many (perhaps half) attended elite private colleges; for instance, the math, science and geography teacher who devised Tree Plot Math and still teaches it is a Dartmouth College graduate. Indeed, many faculty have undergraduate backgrounds that resemble this teacher’s. Moreover, three faculty members have received masters degrees from Antioch New England, which has become a center for the development of a place-conscious environmental education (see Sobel, 2004). Arguably, teachers here are more widely read, and (to judge, at least, from the school website) more visibly engaged in the arts and the humanities than K-12 faculty elsewhere. Faculty members likely harbor expectations and possess experiences much like those of the families they predominantly serve.

Circumstances at the school—including its ownership of a small tract of timber—would be predicted to provide favorable conditions for adventurous teaching: mostly receptive students and families, colleagues with shared values and experiences, habits of mind sufficient to the challenge, an accountability regime centered on satisfying patrons and not a remote state or national entity, and evidently sustainable school operations (on the private progressive model).

Confluence District Collaborative

Within a northern portion of a Great Plains state, the Confluence Collaborative combines four districts, Springfield-Elm, Roosevelt, Homestead, and Pioneer, into one administrative unit with leadership provided by the same superintendent and central office staff. In the Homestead and Pioneer districts, one building in each houses all students K-12, and in the other two districts (Springfield-Elm and Roosevelt), schools are divided by level, with K-6 elementary schools housing the younger students and 7-12 high schools housing the older ones.

Description of the Districts

The communities represented by the separate school districts differ in terms of their histories and future trajectories. By virtue of location and emerging demographics, some of these communities seem headed toward the continuation of farming (or “agribusiness”) as their principal focus, and therefore they appear to be retaining a rural character. Others are beginning to identify more closely with the suburban and urban communities growing up around them and seem to be losing touch with an agrarian way of life.

Of the four districts represented in the Collaborative, three serve more than one community (Springfield-Elm, Homestead, and Pioneer), while one (Roosevelt) serves just one community. The most recent census estimates indicate that the population of the Springfield-Elm District is 1,986 (US Census Bureau, 2009). Of those people, 329 are school-aged children. In the Roosevelt District the population of 891 includes 156 school-aged children. The Homestead District, with a population of 840, has 155 school age children, and the Pioneer District, with a total population of 831 people, serves 172 school-aged children.⁹ According to information provided by interviewees, the Pioneer District seems to be losing enrollment to a Catholic school in a more affluent neighboring district.

Although none of the districts is wealthy, the percentages of children living in poverty fall at or below the national average of 17.4% (National Poverty Center, 2009). In Springfield-Elm and Roosevelt, roughly 13% of the school-aged population lives in families with incomes below the poverty line. In Homestead, the rate of poverty among the school-aged population is 17%, and in Pioneer the poverty rate among school-aged children is reported to be approximately 11% even though its median household income of \$27,750 is the lowest in the Collaborative (US Census Bureau, 2009).

The Springfield-Elm District. Serving the largest population enclave in the Collaborative, this district, which came about through the consolidation of several districts during the 1950s and 1960s, appears to have access to the most resources. Its schools are also the largest. The elementary and the high

school together employ a staff of 47, including two principals. The State Department of Education’s Report Card for 2007-08 shows the graduation rate at 90% and the percentage of teachers with appropriate licensure at 95%, commensurate with state averages. The schools serve upwards of 300 students, approximately 25% of whom are eligible for free and reduced-price lunch rates—well under the state average of 34%.¹⁰

With respect to academic achievement, student performance at Springfield-Elm tended to be more than proficient. Between school years 2002-03 and 2007-08, fourth-grade reading scores rose from a pass rate of 76% to a pass rate of 95.24%.¹¹ In 2007-08, grades 8 and 11 had reading pass rates of 100% and 93.1% respectively. Pass rates in math for third and eighth grade were 100%, and the math pass rate for 11th grade was 81.48%. Science testing had just started in the year in which we conducted interviews, but pass rates were high: 95% for fifth grade, 93.6% for eighth grade, and 92.9% for 11th grade. Writing pass rates were 100% at all three grade levels at which tests were administered (i.e., 4th, 8th, and 11th).

The Roosevelt District. Educating fewer than half of the number of students served in Springfield-Elm, the Roosevelt District consists of just one building and employs 10 teachers and one principal. Although the district presents itself as serving all students in grades K-12, its K-2 students are actually bused to Springfield-Elm, and students in the other grades are taught some subjects by itinerant teachers who travel between Springfield-Elm and Roosevelt.

The Roosevelt District’s free- and reduced-price lunch rate of about 27% is slightly higher than that of Springfield-Elm. Nevertheless, its graduation rate of 100% exceeds that of the larger district, as does the percentage of its teachers who hold proper licensure (96%). Achievement test performance is also uniformly high. In 2007-08, 100% of students in all grades passed the reading test. In math, 100% of fourth- and eighth-grade students passed the test, as did 87% of the 11th-grade students. At all grade levels tested in science and writing, pass rates were 100%.

Homestead District. The Homestead district serves three communities and enrolls approximately 150 students in one K-12 school. Forty-seven percent of these students were participants in the free- and reduced-price lunch program in 2007-08. The school employs 15 teachers, eight of whom possess master’s degrees and 86% of whom hold full licensure to teach in the grades and fields to which they are assigned.

The school reports a graduation rate of 100%; and, like the other districts in the Collaborative, its academic performance, in general, is high. In all grade levels tested in 2007-08, the district received 100% pass rates in

⁹These population data all come from U.S. Census estimates (<http://www.census.gov/cgi-bin/saigp/saigp.cgi>). They differ from data provided by the National Center for Education Statistics.

¹⁰These data come from state report cards.

¹¹Apparent changes in performance may reflect the kinds of fluctuations that are often observed with small cohort sizes.

reading and science. Math proficiency rates were 100% at the fourth grade, 91.7% at the eighth grade, and 93% at the 11th grade. The fact that this one-school district is small may contribute to variability in performance from year to year, but a review of scores over several years does point to a consistent pattern of improvement.

Because the district employs such a small number of professional educators and support personnel, employees often fill several roles. For example, the high school principal also serves as the guidance counselor and the activities director. Most of the teachers listed also perform more than one role—serving as a coach, leading an extra-curricular program—in addition to teaching. Doubling up in this way is common in small rural districts across the nation, but, curiously, this practice was more prevalent in Homestead than in the other small districts (Roosevelt and Pioneer) in the Collaborative.

Pioneer District. The Pioneer district, like the Homestead district, operates one K-12 school and serves a small population of students. Identifying features of the district listed in materials describing it are: (1) its progressive nature, (2) its enrollment of students from small farming communities, (3) its use of technology to provide distance education, and (4) its more than 20-year practice of scheduling instruction over a four-day school week. The district represents its four-day schedule as a strategy for retaining the school while at the same time realizing cost savings.

Whereas financial concerns appear evident in all four districts, they seem most pressing in Pioneer. Despite the fact that it has a lower percentage of children living below the poverty line than the other three districts, its lower median income and high free and reduced-price lunch rate (40%) suggest that it might be the least affluent. Furthermore, as mentioned previously, the district seems to be competing for enrollment with a Catholic school in a neighboring community.

Serving around 150 students, the district employs 19 teachers, approximately 70% of whom meet “highly qualified teacher” standards. This relatively high rate of inadequately licensed teachers probably reflects the fact that many teachers in the district deliver instruction in several subjects and at several different grade levels. Whereas licensure subdivides teachers by specialization, the realities of a small rural district often require teachers to serve as generalists.

With regard to academic performance, pass rates on state-mandated tests seemed relatively high. In 2007-08, 100% of students in grades 4, 8, and 11 passed the reading test, as did 95% of seventh graders. In math the pass rate for both fourth and 11th graders was 100%, and for eighth graders it was 92%. In science, the pass rate was 91.7%, for the eighth grade and 100% for the 11th grade. The pass rate on the writing test was 100% for fourth and 11th grades and 83.3% for the eighth grade—the lowest writing pass rate reported in the district since 2003-04. Again, random variability is an issue in small schools and districts.

Evolution of the Collaborative

The story of how the four districts came to merge into one collaborative spans many years. Some of what set the stage for the merger happened well before the collaboration actually began, but all of the events discussed in this section help to explain why the Confluence Collaborative now functions as it does as well as informing speculations about what may happen to the Collaborative in the future.

Origin. Based on evidence found on district websites but also mentioned in some interviews, we identified two events that seemed to foreshadow the partial merger of the four districts. First, in the 1986-87 school year, Pioneer, the northernmost district, moved from a five-day to a four-day school week in order to save money.¹² Second, in 1989, Springfield-Elm established an education foundation in order to raise private monies to improve the educational infrastructure of the district. Although it did not offer direct support to the local K-12 schools, the foundation’s mission was to enhance quality of life in the district by providing college scholarships and building new facilities (e.g., library, adult education center, fitness center). Indirectly, however, by increasing the attractiveness of Springfield-Elm as a community and by adding services and facilities that the schools could use, the foundation also helped sustain the local schools.

Noteworthy in this recounting of events is the fact that from the mid-1980’s forward, the districts began to confront budget shortfalls. Also significant is the fact that the districts responded to changing circumstances in different ways, perhaps resulting from differences in their size and proximity to urban centers. While Pioneer cut school days in order to deal with budget woes, Springfield-Elm expanded community infrastructure through reliance on private funding from local residents and school alumni. These choices exacerbated already evident discrepancies in the resources available to the districts resulting from community wealth and proximity to urban centers.

Timeline. An appropriate starting point for this timeline is 1994, the year in which the superintendent at the time of our interviews assumed the top leadership role at Springfield-Elm. He remained in the position for 14 years, over the course of which the three other districts joined the Collaborative. Three changes signaled the collaboration in each case: (1) replacement of the local superintendent with the superintendent of Springfield-Elm, (2) sharing of administrators and teachers, and (3) participation in Collaborative-wide planning.

The first district to join Springfield-Elm in forming the Collaborative was Roosevelt, which ceased to employ its own superintendent in 2002-2003. At the time, in fact, Roosevelt also lost its high school principal, and one administrator began to serve both Springfield-Elm High School and Roosevelt High School. This arrangement persisted for just one year, but financial difficulties in 2009 again required the districts to cut back to one principal in a position shared by the two high schools.

¹²This arrangement persists today, but is not used in the other districts in the collaborative.

The collaboration with Homestead took place in 2006-2007, and Pioneer joined the Collaborative in 2007-2008. With four districts trying to retain separate identities yet cooperate in an effort to share resources, the Collaborative saw a need for a more formalized planning mechanism—an annual planning retreat involving local board members, community members, teachers, and administrators from all four districts.

By the start of the 2009-2010 school year, the long-time superintendent had left his position with the Collaborative. The new superintendent is an “outsider” from a distant state, and he seems to be leading the four districts toward greater centralization. For example, he is overseeing the construction of the first cross-district facility—a middle school to serve students from both Springfield-Elm and Roosevelt. In addition, he has hired a central office administrator to manage operations, finance, and technology across the four districts.

Data Collected at Confluence District Collaborative

One of the researchers on the team conducted interviews with various participants from the four districts in the Collaborative. Table 6 presents these participants by district, and Table 7 presents them by role.

TABLE 6 // Participants by District¹³

| Springfield-Elm | Roosevelt | Shared Across Two Districts | Shared Across Four Districts |
|-------------------------------------|------------------------|--|----------------------------------|
| HS Principal | HS Principal | Springfield-Elm-Roosevelt Elementary Principal | Superintendent |
| HS Math Teacher | HS Math Teacher | Springfield-Elm-Roosevelt Science Teacher | HS Industrial Technology Teacher |
| HS Science Teacher | HS Business Teacher | Homestead-Pioneer Math Teacher | |
| HS Business Teacher | HS Math Teacher | Homestead-Pioneer Science Teacher | |
| MS Math Teacher | HS Student Focus Group | | |
| 7th-8th Grade Student Focus Group | Parent | | |
| 9th-10th Grade Student Focus Group | | | |
| 11th-12th Grade Student Focus Group | | | |
| Parent #1 | | | |
| Parent #2 | | | |

TABLE 7 // Participants by Role

| Administrator | Teacher | Student | Parent |
|--|---|---|---------------------------|
| Superintendent | Springfield-Elm HS Math Teacher | Springfield-Elm 7th-8th Grade Student Focus Group | Springfield-Elm Parent #1 |
| Springfield-Elm HS Principal | Springfield-Elm HS Science Teacher | Springfield-Elm 9th-10th Grade Student Focus Group | Springfield-Elm Parent #2 |
| Roosevelt HS Principal | Springfield-Elm HS Business Teacher | Springfield-Elm 11th-12th Grade Student Focus Group | Roosevelt Parent |
| Springfield-Elm-Roosevelt Elementary Principal | Springfield-Elm MS Math Teacher | Roosevelt HS Student Focus Group | |
| | Roosevelt HS Math Teacher | | |
| | Roosevelt HS Business Teacher | | |
| | Roosevelt MS Math Teacher | | |
| | HS Industrial Technology Teacher | | |
| | Homestead-Pioneer Science Teacher | | |
| | Homestead-Pioneer Math Teacher | | |
| | Springfield-Elm-Roosevelt Science Teacher | | |

The researcher who conducted the interviews also developed field notes capturing information from participant observation and gathered relevant artifacts (newspapers, school plans, community documents, and so forth). The researcher recorded all interviews digitally, and another member of the research team transcribed the interviews.

Data Analysis

The aims of data analysis were (1) to identify information enabling a detailed description of how place- and community-based methods were being used to teach significant mathematics and (2) to surface themes with a bearing on the dynamics of establishing, integrating, and sustaining place- and community-based instructional methods in a complex collaborative comprised of multiple districts. Two members of the team analyzed data from interview transcripts, field notes, and documents.

¹³The researchers are sensitive to the fact that the data may be skewed toward Springfield-Elm because the interviewer was able to interview more participants there than in any of the other districts.

The researchers responsible for data analysis used a broad coding scheme, first to organize data by district, next to organize it by respondent group, and finally to organize it by theme. Fine-grained coding and analysis using Atlas-TI then enabled these researchers to discern dynamics within the four broad themes that explained how place- and community-based mathematics education functioned in the Collaborative. The researchers went back and forth between the data and emerging descriptions of the themes to construct an audit trail, which revealed that ample evidence from the interviews and field-notes supported each explanatory claim.

Themes

The emergent themes, which we discuss in detail below, position the Collaborative’s use of place- and community-based methods for teaching mathematics as a small but significant part of a complex scenario in which the struggle for survival takes center stage. Despite its reputation as a front-runner in the use of such methods, the Collaborative’s responses to declining resources—strategies enabling schools in all four districts to be maintained—seemed to be dampening enthusiasm for the progressive instructional methods (including place- and community-based education) that the superintendent preferred, as well as limiting energy to devote to them. We examine these dynamics under four thematic headings that organize this section: struggle for survival, noble but less-than-workable strategies, the superintendent’s leadership, and making a place for place-based mathematics education.

Struggle for survival. Struggle for the survival of each district—and its unique identity—explains much of what has been going on in the Collaborative for the past 15 years, including its efforts to use place- and community-based educational methods. As the discussion above suggests, diminishing resources and declining enrollments threaten the sustainability of all districts in the Collaborative, although each of the districts faces particular challenges:

- Springfield-Elm, the largest and best provisioned of the districts, is dealing with the encroachment of an urban center. Not only are residents moving out of the district, but increasing numbers who remain are commuting to work in the city. The rural tradition of grounding cultural life in the school is no longer as salient as it once was. Furthermore, the need for Springfield-Elm to share its somewhat more ample resources with three other districts has taken a toll.
- Roosevelt, the second largest district, is nonetheless small and continues to lose population. As a result, it is most in danger of being absorbed by Springfield-Elm through consolidation. Already, the district shares administrators with the Springfield-Elm district and sends its K-2 students to a building there. And the Collaborative has made plans for the construction of a middle school that will bring together students from the two districts into one facility.

- Homestead and Pioneer are the smallest and most remote of the four districts, and they face the sharpest financial challenges. Educators reported that the formation of the Collaborative allowed these districts to survive at a time when they would not have been able to do so on their own. Their distance from Roosevelt and Springfield-Elm, however, protects them from possible consolidation with either of those larger districts, even if the residents of one or both communities were to see that option as acceptable.

Based on these dynamics, we might be tempted to view Springfield-Elm as less vulnerable than the other districts to the forces affecting the Collaborative. It does, after all, wield the most power: it is the seat from which the Superintendent governs and the location for meetings of the Collaborative and for cross-district activities that involve students and families. In addition, it is the most affluent of the districts, and Springfield is the community with the most extensive infrastructure (e.g., the Adult Learning Center and Library, the Fitness Center).

But despite its comparative position of power, the Springfield-Elm district shows evidence of vulnerability. Of the districts, it is the only one with a history of consolidation. The inherent connection to a single community, therefore, has already been eroded. Furthermore, as the best provisioned, Springfield-Elm has been the one to give over resources to the other districts. Efforts such as distance learning, shared services, and itinerant teachers, which have been put in place to help the other districts, arguably have hurt Springfield-Elm. Certainly, its students saw it that way. An interchange from the Springfield-Elm High School ninth- and 10th-grade focus-group interview illustrates students’ acknowledgement of and frustration with this circumstance¹⁴:

STUDENT 3:: Well, since we’re from a bigger school, and the superintendent, he’s the head of the other schools now, too. So, that’s probably why we got into this distance learning thing. But, sometimes, you just think it’s not for the education of the student, it’s for saving money.

STUDENT 5:: Yeah, it’s just to save the school.

STUDENT 6:: And, if anything, it might be worse because of it. But, we’re getting by.

STUDENT 4:: We’re not having to close those schools and bring them here.

In contrast to students’ appraisal of the losses inevitably associated with the strategies the Collaborative had used to ward off closure of the smaller districts, the perspective of some adult participants was more hopeful. Parents, the superintendent, the principals, and some teachers expressed the view that hardships across all schools in the Collaborative should be tolerated for the sake of keeping a school in every community and thereby preserving each community’s history and separate identity. A comment from the Springfield-Elm High School principal articulates a point of view that was

¹⁴We saw no evidence in any of the focus-group interviews that students shared the preservationist beliefs expressed by many of the adults.

shared among many of the adults:

One of the top three goals that we set as a big group—four schools—is to keep a school in each community. . . . The perception from my standpoint as an educator, from my school's standpoint, I think, is connection to the community. Community ownership in the school—what goes on inside this brick building that the community can buy in and support. Because obviously some of it is financial. . . . with rising expenses and lower student population, how do you keep things going efficiently, financially?

The tension between the perspective of many adults and that of students illustrates the underlying dynamics of the struggle for survival. On the one hand, the Collaborative would not continue to deploy strategies in the struggle if its aspirations were tangential to community life. On the other, the strategies would begin to produce results—slowing down school and community erosion—if options other than decline were possible. We found ample evidence in the data supporting this fundamental contraction, which circumscribes the struggle and points to its likely trajectory. Our analysis suggests that the dynamics of the struggle can best be characterized in terms of the participants' tenacity and the system's inexorable loss of energy and tendency toward decline (i.e., its evident entropy).

Tenacity. Despite differences between how adult participants, on the one hand, and students, on the other, tended to perceive the likely outcome of the districts' struggles, they were united in their characterization of the four rural communities and their citizens as strong and resilient. Nevertheless, many interviewees seemed to believe that the tenacity prompting the four districts to construct the Collaborative as a hedge against school closure and community decline was a characteristic that would eventually lead to change. In other words, these interviewees held the view that students as resourceful as those in the Collaborative would inevitably lobby for schooling arrangements that moved beyond the fragile approaches currently in use.

We found evidence of the perceived tenacity of community members and students in many interview transcripts. Two quotes illustrate this perspective:

Actually, we got a good bunch of kids. I mean, yes, we're small in numbers, but we hang together. I mean, sure, you have behavior problems, you have all the little things, but they're good to the point where, we move together. . . . Because we're small in numbers we care about each other more, in a sense. (Roosevelt MS Math Teacher)

I know the community wants, it's kind of like every community wants to keep growing. . . . So, because of their numbers, they're more protective: they want to make sure those kids come back in a positive way to the community. (Homestead/Pioneer Science teacher)

Some participants pinned a great deal of hope on the Collaborative, acknowledging that the smaller schools would not be able to survive without the strategies that the Collaborative made possible. But the assessment of the situation, even from the most hopeful participants, such as the two teachers

whose comments are included below, revealed that survival was dependent on the more centralized—and therefore less locally responsive—approach that the Collaborative made possible:

[With] the smaller community size, they're willing to help the schools, especially with the position we're in now, you know, with limited resources. . . . The town wants us to stay open, will do whatever they can to help. (Springfield and Roosevelt Science Teacher)

You know, I remember when my kids were little, they said it would be closed, definitely, before they graduated. Here, they're all graduated and we're still here. . . . But, I do think the distance learning and the working together with other schools is going to hold a strong future for us. I think without that, it would be hard to survive. (Homestead/Pioneer HS Math teacher)

Other participants, however, saw the students' tenacity as a force that would eventually lead to change. For example, one of the elementary school principals remarked, "Our kids are changing and we have to keep up with them. I really believe that. We can't say, 'no, it has to be this way;' we have to move with our kids."

Entropy. The comment from the elementary school principal did not specify the sorts of changes that might lie ahead, but statements from other participants who also recognized the inevitability of change predicted that it would lead to a more cosmopolitan way of life. Two quotes, one from a teacher and one from a student, illustrate this perspective:

I want people to go get a great education, come back, and live in this village. . . . because the internet can bring all that stuff right back here. . . . But not if you don't send them out there to get a good education, and have them come back, and see all the different vision, then, well. If you're just going to have enough skills to get a job at the local gas station, that's not a lot of vision. (Springfield-Elm HS Science Teacher)

I think it would be a lot better if—I mean, it's kind of nice having a small town and everything, but—I mean, if we were in a big town, there's so many more businesses and so many more careers, so that would help with the organization of getting people lined up for that, because there's way more careers out there. Where, here, you have such a small town. (Springfield-Elm HS 9th and 10th Grade Focus Group)

Several participants also linked the diminished economic potential of the communities to the shift in focus away from rural and toward cosmopolitan concerns. As the Springfield-Elm principal put it,

We don't have the kinds of industries that attract great numbers of employees. So, we're . . . pretty much a rural, agricultural society, here. . . . Our school population is declining because of that. You know, the family farm isn't what it used to be. The family farm is now more of a corporate farm, you know, many acres farmed by a corporation. So we have a lot of our students that live in the country, but are not farmers. You know, parents may commute to [the city].

Not only did the communities appear to participants to be heading toward greater cosmopolitanism, outmigration was also clearly taking a toll. According to one of the principals, “as our numbers go, we need our community members to help us. And it’s just going to be a process of working with the community to make sure we keep the schools we want.” Another principal noted, “You know, your [financial expenses] go up as your numbers of students go down. You have to find more cost-effective ways of education.”

In fact, most participants reported on the difficulties that resulted from diminished resources. Some also described the tendency of the Collaborative to move resources from Springfield-Elm to the other districts. As one Springfield-Elm high school student commented, “We’re almost sacrificing our education to make their education a little bit better.” A similar sentiment came from the Industrial Technology teacher, who served all of the high schools in the Collaborative:

[The benefit of sharing resources] depends on which community you’re talking to. If you’re talking to the people up in Homestead and Pioneer, it’s fantastic, because they have a program. They couldn’t afford me up here—mine would be a half-time position. But . . . by doing this, they get an Industrial Tech teacher here, they get a Science teacher there, they get the CAD people . . .

Resource sharing not only led to dissatisfaction among Springfield-Elm educators and students, it also produced other negative consequences. First, it prompted a relatively large number of teachers to find other jobs or retire. Second, it necessitated standardization across the four districts, resulting in greater uniformity of curricula, schedules, and extracurricular offerings. In fact, the systematization that collaboration seemed to require led one principal to characterize the Collaborative’s educators as “interchangeable parts.” Finally, the effort required to share resources and the need to conform to more standardized procedures across the Collaborative reduced teachers’ agency and thereby limited their capacity to develop innovative curricula (e.g., place- or community-based lessons) and sustain commitment to espoused values, such as the preference for student-centered rather than teacher-centered instruction.

Interestingly, despite efforts to create standardization across the districts and to share resources, Springfield-Elm still had access to the greatest number of services, the best equipment, and the newest instructional materials. For example, observation of classrooms in Homestead and Pioneer revealed that students were using textbooks from the 1980s. And elementary school teachers in the outlying districts, according to some participants, were increasingly being asked to teach middle-school classes.

Nevertheless, students in Roosevelt, Homestead, and Pioneer had the benefit of smaller class sizes than were possible at Springfield-Elm. As one Roosevelt student noted,

In our class, it’s really nice because we only have three people, so you’re not really afraid to ask a question on something, because we all know each other, so we don’t really care if it’s a dumb question, or whatever. So, that’s really nice.

But educators were beginning to see these arrangements as untenable. The Roosevelt High School principal, for instance, argued,

I think, if we go by research, if we don’t change, we’re in trouble. And, when I say, “in trouble,” I think that we’re going to lose more kids, we’re going to have a disconnect with more kids than we already have, which is huge.

And according to the superintendent, declining resources were about to force the Collaborative to combine athletic teams, a move that the superintendent claimed was tantamount to district consolidation. One student from Springfield-Elm summed up the devolution in the quote below. His analysis came from observations of what had been happening in the Collaborative and then, in dialog with the interviewer, extended its scope to take stock of the likely fate of other rural communities as well:

You were saying something about how there’s not going to be very many small schools left? Well, there’s not. And I can see, in 10-15 years, all it’s going to be is big cities. We’re not going to have any small towns left anymore.

“Noble” but less than-workable strategies. As noted in the discussion above, the Collaborative was in league with the four communities to find ways to preserve separate schools and thereby safeguard the distinctiveness of each community. Sharing resources was the general approach, and the Collaborative used several strategies to divide scarce resources across the four districts. We found that only some resources could be shared, however. For example, the quality of textbooks and related materials varied across the districts, with Springfield-Elm having the most ample resources and Homestead and Pioneer the least adequate. The Collaborative seemed able to take only a few steps to redress this situation, however. Access to other educational services beyond those available in the schools (e.g., the library, the community learning center) also was much greater in Springfield-Elm than in the other districts because these services were housed in facilities located in Springfield.

The Collaborative, by contrast, put considerable effort into sharing instructional and leadership resources. Curriculum of sufficient breadth seemed to be the resource that was of most concern, and the Collaborative used three strategies for distributing curriculum to students in all districts: (1) distance learning, (2) relocation of some teachers, and (3) some itinerant teachers. Leadership was shared across the districts as well. Not only had the three other districts ceded top leadership to the superintendent of Springfield-Elm, the districts were also sharing principals in various ways. For example, Springfield-Elm and Roosevelt shared an elementary school principal. And the arrangement in Pioneer and Homestead was for one administrator in each district to serve as principal of all three of the district’s schools (i.e., elementary, middle, and high school). Specific arrangements for sharing leadership had changed somewhat over time, and plans for a middle school shared by Springfield-Elm and Roosevelt opened up another possibility for distributing leaders efficiently across the Collaborative.

Despite the faith that the superintendent, other school leaders, and community members put in these strategies, neither teachers nor students found them to be adequate. Teachers resented relocations from one district to another and also the requirement to travel to several schools to provide support to students who were receiving most of their instruction via web-based courseware or video conferencing in certain classes (e.g., science or English). In response to these conditions, in fact, many teachers had left the Collaborative for jobs elsewhere or had chosen early retirement. The remaining teachers seemed to feel put upon by circumstances, but also were sympathetic to the heroic effort to keep all of the districts alive. The students, by contrast, saw the struggle as a losing battle and the strategies as inadequate. Even though they functioned tenaciously under the prevailing arrangements, many students expressed the view that the effort to preserve community identity was not ultimately in their best interests.

To illustrate these dynamics, the discussion below describes each strategy, provides examples of leaders' generally positive assertions about each, and also documents teachers' and students' mostly negative assertions. The discussion of "noble" but less-than-workable strategies concludes with a consideration of what the Collaborative's written plans suggest about the long-term viability of these approaches.

Distance learning. Over time, the Collaborative had come to address the four districts' needs for varied curriculum offerings by using video transmissions and internet-based courseware (i.e., Blackboard) supported by on-site facilitators and occasional visits from itinerant teachers. At the time of our interviews, we heard from various participants that quite a number of courses were being delivered in these ways. According to the Springfield-Elm High School principal,

We have interconnectivity with the four schools, and I don't even know—what is it—50, 60 classes a day that are interconnected between the four school districts via distance learning. Plus, then, we send several outside of that four core school group.

The use of the Internet as one vehicle for providing distance education enabled the Collaborative not only to offer a large number of courses but also to differentiate course offerings based on students' interests and needs. As the Roosevelt High School principal commented,

We have such a broad base of classes, from elementary math to some of the higher levels of math that our kids have been really struggling to get, and I think they're just tickled with it. And, even though we're going to have classes with two or three kids in them, it's meeting the needs of the kids.

Despite the individualization possible through the on-line approach, low-enrollment classes nevertheless posed certain challenges. A comment from a Roosevelt student showed how one such challenge was addressed:

My brother is taking a class with a teacher [at Springfield-Elm]. And she never comes here, so to get help, you know, hands-on, with math, he goes to a teacher that stays here all day. And he gets help from him.

Participants, however, held different views about the seriousness of the difficulties associated with distance education as well as the degree to which the Collaborative's responses to these difficulties were actually effective. As suggested above, school leaders tended to downplay problems that many students and teachers seemed to find troubling. Illustrating the contrast between positive and negative assessments of the distance learning initiative are two sets of quotes:

Positive: We want a school in every community, and we want to make sure that we're getting an education that will meet the needs of our students. And, so, when they go into college, they really have a good foundation from that [on-line] Calculus class. And, so, we think we're going to do that to meet their needs. (Roosevelt HS Principal)

Negative: Well, since, like, we're from a bigger school, and the superintendent—he's the head of the other schools now, too, so that's probably why we got into this distance learning thing? But, like, sometimes you just think it's not for the education of the student, it's for saving money. (Springfield-Elm HS Student)

Positive: The community has been very supportive of everything we've done. . . . They know the enrollment's down. And, so, I would probably sum it up, like, we have a need, we're the ones that are, you might say, out there on the edge of the limb. So, if we do not have the support of distance education and the other schools, we would go away. (Roosevelt HS Principal)

Negative: You know, I think everyone has their own style; you know, time constraints have a lot to do with it. I think that has changed a lot in the last several years. Teachers, here, especially, have more responsibilities, as far as teaching in two places, or trying to teach distance classes—things are changing. So, I think, their style of teaching has also changed because of time constraints. (Springfield/Roosevelt Science Teacher)

As these and numerous other comments reveal, participants who emphasized the benefits of distance learning primarily pointed to its role in sustaining schools in all four communities by enabling the schools to offer a curriculum with sufficient breadth and depth. One student also noted that the distance learning arrangement gave him a chance to work with a greater variety of teachers than would otherwise have been possible.

Overall, however, comments focusing on drawbacks outnumbered by a considerable margin those focusing on benefits. Participants saw the following as restrictions resulting from the need to offer much of the curriculum, particularly at the high school level, through distance education:

- Students in the more remote schools had limited access to assistance from teachers.
- With distance education, teachers were unable to observe many of their students. As a consequence, they had a difficult time determining the extent to which their students actually were learning the material that was presented.

- Despite efforts to distribute materials to student and collect work from them on a daily basis, this arrangement was difficult to sustain. Students often had to wait several days to receive feedback on their work because the distribution and collection processes were inefficient.
- Distance education required teachers to use direct instructional methods—lecture, recitation, practice, homework, and review. It kept teachers from using project-based or place-based approaches.
- Even with paraprofessionals assigned to monitor students who were participating in distance learning at the more remote schools, students still became disruptive. Classroom management seemed to represent a challenge in schools in which teachers were not on site.

Although it posed challenges, distance education seemed to district leaders to be the only way for schools in the four districts to sustain curricular offerings comparable to those in urban and suburban schools. Therefore, despite serious financial difficulties, the Collaborative had recently employed an administrator whose part-time role as technology coordinator involved providing oversight to the distance-learning operation.

Staffing changes. In part to support distance learning and in part to make efficient use of teachers' time, the Collaborative instituted two related strategies involving the assignment of teachers. First, school leaders changed some teachers' instructional assignments—grade-level, subject-matter, school, and even district assignments. According to a student, for example, the computer teacher at one of the high schools had recently been asked to teach a fifth-grade class for part of each day; and the grade 3-8 math teacher at one of the schools also spent some of her time teaching reading and language arts to students in the sixth grade while a paraprofessional kept watch over her math students. Coupled with this strategy was an overall downsizing of the teaching staff across the Collaborative. When teachers left one of the districts or retired, the Collaborative did not replace them. And the districts were providing monetary incentives in order to encourage other seasoned teachers to retire.

Second, school leaders had asked some teachers to travel to two or more schools. In certain cases, itinerant teachers played a role in supporting distance learning. In others, they provided similar classes in different sites. Pioneer and Homestead, for example, shared a math teacher whose role was to offer a variety of classes to beginning through advanced-level students:

I'm a traveling teacher. In Pioneer I have Algebra 1, Geometry, Algebra 2, and Advanced Math from 9th through 12th in the morning. And then at Homestead I have Algebra 1 for the 8th graders, Geometry for the 9th graders, and Algebra 2 for the 10th graders in the afternoon.

The most extreme case in which itinerant teaching was used to spread instructional resources across the districts involved the Industrial Technology teacher, who actually visited three of the high schools on an established rotation. As his comments revealed, however, he found the situation troubling, in part because he thought the arrangement short-changed Springfield-Elm.

The trouble with what we're doing right now is... I can do Homestead today, I'll be in Springfield tomorrow, and then Roosevelt on Friday. I'm in Springfield two days a week, and sometimes, if Mr. P. has basketball, or a track meet, or something, I may not be in Springfield but one day a week.

Other teachers were so distressed by the need to travel to several schools or to work at different schools from the ones where they had accepted employment that they left the district. These circumstances were evident to most participants in the Collaborative, including students, as the following excerpt from the transcript of one of the focus group interviews demonstrates:

INTERVIEWER:: So, they retired?

STUDENT 4:: Right.

STUDENT 5:: Or went somewhere else.

STUDENT 3:: They didn't want to drive to Homestead or Roosevelt, and then come back to Springfield, like a lot of the teachers have to do. They didn't want to have to do that.

Students, particularly those from Springfield-Elm, resented the need to share teachers because they believed it eroded the quality of the education they were receiving:

I mean, the way I'm thinking of it, maybe I'm too selfish or something, but, like, since we're from the bigger school, we have all the teachers, and now, we're going to have to share them. You know? So, like, it's not helping us at all. And, because the teacher that moved—we liked that teacher a lot—and now that we've got the new teacher, everybody wants to go to the better and harder teacher, so now that's probably going to have to slow down our learning process, because we're a little further along in our studies than they are, so... And, they might not even want to try. (Springfield-Elm 9th and 10th Grade Focus Group)

Teachers, too, even those who had decided to continue employment in the Collaborative, viewed their reassignments with concern. Although they supported the aim of the districts to retain separate schools, several felt that the need to travel had limited their creativity and diverted energy from the instructional mission. From their perspective, they were now being spread too thin. In addition, a few teachers expressed the view that current arrangements kept them from serving their home communities. According to the Homestead-Pioneer science teacher, for example, "I went to school in Springfield and so I know stuff around Springfield." This teacher was clearly willing to adjust to working in schools other than Springfield-Elm, where he originally thought he had been placed, but he also found the arrangement disorienting and less than ideal. Another teacher made the comment that the need for itinerant teachers and distance education would discourage talented teachers from applying for positions that might become available in any of the four high schools in the Collaborative.

Some teachers, however, were more hopeful. The Industrial Technology teacher commented, for example,

Is it perfect? No. Is it going to get better? Yes. Mr. P. and I have talked about it. We've gone through this—this is our infancy this year. And as we get better at this, and as we do it year after year, I think you'll see more progress than what you're seeing now.

Along the same lines, but even more optimistic, were comments from school leaders, such as one from the Springfield-Elm High School principal:

So, as we go down the road, I think I see us sharing some of those most experienced teachers from each of the districts more widely. Broadening our community, and hopefully, broadening our aspects for ... students in general.

Prospects for the future. Documents from annual planning workshops (2006-07, 2007-08, and 2008-09) illuminated educators' and community members' general sentiments about the future of the Collaborative. Analysis of these documents revealed some similarities in perspective across the three years, but also some changes over time. For example, the emphasis on retaining community identity seemed to be stronger in 2006-07 than in the two subsequent years. The recommendation for actual consolidation of buildings was absent from the 2006-07 plans and was only mentioned once in 2007-08; by 2008-09, however, the plan listed several consolidation possibilities. Interestingly, as well, we saw a shift in the way the documents discussed community identity across the three years. In 2006-07, the plan positioned the maintenance of a school in each community as the way to preserve community identity. By 2008-09, the maintenance of separate athletic teams "for as long as possible" appeared to serve the same function.

In all three years, the plans focused on financial shortfalls and on approaches that would make operations across the districts more efficient. By 2007-08, planners seemed to address the concern for efficiency through initiatives not only for sharing resources but also for establishing more consistent practices in the four districts. Because distance education supported one set of curriculum offerings in the four high schools and required coordination of schedules and sharing of teachers, it seemed to push the districts toward uniformity. Interestingly, this strategy, which originally had been undertaken as a way to preserve the distinct identities of the four districts, actually seemed to set the stage for greater similarity across the districts.

If shifts in the character of the recommendations coming from the planning workshops can be taken as evidence of actual trends, we might have a basis for imagining some future prospects for the district. Such an approach is speculative, of course. Nevertheless, considering the recommendations in the 2008-09 plan along with financial information showing the continuing need for budget cuts, we suspect that in future years the Collaborative will try to expand the distance-education initiative. In fact, several recommendations in the 2008-09 plan called for the increased use of distance education not only at the high schools but at the middle and elementary schools as well. We imagine also that consolidation efforts will continue to move forward. The construction of the combined Springfield-Elm and Roosevelt Middle School

may signal the inevitability of this approach, and one of the recommendations in the 2008-09 plan was for the consolidation of the high schools in these two districts. With increased uniformity across the districts, moreover, the salience of the claim that the districts need to preserve "distinct identities" may be losing force.

The superintendent's leadership. The communities' struggles, which we discussed above, appeared to serve as the primary motive for the superintendent's approach to educational innovation. At the same time his perspectives on educational aims and strategies clearly had an influence on what he advocated and how he went about communicating this "vision." In a sense, the vision represented an enactment of his perspective within the constraints imposed by particular circumstances, namely the stressors facing the four communities, all striving to maintain distinct rural identities in the face of seemingly inexorable forces pushing them toward greater engagement with the wider, more cosmopolitan world.

Perhaps the requirement to mediate between his own perspective and the stressors circumscribing its realization helps explain why the superintendent's vision embedded significant contradictions. Whatever their source, however, these contradictions to some extent contributed to mixed messages about educational aims and the best methods for accomplishing those aims. In face of the ambiguities inevitably resulting from such a mixed message, the perspectives and practices of the districts' educators exhibited considerable variability. For example, despite the district's sustained focus on instructional methods that might be characterized as "progressive" or "constructivist," many teachers relied heavily on textbooks, worksheets, and a lecture-recitation format.

Representing a good starting point for understanding evident contradictions in the perspectives and practices observed across the Collaborative are statements from the interview with the superintendent in which he provided insights into his theory of action, that is, his system of beliefs about educational aims and the best strategies for accomplishing them. Although many of these beliefs seemed to inform his vision for the district, we are not sure if he would ever attempt to combine them all into one coherent "theory." Indeed, the fundamental contradictions among some of these beliefs might have frustrated such an effort. We nevertheless saw value in pulling together these belief statements in order to demonstrate their theoretical convergences and contradictions.

Theory of action. The superintendent's theory of action addressed three fundamental concerns: (a) what should be the aims of education, (b) what educational strategies work best to accomplish these aims, and (c) what forms of leadership and governance are needed in order to deploy the best set of educational strategies. A point-by-point analysis reveals that the belief statements include few explicit references to "place" or "community," although they clearly support a progressive approach to education that would be hospitable to "place-based" or "community-based" instructional strategies.

As discussed in the section on the communities' struggles, many of the study participants saw careers beyond the communities as the likely (and even the desired) outcomes for students who attended the schools in the Collaborative. Most graduates of the four high schools enrolled in college, and the students who participated in focus group interviews aspired to careers that required at least the baccalaureate degree. The superintendent's concern with high performance and with students' eventual success in careers seemed more to reflect the communities' aspirations for the rising generation than to champion something different. For example, in discussing the impact of the "No Child Left Behind" Act, the superintendent revealed his belief that the career success of students would speak to the quality of the education they received in the Collaborative's schools:

We aren't going to need No Child Left Behind, or a test score to tell us that our kids are capable, in the future, because I think that their pocket books [i.e., their incomes] as adults, and their ability to cope with the changing world, are going to tell us more than a test score will show.

At the same time, adaptability and affluence were not the only ways, and perhaps not even the most important ways, he gauged success: "My true interest is in what kind of adults do we have who really have ownership in their own learning."

Although the superintendent seemed confident that the quality of education in the Collaborative could be gauged by the adult accomplishments of its graduates, he did not appear to be satisfied with the academic performance of the schools in the four districts. In fact, our reading of the interview transcript led us to conclude that the superintendent saw his mission as championing change in the Collaborative, as the following quote illustrates:

I'm saying if you're going to keep a high expectation for students' performance, and you want a different product, or a better product, then it takes some change, and the creation of a new system.

In the role of change agent, the superintendent drew on beliefs about how to improve the academic performance of students in the Collaborative. His theory of action connecting a particular teaching approach to students' learning is summarized in the bullet points below. Following each step in his logic is an illustrative quote from the interview transcript.

- In order for students to perform, their learning needs to be meaningful and they need to experience success. "I think that a whole sense of purpose about 'Why am I learning what I'm learning and how am I going to use it?'—that, without that, learning is fairly hollow. And, it's unconnected. And, we know if it's going to be sustainable, it has to have connections."
- Building new learning on prior learning is necessary in order to make learning meaningful. "We know all new learning has to be tied to previous learning, and that we have to motivate that."

- Meaningful learning involves both analysis of information and emotional force (which inspires creativity and innovation). Both academic learning and affective learning (e.g., conflict resolution) are important. "Where's the creative, where's the innovative? How do I apply what I know to create something new instead of just regurgitating the old? So, I do think that there's a continuum for us to move from left-brained learning to right-brained learning, and I do think that the constant in all of this has to do with being able to apply different contexts to learning."
- To support meaningful learning the teacher needs to be a facilitator, not a director of learning. "But it does matter to us that we place the appropriate focus on learning, and that is, teachers as facilitators of learning, instead of teacher as director of knowledge. And, as a facilitator for learning, you allow kids to explore more."
- Parent support is also critical to efforts to make learning meaningful, and it occurs when parents are direct participants in the learning process. "I think, probably, the biggest step that we have tried to make, and that is, taking parents from being spectators to seeing our parents become more participants in the process."
- Place-based pedagogy is one way to make learning meaningful. "I think, years ago, we looked at place-based learning as taking the concepts of the classroom and making students more aware of how you can apply them to outside life, to outside business, to different jobs, whatever."

This logic suggests that certain changes would be essential in order for improvement to occur, while other changes might be optional. With meaningful learning as the desideratum, changes in teachers' methods of engaging students and changes in the schools' strategies for engaging parents represented essential changes. Place- or community-based pedagogy, by contrast, might be one vehicle through which such changes could be realized, but it was not an essential part of the change process itself. In fact, the superintendent appeared to be just as supportive of project-based learning as he was of place- or community-based education, and the Collaborative had participated in at least one project-based initiative that fit with the state's efforts to promote "High Schools That Work" and school-business partnerships.

Leadership strategies. The superintendent's approach to leadership appeared to correspond to his generally progressive views about education. The leadership strategies that he spoke about in the interview were "collaborative problem-solving," "self-governance," and "equal voice." At the same time, his claims about managing the change process also indicated his advocacy of one approach—direct supervision—that might be viewed as more traditional. Whether or not this combination of strategies represented a coherent or a mixed message cannot be determined by considering the superintendent's interview alone, but principals' and teachers' commentary about the change process suggested that they saw it as more directive and less collaborative than the superintendent might have intended.

Three quotes from the interview with the superintendent illustrate the progressive ideas undergirding his view of leadership:

My job is to listen to principals, to help them problem-solve for their own problems, and then model for them how they should work with their staff on really respecting that their staff can solve their own problems.

That's my challenge. How do I open up enough doors that my teachers can self-govern? Because, when you truly have the autonomy to self-govern, that's when you're going to become most innovative as a teacher.

As long as you recognize that, that every one of those groups is important to your school, and that one voice isn't louder or better than anybody else's... my voice as a superintendent should mean no more than a student voice, in this kind of a system.

Two other quotes reveal the more traditional, direct approach:

My job is directly to develop principals. Their [the principals'] job is to directly develop teachers.

That's basically all my principals do: they go into classrooms and watch you open, and they'll watch you several times start your lesson. How are you opening, how are you motivating, how are you...? And then they'll spend the next month watching closures. How are your kids closing, how are you getting your message...?

Possible contradictions. As the discussion has thus far intimated, the superintendent sought to address the needs of all of the communities in the Collaborative, and in the process his vision of change and his methods of promoting change may have incorporated certain contradictory threads. Arguably, these contradictions reflected and perhaps even illuminated economic and political forces that were more powerful than anything school leadership could be expected to tackle.

The most abstract of these seeming contradictions related to the aims of education in the Collaborative. In this case, preparation of students to function in a cosmopolitan world beyond the local communities—the “changing world” referenced in the quote above—ironically depended upon engagement with their local communities through place and community-based education. What seemed to be the desired outcome was for students to draw sustenance from these rural communities while at the same time preparing themselves for the eventuality of abandoning them. A hopeful alternative would be for the communities to persist by holding onto their unique historically situated identities and thereby making places for members of the rising generation. One message implicit in the superintendent's interview, however, was that this alternative was not something either the school leadership or the community was willing to bank on. Instead he seemed to believe that education grounded in place would at least prepare students to thrive anywhere. Place- and community-based education in this construction had far less to do with saving these particular communities than with equipping the rising generation for a future in which engagement with these communities might not actually represent a viable (or even desirable) option.

Another apparent contradiction entailed the use of distance education and itinerant teaching as approaches to keeping alive the small, local schools in the four different communities. Positioned to offer a rich curriculum in the four high schools, these two approaches nevertheless communicated the message that the outlying schools were insufficient without the addition of content from elsewhere. In particular, as the largest school, Springfield tended to be the one to send content, and the other schools tended to be the ones to receive content and add teaching capacity, if not teaching quality. As one Springfield High School student claimed, “So, the bigger schools usually have the better teachers. So, when we were little, we learned more than these little schools, so we're a little bit farther ahead in some things.”

Furthermore, distance education and itinerant teaching typically are not the easiest ways to engage students with problem-based, project-based, or place-based learning; and the interviews suggested that teachers and students found these strategies (i.e., distance education and itinerant teaching) challenging even for transmitting content. According to one student, for example, “But, like, sometimes you just think it's not for the education of the student, it's for saving money.” Distance and place-based education, while not incompatible in theory, turned out to be mutually exclusive in practice.

Finally, as mentioned above, the superintendent's leadership strategies appeared to be somewhat contradictory. Whereas he claimed to value the self-governance and independent decision-making of teachers, he put rather directive supervisory protocols in place to assure teachers' compliance with a specified lesson format promulgated by an external consulting firm. In addition he did not appear to change school structures (e.g., the 50-minute period, curriculum tracking) in order to support the use of place-based and project-based approaches.

Disjunctions between the superintendent's vision and actual teaching practice. Interviews and observations revealed that most teachers of academic subjects taught in rather traditional ways despite the Collaborative's espoused support for place-based and project-based methods. The following comment from one of the high school math teachers reflected the dominant perspective:

I don't do much in the way of pulling in outside things, really. I work basically from the textbooks and from... a few things that I've pulled together, but it's from other sample texts, and that. You know, I really haven't done a lot as far as trying to pull [in] something from the community ... and use it.

In fact, we heard strong support for place-based and project-based approaches from only a handful of teachers—one science teacher, one math teacher, and one industrial technology teacher. Principals, in general, seemed to endorse these approaches but acknowledged that changing teachers' long-standing practices was difficult. As one principal put it, “teachers ... have been taught to teach the traditional way. You get in front of the classroom, and, and it's been, as far as I'm concerned, a little bit of a struggle to change that.”

Moreover, most teachers tended to view place-based and project-based methods as appropriate primarily for students with below-average academic abilities. Teachers of advanced classes were particularly vocal in sharing their belief that these methods would not work in their classes, as the following quote shows: “I teach upper math, so I don’t know. I teach, like, trig and calculus. So, I doubt if we’d do any calculus in local places around here.”

A few of the teachers interviewed showed interest in varying their instructional formats to a limited degree, but the approaches they discussed were neither as extensive nor as coherent as the approaches to place-based and project-based education that the administrators spoke about. For example, one teacher reported,

A textbook doesn’t carry everything you needed to carry, so you start thinking outside of the box and you hear from other people they’ve had a good speaker in, and so you start using that speaker. I think you use your network of other teachers that you know, to ask them what other ideas they’re using in their classroom.

Some evidence suggested that state standards and accountability testing pressured teachers to cover a prescribed quantity of material and therefore limited the time available for them to use innovative approaches. Even students seemed aware of this situation, as the following quote from a high school student reveals:

Right now we’re taking the state standards that the state requires, but we were...we work on the board with the equations, and we’re working on radicals a lot right now, and we’ll just work out of the book in silence. Here and there there’s a worksheet, but it’s mainly out of the book, in Algebra 2.

A few teachers and students also made the explicit claim that distance learning interfered with place-based and project-based approaches. According to one high school math teacher,

You know, I think if we could come up with something, it would be very conducive, but it’s the time consumption of getting something ready that would be... I mean, we have the long-distance learning classes, we have technology... So, we can do something, but it’s the, I mean, the other little things that get in the way that you just really can’t just focus on... getting community involved with certain projects. You know? It’s the... time related. You don’t, you just, I mean, there’s priorities that you have to do, and by the time we get through that list, there’s not much time left. And, that’s sad, in a sense.

In addition, the Collaborative’s focus on structured lessons may have been inimical to the use of more innovative formats. One principal’s description of the required instructional format showed how prescriptive it was, as did a review of the website of the consulting firm that had developed the approach. According to the principal,

[The consultant firm’s approach] is just the style that we used, that we asked our teachers to put in—called “bell-ringers.” So, when kids come in, they can focus on the lesson, and then we tell them to put their

agenda in, and then a closure. And there’s actually, like, 17 different strategies [used in the approach]. But we really believe that teachers need a bell-ringer, that teachers get students focused. We need an agenda on the board, and we need a proper closure.

Making a place for place-based learning of mathematics. As the discussion of leadership pointed out, the superintendent viewed place- and community-based learning as a way to increase the relevance of instruction and therefore students’ engagement in the learning process. Several teachers also endorsed this approach and talked about various ways it augmented the curricula of the four districts in the Collaborative.

Nevertheless, with a few notable exceptions, the approach was not used widely for teaching mathematics. Elementary and middle-school teachers were more likely than high school teachers to find ways to link mathematics instruction to community activities or to use illustrations and story problems with a rural focus. Of the high school teachers who provided interviews, science teachers were more likely than math teachers to report having used place- and community-based strategies. At the high schools as well, the business and industrial technology teachers saw place- and community-based mathematics education as integral to what they were trying to teach because their mission was to prepare students for jobs in the local labor market. But teachers of college-preparatory classes were less likely to endorse or use place-based approaches.

In the analysis below, we draw on quotes from participants to show how place- and community-based strategies were used to augment mathematics instruction across the Collaborative. The discussion tells three stories: (1) place- and community-based math occurred in the Collaborative in ways that one might expect in any school district—irrespective of locale, (2) the Collaborative employed some teachers at each level who used place- and community-based methods in deeper, more generative ways, and (3) because of the districts’ move to greater uniformity and conventionality, the intellectual territory available for place- and community-based mathematics seemed to be contracting.

The usual places for basing place. Like elementary schools in many districts, those in the Collaborative sought opportunities to involve parents and community members in the schooling process and to provide authentic learning experiences through field trips to community locations (e.g., the bank, the grocery store). Participants also described how some of these activities did indeed incorporate mathematics content. Such activities, however, did not seem to be central to the learning process, nor to be closely attentive to the particularities of the communities in which they took place. The visit to the bank, for example, could have been to any bank—urban, suburban, or rural. In a sense, then, these activities demonstrated engagement with place- and community-based pedagogy. But they did not demonstrate deep engagement.

Similarly, industrial technology, entrepreneurship, and business education classes at the high schools—classes in which place and community were prominently connected to the curriculum—drew on a prevalent teaching

model used in vocational programs across the U.S. Because such programs often emphasize career development and life adjustment, thereby preparing students to participate in the local workforce, they often incorporate learning experiences that entail authentic engagement with community businesses.

One example of how this approach was used in the Collaborative involved the instruction of the Industrial Technology students in the operation of a computer-controlled lathe similar to one used in a local manufacturing company. The purpose of the training was, ostensibly, to prepare students for work in that company, but the schools were preparing many more students than were likely to be needed as local lathe operators. Interestingly, however, the teacher reported that the mathematical principles needed for understanding this complex equipment were not, in fact, “lower level.”

Another example of meaningful place-based math instruction with a vocational focus also came from the Industrial Technology class. The teacher, who had been teaching a unit on mass production for 25 years, involved his students in the manufacture of signs for local businesses and government agencies:

What we do is we bring the business community into it. I have business people come and give talks about how to issue stock, and Mr. P. can show you the stock that we issue. We issue stock . . . we produce the product, and then we manufacture the product, and we have an open house, and we sell it, and the kids reap their money after their expenses, and get their money back. So, this is one of the few classes where a student can walk out a class with 25 bucks in their pocket. (Industrial Tech Teacher)

The entrepreneurship program at Roosevelt High School also benefitted from an inventive teacher with a long-term commitment to local enterprise. This teacher had recently helped students establish an EBay business that served local community members who wanted to sell items but did not want to handle the transactions themselves. The start-up of a new community-based effort during a period in which the Roosevelt district was facing increasing threats to its existence attests to both the dedication of the teacher and the generative quality of this instructional approach. As the teacher noted,

It’s been a very good experience. We’ve had a few stumbles along the way, but since this is our first year, next year should run a whole lot smoother. But . . . it’s very good for us and for the school to be out and in the community.

Through the auspices of the business education program, some students also participated in “co-op” arrangements, working in local companies in order to prepare for the transition between school and the workplace. In addition to these initiatives, the teacher invited members of the community to come into the class on a regular basis, in part to convince students that academic study was relevant to career preparation:

We have the community members come in, and when they’re talking about their business and how important education is, and especially basic education . . . so, mathematics is a function that they need to leave the school with, that they have to be well-versed and well-prepared. (Roosevelt Business Teacher)

Whereas the vocational teachers recognized that place-based activities contributed to instruction in applied mathematics, some of the teachers of college-preparatory classes did not credit these activities as legitimate parts of the mathematics curriculum, despite the complexity of the math used. These teachers saw mathematics instruction, particularly in upper-level classes, as abstract and theoretical, with little need to make connections to local places or to community issues. As one such teacher remarked,

We don’t really do anything in places. We don’t really do any of that. I would say, maybe, the shop class is where you’re going to find that. . . . Probability—are we really going to put that in a place? The only way that’s going to happen is through some sort of block scheduling. I’m not sure that the upper math classes (maybe [students from] a lower-income average are going to need that), but my upper math classes—I don’t know that they’d benefit a whole lot (Springfield-Elm HS Math Teacher)

Some teachers had similar things to say about instruction in other academic subjects. The following quote, for example, contrasts a science class in the “general” track with the chemistry class in the “college-preparatory” track:

It’s actually called, “Community Chemistry.” I feel it’s more a community science . . . just because of the curriculum that we have. It’s more of a general class than a specific chemistry class. Usually, [it’s for] the students who didn’t want to be in chemistry. We’re throwing in a little bit of chemistry with environmental and, just, some good science review in the 11th grade year is basically what it is. (Springfield Elm-Roosevelt HS Science Teacher)

The generative possibilities of place- and community-based math. In contrast to the elitist sentiments of some high school teachers, most students and school-level administrators saw value in a more inclusive and practical approach to mathematics instruction. As one of the high school principals reported,

I do think we do math across the curriculum . . . we offer a program called Electric Power Car competitions, where the kids do a lot of math. When we started a few years ago with the electric car process, and kids really had to get into the math, because they had to draw their plans up, for this electric car. They had to build it from scratch, that’s all electric-powered from batteries, and they had to know how much it would pull—how many amps it would pull for how long. . . . And, so, when they got into the math part, I think they started to enjoy that. . . . They saw the value of the math, where some kids [say] (and you’ve heard it before too) “where will I ever use this?” . . . And, I do know that in our sciences, of course, we have a lot of math in science. (Roosevelt HS Principal)

Students across the curriculum tracks not only appreciated large-scale projects that enabled them to learn and apply math, they also enjoyed instruction in which teachers used authentic examples to illustrate math concepts. Describing one of the math teachers, a student commented,

Well, she is so math-y. She relates everything to math in her life. So, then, she'll always get these little stories, like, she was grocery shopping, and she thought of this, or something. And, so, each day, basically, she has something that relates to our lesson that she thought of, or something. (Springfield-Elm 11th and 12th grade Focus Group)

The schools also used service-learning projects as a way to link academic instruction to the needs of the local communities. Participants described various such initiatives in which students learned mathematics through their participation in construction projects:

We're just building a shed. It's like an 8-by-10 shed, and I figured the angle for the rafters and everything like that. So, that was a lot of math, I guess, related to... something that would be part of the community, I suppose. (Springfield HS 11th and 12th Student Forum)

They've built some things for the city, along the walking trail. And, like I said, they built some garages. We usually build two or three sheds a year, where people will come in and say, you know, "I'd like a garden shed for my backyard," or something. So, we go out and see, ok, "How big is your backyard; what dimensions do you think you'd like this?" And, then, we come back and some of our math kids will sit down and start plotting, drawing it out. The kids really enjoy that hands-on, get out of the building. (Springfield-Elm HS Principal)

Science classes also gave students the chance to learn mathematics through engagement with place and community. At Springfield-Elm High School, the science program had a research focus, which provided learning experiences that were both technologically sophisticated and attentive to local issues. Testing water quality, for example, was one way that students could connect realities of large-scale agriculture to significant environmental concerns.

I have some ... probes that people will stick into a solution that helps them visualize the type of mathematics that's possible on a local basis. Like, we test for nitrates in the water or things like that. And, you can look with your eye—it looks like an iced tea solution, so you can sort of see a spectrum of how many parts per million might be in something. And, you can actually, physically, guess close and then you put it in an instrument and it will shoot this beam of light through it, and tell you what amount of light is actually going through the material, compared to a standard. And, that's all that those machines (spectrophotometers) are, which is really a big link between math and science, because it shows you how the probe can fit into that, to tell a mathematical reading. So, there's math in both—and math in all kinds of things. (Springfield HS Science Teacher)

Whereas in the higher grades educators saw community as the context for connecting students with vocations and as a way to increase curricular relevance, at the elementary level, educators treated the community as an affective touchstone, sometimes in the superficial ways described above, but sometimes in deeper and more generative ways. Because each community served as a source of support and meaning for its residents, it lent emotional force to what the school was trying to accomplish. In the following quote, for

example, a math teacher from one of the middle schools revealed her belief that connection with the community would increase students' appreciation for mathematics as a subject:

But, it is important that we try to build a relationship between the community with math as a subject... They built a new pool, and so I took the grades 3 through 8, but we studied perimeter and area and volume, and did those. We measured the new pool and so on, and so forth... We studied stuff in math at a community place, you know, if that makes sense. (Roosevelt MS Math Teacher)

A math teacher from a middle school in one of the other communities also shared the view that grounding in the familiar—students' homes and places of residence—would help them see math as a purposeful part of daily life:

We'll talk about the carpenters in town or the computer place, or the local businesses, that way. And, they're able to connect to those people because they know those people. Or, they'll bring in their own parents' positions, and maybe reflect, "My dad's a business owner. What does he do? What does he do mathematically?" (Springfield-Elm MS Math Teacher)

Using problems and examples with local relevance was, in fact, something that math teachers at all grade levels tried to do. The math teacher at Pioneer and Homestead, for instance, reported, "When I think about instruction, especially story problems, I like to include something, for instance, agriculture. For instance, if we're doing mixture problems, possibly relate it to herbicide or something like that."

Students also were quick to point out their awareness of ways in which mathematics fit with important activities in the community. For some, knowledge about how mathematics was used in the community was grounded in the experience of farming, as the following quote illustrates.

My dad—he put up a new hog unit, and so he was just going over... the money you need to do this stuff, and actually, kind of, the money he brings in, he kind of went over with me about that. And, you don't really expect that math to be that complicated with a simple hog farm, but it's more complicated, I think, than people think it is. (Roosevelt HS Student Focus Group)

Other students talked about the math used in various jobs in the community, such as carpentry and the operation of a small business. Some, like the student quoted below, reported about how they had used math in the work required by a summer job or on the family farm.

And, this summer I worked at a trailer manufacturing place, building trailers, so it was huge. Everything's got to be perfect angles, and everything's got to match up and be symmetric. So, I use it a lot. (Roosevelt HS Student Focus Group)

The parents who were interviewed also expressed the hope that the schools would provide math instruction that showed explicit linkages between academic subject matter and valued community enterprises, particularly farming:



While appreciating the benefits of place- and community-based methods of instruction, teachers nevertheless recognized that challenges facing the Collaborative sometimes functioned as impediments to the use of such methods. In particular, budgetary constraints and increasing standardization limited the extent to which teachers were able to use these forms of pedagogy.

Well, I'd like to see them [i.e., the teachers]—this is coming from the farm aspect. You know, you have to figure how much chemical to fertilizer and all that. And, my son uses it all the time. I mean, sometimes you want to change the ratio. So sometimes maybe if they would ... throw in just a section on figuring—using your math ability to formulate. ... Or, sometimes you have to, I mean, teach them how to measure out an acre of farmland, or something, you know, since we are an agricultural community, and if the kids stay around here... (Springfield Parent #1)

As the discussion has thus far showed, a number of teachers were dedicated to place- and community-based education and found inventive ways to use it to teach math as well as other subjects. For at least one of these teachers—a teacher who had recently assumed responsibility for educating not only elementary, but also middle school students—connecting math to community life supported the complicated task of teaching math to students at several grade levels.

While appreciating the benefits of place- and community-based methods of instruction, teachers nevertheless recognized that challenges facing the Collaborative sometimes functioned as impediments to the use of such methods. In particular, budgetary constraints and increasing standardization limited the extent to which teachers were able to use these forms of pedagogy. As the math teacher at one of the middle schools noted, "If we could get past (I hate to say it) the standards and that kind of thing, we could... connect math to the real world." Despite the difficulties, the teachers who were committed to this approach found creative ways to work around the impediments. One science teacher—the same teacher who ran the science research program—had obtained a bus driver's license, for example. Having the license meant that he no longer needed to forgo field trips but could drive his students to locations in the community where they could test water quality.

The shrinking place for place-based education. Perhaps the word "distance" and the word "place" are, in important ways, opposed. Yet both distance education and place-based education were occurring within the Collaborative at a time when enrollment losses and funding problems seemed to be requiring the former approach to take priority over the latter. As the discussion above showed, parents and administrators preferred any approach—even one where place- and community-based education might be sacrificed—that would allow each community to retain its schools. Their stance resulted not from the belief that distance education is a better pedagogical method than place- or community-based education, but from the strong conviction that survival of the communities was an important aim of schooling in the Collaborative.

Unlike parents and school-level administrators, the superintendent seemed to see the demise of the communities as inevitable, and his comments about the primary aim of schooling—to prepare students for high-paying jobs, most likely jobs beyond the borders of the four communities—motivated his emphasis on educational quality. In his mind, distance education and place-based education could co-exist because both contributed to the academic—and eventual career—achievement of students.

Teachers, by contrast, saw the two approaches as ultimately incompatible. For teachers, the instructional roles required under the two approaches were so significantly different that the (perhaps preferred) option of exposing all students to both approaches seemed already to be out of reach. At the time of the study, the Collaborative appeared to be working out the contradictions in two ways. First, administrators were asking teachers to take on different roles, some of which entailed extensive involvement with distance education and some of which permitted on-going engagement with place- and community-based initiatives. Second, particularly at the high schools, distinctions in curriculum tracks guided the allocation of instructional methods. Distance education, which allowed for the provision of advanced

content, seemed to fit the needs of high-ability students. And place-based education, with its focus on concrete applications of academic content, seemed to many participants better suited to the needs of less academically capable students, namely those in general and vocational tracks. Teachers and administrators viewed involvement with place and community as especially motivating to students whose limited academic talent might predispose them to seek jobs in local markets rather than pursuing college degrees and lucrative employment elsewhere.

Curiously, the students who participated in focus-group interviews appeared to have a more complete understanding of these dynamics than any other participant group. Their comments revealed awareness of and sympathy for the various, competing concerns (i.e., the concern for community survival, the concern to prepare talented students for jobs elsewhere, the concern to motivate disengaged students, the concern to provide a wide-range of curriculum offerings). Of the participants, moreover, the students seemed to us to be the most realistic in their appraisal of efforts to create an education system by combining essentially incompatible approaches. The comment made by a Springfield-Elm High School student captured what many other students also alluded to: “They’re not doing it to educate us better; they’re doing it so that they can save money. And, if anything, it might be worse because of it. But, we’re getting by.”

Many participants seemed to realize that “getting by” under current arrangements was a temporary condition and that economic pressures were impinging on the options available to the Collaborative. The fact that the most recent strategic plan included discussion of extending distance learning to the elementary and middle school levels perhaps stands as evidence that “distance,” rather than “place,” may be winning out as the paradigm under which the districts’ students will be schooled in the future. Moreover, the contrast between the formality and standardization of distance education and the informality and spontaneity of place- and community-based initiatives also speaks to the likely trajectory. Under conditions of increasing stringency, streamlined and efficient approaches seem destined to prevail.

Summary and Conclusions

The study of the Confluence Collaborative provided a detailed look at the dynamics of place- and community-based education within four rural districts that are facing population loss and financial difficulties. As the discussion showed, one of the districts, Springfield-Elm, was larger and better provisioned than the other three. It was also closer to an urban center, and the outlook of its citizens and educators was therefore changing from a primarily localist and agrarian perspective to an increasingly more cosmopolitan one. This district provided the power and leadership needed to deploy a set of strategies designed to protect the survival of the three more rural districts. The irony of this circumstance was not lost on participants.

The study disclosed four themes that characterized the aims and strategies of the Collaborative and its likely trajectory. The discussion of the themes disclosed the following significant dynamics:

- The preservation of four distinct communities represented by four separate school districts was a priority of the adult residents of those communities. Across the board, however, participants acknowledged that the smaller districts would not be able to survive without the strategies the Collaborative made possible.
- Despite their utility in sustaining the four separate districts, these strategies nevertheless required greater centralization and standardization. The strategies involved the sharing of leaders, teachers, and various resources as well as the extensive use of distance education, particularly at the high school level. Although citizens and school leaders saw these strategies as necessary, they frustrated many teachers and students. Some teachers were so disaffected that they decided to retire from or leave the Collaborative.
- Sharing of leadership, which was one of the strategies used by the Collaborative, involved the employment of just one superintendent for all four districts. This individual had strong views about the types of education that would engage students sufficiently to ensure high levels of academic achievement. Nevertheless, the stressors facing the four districts limited the degree to which the districts in the Collaborative could actually provide the types of education that the superintendent preferred. Therefore, although the superintendent saw place- and community-based pedagogy as productive methods for improving education in the districts, he was unable to promote them as essential features of the Collaborative’s approach. Distance education, by contrast, had become an essential approach because it allowed the districts to function even as resources increasingly became scarce.
- Throughout the district, some teachers continued to use place- and community-based pedagogy even though doing so was difficult. At the high schools, vocational teachers and science teachers were more likely than math teachers to use these approaches. At the elementary level, many teachers used these approaches to lend affective force to the lessons they were teaching. Nevertheless, for the long term, the instructional roles required by distance education and place-based instruction were so significantly different that the option of exposing all students to both approaches was becoming more and more elusive.

As these themes revealed, the effort required in order to share resources and the need to conform to standardized procedures across the Collaborative reduced teachers’ agency and thereby limited their capacity to develop or sustain innovative curricula. Ironically, the resulting approach to education actually interfered with the ability of each district to maintain a distinct identity. Whether or not these dynamics would actually lead to district consolidation was not clear, but some evidence pointed to an increased willingness of adult citizens and educators to accept the inevitability of this outcome in the face of declining enrollments and diminished resources.

Lafayette County High School

The study team selected Lafayette County High School because of the interesting work of one mathematics teacher, Tony Perdue (pseudonym). Tony was a promising ACCLAIM doctoral student who had decided to leave the program after his first year (2004-2005). During that year, however, faculty had learned of his intention to found a lutherie class at the rural high school where he taught. "Lutherie" is not even a word in common usage; it means "stringed-instrument building." Tony was seemingly interested in combining his two passions: music (he was an accomplished guitarist) and teaching mathematics. As we learned during the visit, the school and the district and the community supported the program in varied ways. Tony had also been successful in securing grants for the work, and the district reportedly helped purchase a CNC (computer-numerical-controlled) router, which some students, we were told, had learned to program.

Context

After the site was nominated, researchers learned that Tony had indeed established the class and that it was operating successfully in 2007. Tony and the school leadership agreed to participate in the study, and in May 2008 we interviewed both the superintendent and the assistant principal, the two teachers involved in the lutherie class (including Tony), as well as a former teacher, parents, students, and community members without children currently in the school.

School and district. Lafayette County High School, enrolling over 1,000 students in grades 9-12, is a comprehensive four-year public high school. It is a Title I school, and about half the students are eligible to receive subsidized meals. Seven 50-minute periods comprise the instructional day. The Lafayette County School District (about 8,000 students) at this writing operates 8 elementary schools, 2 middle schools, 2 high schools, an adult education center, a preschool, and a community-education program for citizens 55 or older. The district, though rural, ranks among the largest 20 (of 176) in Kentucky. The school is located in the county seat.

Community. The county seat, however, operates its own school district, the Lafayette City Schools, which enroll about 1,500 students (and about 400 in the town high school). Such circumstances are common in rural Tennessee, Kentucky, and Virginia. There, the remaining "independent" town schools were more successfully defended from state consolidation efforts by local citizens enjoying generally more affluent circumstances in the previous century than schools out in the countryside; available census data suggests this differential, if it once existed here, no longer does (both county-district high schools have subsidized meal rates of about 50%, whereas town district's high school has a rate of about 60%). Lafayette, both town (pop. ~ 13,000) and county (pop. ~ 48,000, exclusive of the town), retain a comparatively healthy rural economy, though neither the town nor the county district qualifies as "affluent," except possibly by comparison with the destitute coal counties to the mountainous east.

In 1950, the US Army Corps of Engineers completed a large flood-control lake at the edge of town, and this event enabled Lafayette County to become a "rural amenities" county. Nearly 2 million visitors (known locally as "the Ohio Navy," according to one interviewee) come to the area each year, most during the summer (Wikipedia, 2010), and our interviewees, indeed, spoke repeatedly of the heavy summertime traffic on county roads and of the economic benefit of the lake. Interviewees also told us that Lafayette has become the central shopping location for County residents, and a medical hub, with its regional hospital. Unusually for rural places, then, both Lafayette City and Lafayette County exhibit steady population growth from 1800 through 2008 (Wikipedia, 2010). County population has increased nearly 60% since 1950, and the town population by 75%. A nearby coal county, famed for industrial unrest and union organizing, has, by contrast, lost nearly 55% of its 1950 population. Among rural counties, then, Lafayette County as a whole (including the town) has fared rather well: median household income in 2008 was about \$33,000 and mean household income was about \$45,000: 41% of households reported 2008 incomes below \$25,000 and 42% reported between \$25,000 and \$75,000. By skin color, the population is 96% "white," 2% "brown," and 1% "yellow" (US Bureau of the Census, 2010).

Within a workforce of about 24,000 in 2008, employment in the county (including the town) is sharply concentrated in education and human services (7,000 employed). Other industries employing substantial proportions of local workers include manufacturing (4,000), transportation and related industries (3,000), recreation and related industries (2,000) and construction (2,000) (US Bureau of the Census, 2010).

Education. Lafayette County High School offers a reported 127 courses to students, including: Physics, Forensic Science, Economics, Equine Science, Agricultural Science, Studio Art, Banking and Financial Services, Legal and Medical Office, Network Administration, Travel and Tourism Marketing, Theatre and Drama and JROTC. The new County Area Technical Center offers five other programs for students likely to seek employment after high school: automotive technology, construction technology, health sciences, information technology, and welding technology. The Technical Center seems to enroll about 15 students in each program, under the tutelage of a single faculty member (inferences from suppressed website).

State accountability report cards show somewhat lower percentages of students at Lafayette County High School scoring at "proficient or distinguished" levels than the other County high school, which was recently ranked by US News and World Report (January 2010) among the "best" American high schools ("Bronze Medal," source data suppressed). Lafayette County High School, however, despite a high proportion of students on subsidized meals, is judged by the State to be "progressing" towards the commonwealth goal of making all students "proficient or distinguished" by 2014. In other words, the school is not academically troubled. Current (2008) percentages of students judged "proficient or distinguished" by

accountability tests are reading (grade 10, 54%); math (grade 11, 31%); science (grade 11, 47%); social studies (grade 11, 38%); and writing portfolio (grade 12) 45%. (Kentucky Department of Education, 2010).

Lafayette Community College is also located in the town of Lafayette. Indeed, the origins of the this two-year college rest with the Lafayette City Board of Education, which established Lafayette Technical College in 1940. The current school (with its six locations) is the result of a 2002 merger of three local postsecondary institutions (local reference suppressed to safeguard confidentiality). Again, Lafayette County—though no interstate runs through it—presents a somewhat unusual rural profile. One might also note that Berea College, famed for Appalachian cultural programming, is an hour's drive distant (about 45 miles over secondary roads).

Of adult county residents, 76% have completed at least high school, as of 2008. About 24% of Lafayette residents have some postsecondary experience or an associate's degree, and 14% at least a bachelor's degree. In 2008, nearly as many residents (about 3,000) were enrolled in college or graduate programs at present as are enrolled in the county's three high schools (US Bureau of the Census, 2010).

Themes

The themes identified here, as at other sites, relate to one another, often in nuanced and significant ways, and together suggest a single story about the connectedness of schooling to the local community, a story more to be inferred than definitively concluded, either from the themes or from a reading of the full transcript. It is a contested connectedness, as in most rural places.

These themes are: (1) the evolving competence of youth; (2) frustration, patience, and problem-solving; (3) mathematical immanence and imminence; and (4) trespass to keep it together. The first two themes are easy to grasp, even given the evident contradictions and tensions, but themes three and four are more subtle and so interestingly contradictory that they might strike some readers as ambiguous or perhaps as too much of a stretch. These second themes, however, are the ones that most stitch up the story on view when data were gathered in 2008, in the eyes of the report author.

The evolving competence of youth. What are schools for? Neither pollsters nor researchers typically put this question to ordinary citizens, though sometimes local groups do ask selected citizens what sort of person (sometimes "product") the schools should produce, or what "every student should know and be able to do." We didn't ask, either, but interviewees, both adults and high school students, did seem to offer a response, and this theme characterizes that response.

Those we interviewed expressed strong concern (in dozens of references) about competence to do *something*. These references, in this study, of course, all occur as commentary on involvement with the lutherie class, and so these views are tied to what the class seems to be doing, and doing *unusually* by comparison to what interviewees saw as the usual routine. The assistant principal, for instance, observed,

It has given us a little notoriety . . . because . . . we have parents now remembering when they went to school they built a little bookshelf and now here this, this child [is] . . . building not only a guitar but a very handsome guitar that . . . is acoustically sound . . . I think they're amazed that a high school student is doing something in . . . what they [would] call "shop."

Transcripts characterize this reaction from the community again and again. A former lutherie student, for instance, reported, "I've been in the paper a couple of times with my instruments and people just come up to me and they're like, 'Oh, it's so amazing that you can do that.'" When asked about how she reacted when her daughter brought her dulcimer home, a parent responded:

Well, I'll tell you: I was very shocked. Now to begin with I got a letter coming in that said she was going to be recognized from the Chamber of Commerce and they actually had her dulcimer on display at several different places throughout the community. And I was really surprised to see the detail and the work on it.

The surprise to parents, to the Chamber of Commerce, and to the common readers of local newspapers seems to have been simply that their own children in their own school could create such subtle products as musical instruments. According to one interviewee, "They just can't believe that . . . high school students can . . . do stuff like that."

One parent summed up this awe with considerable insight and deep appreciation in the following interchange, which probed the interviewee about competence:

RESEARCHER:: She's working on the guitar, and yet the Adirondack chair sits unfinished. Why is that, do you think?

PARENT:: I mean, there's some satisfaction probably to seeing that chair sitting out on the porch but, I mean, that's what it does: It sits there on the porch. It doesn't really perform a function any different than any other lounge chair might. You know, when you take that dulcimer and you put in Tony Perdue's hands and he tunes that . . . and plays music on it, it's creating something. You know, that Adirondack chair doesn't have a life of its own, doesn't create anything, where those instruments, they have a life of their own that's going to go on.

It seems, then, that the lutherie class has caught not only the attention of the community, but its imagination, arguably through the specific ways its final products connect to community life, and particularly, the ongoing evolution of local meanings.

As any creative worker knows, however, a finished tangible object ensues from a process of struggle. Doing good work is not simple, not easy, not fast, and it remains somewhat unsure at every step, even to seasoned workers—whose expertise perhaps consists in ways to deal with the inherent uncertainty. For such reasons and others, confronting the possibility of doing good work is, in fact, frightening for students, since the confrontation embeds the option or the possibility of doing bad work.

Taking this argument a bit further, one might speculate, in fact, that children become accustomed to doing bad work in school (e.g., Brown, 1991; Schlechty, 2002). In fact, student interviewees spoke to this effect. As one student in the focus group asserted, "I'll take the knowledge [from the lutherie class] with me, whereas in other classes I won't take the knowledge with me. It's just useless, another credit." This student's views embed a monumental critique of schooling, though students of this opinion are, no doubt, largely unaware of how common and how very old this general critique of schooling actually is (see, e.g., Adams, 1918; Collins, 1979; Goodman, 1962).

Doing such visibly good work (in the lutherie class), then, seems almost to have been a new experience, not only for adult patrons of the school district, but especially for students. In the venue of the lutherie class, at any rate, students had to confront the uncertainties and disasters that plague serious attempts at good work. Sam Roberts (pseudonym), the vocational agriculture teacher who had co-taught the lutherie class with Tony Perdue, observed:

On almost a daily basis we have something go wrong. I mean, I had a kid who had a very, very nice ukulele and he was using a shaper to trim the outside. The router bit caught, threw his ukulele out on the floor, jerked about a dime-sized chunk out of the top, and he went to his bench, sat down, and cried.

This male student's reaction (boy crying in school?) is not only uncommon but, but arguably, starkly authentic. His engagement with and devotion to the project seemingly overcame that emotional restraint so characteristic of many high school boys. Such is the price in emotional risk that one must pay for trying to do good work (the story continues in the next theme).

The reverse of competence is incompetence, and challenges (such as the one just reported) that are left unmet, breed incompetence. In the lutherie class, however, such challenges take form not only in the mind (where they are likely to hide and indeed to go unmet) or in language (where they can fail to communicate), but also in an actual object that cannot be hidden and that rarely fails to communicate. A musical instrument, moreover, is an especially *nuanced* and *exacting* object, a circumstance that makes error all the more common and notable.

In contrast to their appreciation of students' accomplishments in the lutherie class, parents and other adults bemoaned students' typical practical incompetence, especially in the remarks made to the study with respect to seemingly simple applications of arithmetic. Moreover, the adults tended to interpret the lutherie class as making significant inroads against shortcomings of which students themselves were actually aware. The quite talented former student interviewed by the study observed:

FORMER STUDENT:: Even just stuff as simple as reading a tape measure, you know, I was never that good at it... you know, your measurements, your centimeters, millimeters, your dial caliper...you figure that into like hundredths and thousandths of inches which, you know, was different for me and new.

RESEARCHER:: What's challenging about it?

STUDENT:: Just remembering it. You know, where the eighth of an inch and three eighths of an inch [are], and if you have something that's one-and-five-eighths, what's half of that, you know, if you need to split that...difference?

Other students in the focus group reported the same new learning:

RESEARCHER:: In what other ways does Mr. Robert's class help you learn math?

STUDENT 1:: I never knew what the little notches were until this class. I know it's sad. I'm a senior, but I couldn't ever read the notches on a ruler.

STUDENT 2:: On a tape measure.

The careful interviewer at this site was a math educator who was moved to this follow-up interchange with teacher Sam Roberts:

RESEARCHER:: I guess I'm kind of surprised that they have problems reading rulers and measuring tapes.

ROBERTS:: Oh, yeah. I mean, you know, to measure – to measure to a sixteenth or, you know, an odd fraction of the inch, most students are lost. ...My experience as an ag teacher from all these years is that *most adults* have the same trouble [emphasis added].

The mistake, on this view, is the presumption that ordinary manual labor is much, much simpler than and requires so much less competence than it actually does. Such ignorance about the ordinary embeds a strange hubris—the hubris that taking courses with a passing grade, for instance, produces inevitable competence (see Crawford, 2009, for a complete argument).

The prevalence of practical incompetence among the young—the counter- and sub-text to the widespread delight with the lutherie class—extends to a seeming range of performances to which high school kids don't measure up. Sliding, in this excerpt, from an account of his own child to a generalization about all children, one parent interviewee complained:

My son is in college and about to move to Louisville. And, you know, we sat down and we talked about financing. He's looking at student loans. And there's very practical things, such as, "Okay, let's say you're borrowing five thousand dollars in student loans at six percent interest. You know, what's the monthly [payment] going to be on that?" Well, they can't just figure simple math. And, I mean, basically on something like that I'd say, "Okay, five thousand, six percent, six times five is thirty, you know?" That's what it's going to cost them a month. And they just don't run that through real easy.

This complaint is hardly restricted to parents in Lafayette. ACCLAIM's research elsewhere, for instance in a West Virginia rural town and in an Illinois rural town, surfaced the same concern (e.g., Lucas & Fugitt, 2007). This case study will deal more extensively with this concern as it specifically applies to mathematics in the third theme (the immanence and imminence of mathematics), but it's too easy to dismiss the concern as a misguided fixation on the automaticity of arithmetic computations. The discussion section will also interpret this circumstance.

Perhaps the development of competence turns on a willingness to find pathways into new experiences, including those denied one so systematically via schooling (e.g., math applications), and those available more widely, for instance in the community (e.g., intense music instruction). The former student interviewed by the study may have exhibited such willingness in the following interchange:

RESEARCHER:: Do you play?

STUDENT:: I don't play. My dad bought me a guitar when I was younger. And I've always wanted to play. And I'm hoping, you know, once I finish my own guitar, maybe that'll encourage me more to learn.

This remark exhibits not only a continuing hopefulness (that one might do something long desired), but an experiencing of the old hope in a new light. Education in this light is not the accumulation and storage of sound-bites, but an evolving engagement with meanings and performances.

As the study learned in the Magnolia, AL, case, however, this sort of instruction is sufficiently powerful that it changes students' aspirations substantially. Several informants told us of one student who was intending to pursue post-secondary lutherie studies. In Tony Perdue's words,

And there's [a student] ... in the class currently who just mentioned to me the other day that she thought she wanted to do this for a living, you know? And so she was looking at attending a school. I think the one she was looking at was down in Georgia. I gave her some other options on accredited lutherie schools.

Finally, it seems that competence is not only about skill, but also about the confidence that increasing skillfulness bestows, as the following exchange may suggest:

RESEARCHER:: What have you noticed are the results of teaching in this way?

ROBERTS:: Probably students develop a confidence in their ability to do things. When we start out, most students are afraid of the machines. They need lots and lots and lots of affirmation that the choices they're making are good ones. And, you know, they question their measurements and they question everything. And then, as the year goes by, they become more and more confident.

Competence is a particular skillfulness, but as the comments of teachers Perdue and Roberts suggest, together with such astute observers as Phil Schlechty and Henry Adams, it is also a continuing processes of growing skill.

Children cannot, in fact, exhibit all the skills that might prove useful in life, especially when they remain (as with the feel and reality of paying interest) isolated from the pertinent realities. There's a lot more to learning and doing than the easy phrase "learning by doing" captures.

Frustration, patience, and problem-solving. The previous theme stressed the struggle that characterizes the process of increasing skillfulness because students told us about it. Their stories—and Roberts's account—of their struggle to become increasingly skillful at measurement is a case in point.

Readers should remind themselves that this skillfulness can only really be appreciated from the vantage of making a product *that needs to function well*. In this sense, "measurement" is about much more than the decontextualized rehearsal of parsing distance in various ways, where clumsiness is immaterial and only ignorance itself counts—because, lacking a performance, actual competence can never really be demonstrated. Clumsiness here, by contrast, has effects that validate the necessity of skill, usually in painful ways. This point was recognized by students, one of whom, when asked what he liked about math in the lutherie class, observed, perhaps wryly, "I like that it doesn't get our ukuleles messed up" [i.e., that it keeps them from getting "messed up"].

Here is where the partial story of the accident with the shaper resumes. The ukulele was damaged, and the maker distraught. The clumsiness was momentary (an experience common to all woodworkers) and the damage seemingly disastrous: a classic teachable moment. And here is what Sam Roberts taught:

So I said, you know, "Look, we're going to figure out a way to salvage this." I said, "Let's don't think of it as a lost cause. Let's think about what we can do to solve that problem." And you'll need – you [researcher] need to see it when we go out here. You won't know where the blemish is [see picture, Figure 3].

FIGURE 3 // *Invisible damage*



Students pick up this approach by example. It's not subtle or difficult, but it requires a patience and a perspicacity that students seldom develop in those courses that are, for them, "just another useless credit." They appreciate the example, as one student noted:

Mr. Roberts can solve any problem. I think anytime last year if I messed something up or something didn't come out exactly right, the next day he'd be in there and be like, "I thought about it last night and here's what we can do."

When asked what one of the most important lessons of the lutherie class might be, the same student responded,

Basic problem solving. It seems like in lutherie class we'd come up with a roadblock for just about everything. You know, you make a mistake or you do something and now it's like, "Okay. Well, what am I going to do fix it or what's the alternative to this?" And it's just coming up with those kinds of solutions. *And you even use that in your life.* You know, I live on a farm and it's the same thing now. You know, when you're doing a fence or, you know, working on the barn or fixing something and then, you – you know, something comes up it's like, "Okay, let's – let's sit back here and think of, 'Okay, what's – what's the solution to this? What can I do to fix this problem?'" *Without getting frustrated.* [emphasis added]

"Without getting frustrated." That is indeed a useful skill, possibly a superordinate one. It's difficult to believe that schools can teach this lesson well, and routinely, given the roadblocks (see Henry Adams and company)! One suspects, also, that this lesson might be far more common in the ag shop and on the sports field than in academic courses. Tony Perdue, a mathematics teacher, worries about just this circumstance:

Well, this is something that would appeal to a good percentage of our students. And so some of the ideas that I've had for other departments would be, say, recording technology, musical recording technology, maybe a broadcast class in the language arts department. And I would like to see more of these types of classes because I can see the benefits for the students. [This approach] could help us out in some of our quote-unquote, "regular classes" [report author comment: other useless credits?] We want them to be able to think, you know?

This sort of thinking, by the way, took Perdue out of the classroom and into the position of Curriculum Specialist in 2008 (claim supported by superintendent's remarks). It seems, indeed, that Perdue grasps the struggle for increasing skillfulness that one might call "good teaching."

Although the student with the damaged instrument attributed the problem solving to Mr. Roberts, Roberts told a different story himself:

The next day he came in and he said, "You know, Mr. Roberts, I've been thinking about this." He said, "I think we can [fix it]." What we were having trouble with was devising a way to clamp a piece of wood back in there to fill that void and he had an excellent idea, and his idea is what we used. He went from devastation to, you know, being very confident in his ability to come up with a solution.

Roberts went further, ascribing to problem-solving a generative role at the curricular and instructional core of the lutherie class:

I couldn't sit here and tell you that there's a set curriculum for this class because, you know, it's a daily exercise in solving whatever problem the kid has.

At the end of the year, students in our focus group could recount some of the problems that could be understood and dealt with, or described, mathematically (see above: "that it doesn't get our ukuleles messed up"):

STUDENT 1:: It – it could be like your center line being off or your – your sound hole being somewhere where your ukulele is not going to sound good or just – or – I mean, things may not fit the way they're supposed to. Like when you drill for your tuning pegs like you could have a big – big chunk of metal sticking out of the side of your headstock if you – if you're off.

STUDENT 2:: There's stuff a thousandth of an inch, like, with the thickness and stuff. And if you don't have it right – everything affects the sound in the end.

STUDENT 3:: My fret board is off by that much and it's killing me. And I cannot fix that and I'm just upset. It's... it's bad.

The former student related the struggle on behalf of good work to patience:

You know, that was – that's a big thing you learn in that class is – is patience. I think Mr. Perdue's saying always was, you know, "Don't rush the monkey and you'll see a better show." He used to tell us that all the time.

The sort of problem-solving on view in the lutherie class has little outwardly in common with the sort considered in mathematics classes, simply because the content (wood) is not strictly mathematical. And yet, the lesson that frustrations can be reduced to difficulties and that difficulties can be addressed successfully with patience and ingenuity is of course relevant to approaching mathematical problems. In a perfect world, one could readily imagine Mr. Perdue teaching logarithms in a math class (e.g., Algebra II) and coaching mathematical problem solving *with these same students* with reference to the problem solving learning of the lutherie class.

Mathematical immanence and imminence. The former lutherie student offered the insight around which this theme is built:

And I never thought I'd use math every day, and then I got a job at a bank. And, you know, it took me a few weeks, you know, just to get used to like counting denominations, you know, counting a handful of twenties, stuff like that. You know, and *that's the side of math you don't see every day is the everyday math* [emphasis added].

But does such a circumstance, so characteristic of everyday life, have any relevance to mathematics per se? The third sentence asserts the claim that it *does*:

The side of math you don't see every day is the everyday math.

This is an aphorism (a concise statement of a principle), and with its sharp irony, a notably witty one.

The point of this theme, then, is that much remains undone, and that, quite likely, considerable fear surrounds getting local everyday mathematics into the open. Math indeed may be everywhere, including in the every-day, but it nonetheless remains unrecognized, locally *immanent* (indwelling) and peculiarly dreaded (“Math is imminent: yikes!”). Moreover, getting the *local* everyday-ness of mathematics into the open has remained a largely neglected project.¹⁵ The analysis here will illustrate the preceding points, first immanence and then imminence, and then interpret them, though with less theoretical elaboration at this juncture than might be wished. The discussion section of this case study, however, does extend the focus on mathematics learning.

“Immanence” is a very uncommon word, and it embeds the irony required here. The first meaning of *immanent* is “remaining or operating within a domain of reality or realm of discourse” (Mish, 1984, p. 601); the second is “inherent, specif: having existence or effect only within the mind or consciousness—compare *transcendent*” (Mish, 1984, p. 601). The word, in fact, in its second meaning, captures the Platonic tradition, perhaps the dominant outlook of mathematicians (Hersh, 1997): mathematical objects are already there, in the mind, and perfect.

The first meaning, though, captures the sense that everyday mathematics remains *confined* to the obscurities of people’s daily routines, where so much is taken for granted and so much remains unquestioned, unaccounted for, and even unacknowledged (e.g., Schutz, 1973). One community member claimed, “I mean, even on the farm most any farmer is going to use mathematics every day, you know, whether they even think about it or not.” At perhaps a more general level, the district superintendent noted, “As far as the community goes, you know, there’s not a lot of awareness about the issues with mathematics.” Inspection of the transcript context shows that the superintendent was referring to awareness of mathematics per se, and not evidently to issues related to mathematics *instruction*. The gist of such comments—and there were similar additional remarks in the transcripts—is that (1) most citizens do not consciously engage “mathematics,” even though they manage money and may perform routine calculations, and (2) people who use varied problem-solving skills (perhaps with routine calculations) aren’t likely to regard their experience as “mathematical,” even though problem-solving is practically a hallmark of mathematical thinking.

Tony Perdue, concerned to bring memorable and engaging experiences to students, believed students would overlook the math inherent in the lutherie class:

If you go talk to the students, they would...say, “Oh, we don’t use any math here...We’re just building instruments.” And that’s kind of what I wanted...I mean...every day in the class, one, they’re going to be measuring, which means that they’re going to have to be able to read a ruler obviously and convert fractions and... that sort of thing.

It’s notable that Tony, as a high school math teacher, *does* regard measuring, calculating proportions, scaling, reading blueprints, and problem solving as *mathematical*. Not only that, of course, he regards this connection (in instrument-building) as educationally valuable for high school seniors.

One suspects that some, perhaps many, math educators and many academic mathematicians would contest such a position. The position, nonetheless, shows Perdue’s appreciation for the way in which mathematics remains immanent in non-academic ventures (out of school, and it would seem, also strangely within most schools). Part of the strangeness, and part of the general refusal to acknowledge the immanence of mathematics in ordinary life, may be the social construction of transcendent (academic or elite) knowledge versus applied (vocational or popular) knowledge (DeYoung, 2003). Perhaps real math (academic-elite) is the math *inapplicable* to the real world, so that the treatment of number and space in the “real world” (vocational-popular) is therefore inherently *not* mathematical. One is hard-pressed to judge this conundrum fairly, but the bifurcation seems more to concern contemporary issues of social status and power than it does mathematics.

The transcripts report a variety of math-related applications in use in the community, and though certainly not investigated in this study, it would be possible to adapt such applications to an *Everyday Mathematics* sort of classroom application. The following remarks indicate locations that could be explored for such a purpose:

Our molding catalogue, I mean, everything is listed, “five-eighths thick by three and a quarter wide,” but when you’re setting that up on the motor, it’s actually decimal form (cabinetmaker).

Making wine involves lots of math. And if the decimal point is in the wrong place, you can have a major screw-up (vintner).

And the mathematics instruction that I received has helped me even in this business in – you know, in the knife business and especially since I’ve got the engraver. It’s – you were talking about the precision aspects of it. It’s really precise when you get down to it (music store owner).

Perhaps most interestingly, the music store owner (who also makes knives and offers an engraving service)—who liked math and took a semester of

¹⁵But see (1) Ron Eglash’s work (e.g., Eglash, 2004) for an existence proof with local practices and (2) the University of Chicago PK-6 Everyday Mathematics Series for an example of a systematic engagement with everyday-ness, but using predetermined instructional routines—routines that would nonetheless lend themselves to local adaptation). For an example of rural mathematics teachers engaging rural everyday-ness, see Klein (2010). The researcher who conducted the site visit and interviews observes at this juncture, as follows (1) teachers are the first to tell you that students need mathematics to be connected to real life, and that we all use math everyday but they also claim that it’s nearly impossible to make such connections to their curriculum (Klein, 2007); and (2) this may be because of “responsibility to coverage of the indicators,” which in most states point to mathematics as a loose collection of facts taught for their own sake or for some future use not communicated to the students.

calculus in college (studying agriculture), has developed and is marketing a device for teaching elementary music theory that displays the relationships of tones and keys mathematically. Once again, it might seem that none of this applied mathematics harbors opportunities to explore topics in the typical high school math curriculum (e.g., linear and quadratic equations; trigonometric, logarithmic, and other functions; proof and theorems in geometry; change and the application of differentiation and integration), but further conversations and interaction with such community members would likely surface opportunities. Mathematicians and mathematics educators are, in fact, equipped to articulate such connections (again, see Eglash, 2004, for some brilliant examples).

“Imminence” is perhaps a word more familiar than “immanence,” but it, too, bears closer inspection. *The Oxford English Dictionary* (1971, p. 1380) reports this first definition: “Of an event, etc. (almost always of evil or danger): Impending threateningly, hanging over one’s head; ready to befall or overtake one; close at hand in its incidence; coming on shortly.” The *Collegiate Dictionary* (Mish, 1984, p. 602) gives “ready to take place; esp: hanging threateningly over one’s head.” Mathematics brings, in fact, a relevant sort of overhanging authority, one that Ole Skovsmose (1994) constructs as *formatting power*.

Math is avowedly useful, widely applied in the world mostly in ways regarded as simple, but certainly also, if less commonly but with greater acknowledged status and significance, in technical, scientific, and scholarly professions. Whereas everyday life seems to be pretty well covered by knowledge of arithmetic (e.g., construction, cabinet-making, nursing, bookkeeping), professional work in technical, scientific, and scholarly fields, it is generally agreed, requires high school math (equivalent knowledge, at any rate) as a foundation for specialized professional training. The truth, of course, is that a small minority of citizens enters such professions, although a great many students “take” the familiar high school math sequence. Moreover, it seems that with far too many “takers” their math instruction doesn’t actually take. Math of the sort conventionally prized (algebra, geometry, trigonometry, calculus) inspires continuing bad memories, and perhaps ongoing confusion and resentment. Adults made the familiar confessions to the study, for instance the following:

RETIRED TEACHER:: You know, in music you just go up to four [beats] and then you start over again. So little by little during my music career I forgot everything that was five and above. . . . I had a hard time figuring out algebra – it was not for anything I was ever going to do.

VINTNER:: I could not see when I was going to high school what – I mean, what the use was for anything and so pretty much – but now I use mathematics all the time and – not all the time but a lot and – you know, chemistry, different things that I should have paid attention to.

CABINETMAKER:: I wish I could say . . . I loved school but, math? . . . Geometry I was into, but when it came to algebra, it was over my head, you know? It , I just, I couldn’t ever get it.

TEACHER:: Around the country, students really have a hard time with mathematics and just seeing the relevance of mathematics.

SUPERINTENDENT:: And math for some reason in this area is a very feared subject – by many kids. They have a fear of mathematics and, you know, they’re kind of turned off to math.

Such outlooks may be tediously familiar in the literature, but they point to genuine and durable issues and *not*, as some would have it, to the complacency of adults towards mathematical knowledge. This assertion is nicely warranted here because the same adults who confess to bad experiences with school math also report using mathematics in their work.

What are the “genuine issues?” Why should mathematics remain so widely threatening? Perhaps because math is difficult? Perhaps, but it seems also that the persistence of this issue must have something essential to do with schooling and with the conduct of mathematics instruction in American schooling, perhaps with the dominance of platonic and formalist notions of mathematics among math teachers (Charalambous et al., 2002; Hersh, 2002; Hiebert et al., 2005; Muis, 2004). Prevalent views of what mathematics is in fact seem to privilege transcendent knowledge (arguably useful to a minority of academic-elite students) over applied knowledge (arguably useful to a majority of vocational-popular students). Whatever the reason, the prevalent antipathy would seemingly complicate access to everyday math (see Civil, 2005, for an example of both the difficulties and the access). Conveniently, perhaps, this arrangement would predictably keep transcendent knowledge intact as a preserve for the few, while denying the many access to the range of useful math applications. Fortunately for the functioning of the world, adults seem quite capable of implementing these applications anyhow.

These difficult issues (the immanence and imminence of mathematics) raise the question of what mathematics is and what it is for (i.e., beliefs about the nature and purposes of mathematical knowledge). For some reason, ordinary citizens are seldom any longer asked about the overall purposes of education (Howley, Pickett, Kay, & Brown, 2010; see Downey, 1960 for the historical precedent; Theobald, 2009), much less about the purposes of one of its supposed areas of expertise. Aware of the unique possibilities for such questioning, the study protocol did include “What is math?” and “What is math for?” as optional questions. The answers provide some perspective on issues of mathematical immanence and imminence.

The retired music teacher who advanced the humorous theory about counting to four and starting over, for instance, confessed,

RESEARCHER:: What is math and what is math for?

RETIRED TEACHER:: Math is for problem solving, isn’t it? Getting from one place to another. . . . It’s a process of getting from one place to another that you can’t do any other way. . . . I thought about majoring in math. I respect math and appreciate it, and have mathematicians¹⁷ in my family, but I went into music instead. [Nonetheless,] I’ve always fancied myself as a kind of a shade-tree mathematician.

¹⁷In the various ACCLAIM studies, interviewees use the sobriquet “mathematician” not to refer to professors of mathematics, but to anyone who exhibits mathematical talent.

The teacher followed this statement up with a seemingly unrelated story about her son:

When he was a senior...computers were new and he was very high on math and did it well and thought that's what he wanted to do. He went to Columbia as an engineering student and he called me sophomore year and he said, "I'm changing majors!" And I said, "Oh, what into?" He said, "I don't know. I just know I don't want to do this." He missed the humanities part. He ended up majoring in philosophy.... So he went that way and now he's here *grinding rock*. But he's the owner of this company [a monument company].

Both passages can be interpreted together, not as unrelated, but as a single poignant cautionary tale about education, writ large. In this story one makes choices that both *constitute* one's education and that *result* from one's education. Clearly, the son was what *Hollowing Out the Middle* authors Carr and Kefalas (2009) dub a "high-flyer": a local boy from a comparatively advantaged home, working hard to realize "high aspirations." Due at least partly to his evident mathematical talent, and to the community's investment¹⁸ in his education, he first pursued a technical career, then an equally arcane jewel of the humanities (i.e., philosophy), and then, contrary to the usual script requiring permanent departure, returned home to take up the family monument business (which his mother humorously calls "grinding rock"). But recall that the frame for this story is "the process of getting from one place to another that you can't do any other way." On this well-articulated view, engagement with mathematics implies a good deal more than knowledge of number and space (the conventional response to what mathematics is, cf. Hersh, 1997)—for instance, making sense of life. And though she became a music teacher, the mother understands that she might have become something else, even an engineer, even an academic mathematician.

Other interviewees were predictably more modest in their answers to our strange questions:

RESEARCHER:: What is math and what is math for, in your opinion?

PARENT:: Well, I think the importance of math is the practicality of it for day-to-day life, first and foremost.

MUSIC STORE OWNER:: Everyone uses math probably everyday if they'll stop and think about it because everyone is spending money [emphasis added].

CABINETMAKER:: You're asking the wrong person!

FORMER STUDENT:: Well, to me math – there's – there's two sides to math. There's [first] the math you have to do in high school and the horrible math you have to do in college, because that's what's required! And I feel like really and truly some of it you may never use... But, you know, it's just one of those things you've got to learn. But then [second] there's the other side of math that you use every day.

VINTNER:: Well, I'm kind of a simplistic person, so it would be to figure out things is what I would say.

It's no surprise (in the literature) that ordinary citizens most appreciate the usefulness of mathematics, and it's little surprise that no one at all mentioned the beauty of mathematics ("transcendence"), though perhaps such an appreciation is immanent in the thinking of the retired music teacher. The surprise, of course, is that school math has traditionally done so little to engage the usefulness of math, to intersect robustly with the "everyday" quality of mathematical knowledge, and that the disjunction is implanted so very strongly in the minds of adults. And, as researchers heard in all sites to some degree, connections between *local* every-day life and *formal mathematics instruction* are limited and rare.¹⁹

Trespass to keep it together. This theme is about keeping the community whole in face of the centrifugal pulls of the macro economy (national and global). While such a meaning may seem remote from the moment-to-moment experiences of the lutherie class, both the aspirations for the class (as reported by the teachers, the assistant principal, and the superintendent) and the way it enrolled students from across "the tracks"—the literal curricular tracks in the high school and the symbolic train-tracks in the community—did concern the integrity and sustainability of local cultures and ways of being.

The class is held in the agriculture program's space, but it has evidently appealed to a wide range of students, who may have been encountering each other for the first time in this class. The former student stressed the uniqueness of the track-trespass:

RESEARCHER:: Is it primarily ag students that take the lutherie class?

FORMER STUDENT:: No. There's some of them that do, but a lot of them [lutherie students] have never been in the ag shop before.... You know, they hear about it and ... a lot of them have interest in music and that's what brings them down there.... I think my senior year it was pretty much half and half.

But is there an actual cultural and social-class divide that the lutherie class bridges? Again, the former student explained,

¹⁸A disproportionate investment that Carr and Kefalas (2009) judge to be illogical, since it diverts resources away from blue-collar and working-class students who are much more likely to remain in the community, contributing to its future. High-flyers leave, taking their potential with them. The poignancy here is that this high-flyer rather dramatically behaved unpredictably (as occasionally happens, according to the stories in *Hollowing Out the Middle*).

¹⁹The researcher who conducted the site visit and interviews commented at this juncture in the text as follows: Then there is the whole "absence of evidence isn't evidence of absence" argument. What didn't we hear, and what suggests to me one limitation of our study protocols, were answers to questions about value. As in, "what math is valuable and why and to whom?" For instance, one might respond "I value measurement for its... but I'm sure some value calculus for its..." Hypothetically, if citizens value something ... and they value it enough, then they will or should act to have this value reflected in the curriculum. Has the evolution vs. creation debate subsumed all other public discussions of what's valuable in curriculum?

The ag classes in general are very stereotypical redneck, good old country boys and girls kind of thing, and there's actually a lot of girls in ag in general. But, you know, that's the stereotype you get: ... "Okay, that's the redneck community." But then you get that lutherie class thrown in there [i.e., in the ag shop], and when you're down there during that hour it's just a completely different scene. There's different kinds of people down there that'd you wouldn't normally see down there. And as far as like the female thing goes, a lot of the females actually turned out to be better wood workers.... They pay more attention to detail, [they are] a little more patient, [and they] don't get frustrated as much. And, you know, a lot of times they turned out better instruments than some of the guys.

On this testimony, at least, the lutherie class bridged the divisions of class, culture, and gender that characterize many schools of this size.²⁰ The current students were also keenly aware of this other sort of learning that was taking place:

RESEARCHER:: So has this lutherie class helped to expose more of those people that you might describe as non-ag program?

STUDENT 1:: Yeah.

Researcher: You're all nodding your heads yes.

STUDENT 2:: A week ago we taught a girl in this class what a tractor was and what it did.

STUDENT 3:: Yeah, and we let her pet a turkey.

STUDENT 4:: Yeah. She'd never seen a chicken [either].

At a later point in the focus-group interview transcript, a student observed: "Even outside of the classroom now, you know, different groups of students get together and talk and are friends because of this diverse class."

The lutherie class held wide appeal possibly because it was rather different from typical school offerings (though perhaps not so different from typical vo-ag courses), and because the cultural focus (music-making, bluegrass music) was something many local people, regardless of social class, shared (in the lutherie class, in fact, students *sang* as they worked). Students appreciated the class—the autonomy and self-direction elicited from them, the ability to develop patience and a disposition toward problem solving, and the production of a uniquely tangible (i.e., playable) object. A focus-group student, asked what she liked best responded: "Just watching what we're doing turn into something...out of all our work." According to Tony Perdue, the lutherie class helped attach disaffected students to the school:

The parents see that, you know, just in talking with them, you know? They say, "Little Johnny, he's never been interested in school. Now he loves his class. He doesn't want to miss." Those are the types of comments that we're typically getting.

During his interview, the superintendent praised Perdue for far-sightedness because, in his view, the State was increasingly asking schools to provide more inventive, more relevant, more rigorous instruction for students—desiderata he believed the lutherie program exhibited. Perdue's initiative with the lutherie program probably helped persuade the superintendent to tap Perdue for the curriculum specialist's job at the high school. Deeper meanings, however, seem to attach to what the course represents. The superintendent said,

I certainly see the value of those programs [i.e., project-based, place-based, hands-on] for the kids. I have seen shy, backward kids get into [a similar program at the other high school] and become master presenters, and one of them on state TV. The shyest girl that you could ever meet: but her confidence [grew]—when she got into [that program]—and now she's in college *wanting to come back someday* and do that. [emphasis added]

The added emphasis highlights the deeper sub-theme, which concerns not helping kids overcome shyness, but somehow helping them to "want to come back someday." What the student may want to come back to do is unclear, but it might well be to teach in the lutherie program. (Sustaining the program, said Perdue, was a worry since he'd taken his new role and since Mr. Roberts would retire in several years.) The superintendent continued:

We would like for our kids to stay at home and work because this community is growing, and we have aligned our programs at the Area Technical School with the needs of our community. And so we're thinking that we're scratching the surface but we've got tons of work to do.

These sorts of sentiments would seem to qualify the district administrator as a localist rather than a cosmopolitan educator—someone as concerned with the school system's role in contributing to the community as with "meeting the needs of individual students." From the parents and community members, too, we heard the aspiration that children live their adult lives in Lafayette, rather than in Lexington, Chicago, Atlanta, or Hong Kong.

In particular, among these interviewees, researchers heard that the district should take vocational education more seriously; perhaps this sentiment is partly responsible for the recent establishment of the "Area Technical School," which, however, so far seems to enroll fewer than 100 students. As the superintendent observed,

We think we're starting to scratch the surface on even getting those kids job-skill training that will give them a \$22-an-hour welding job with a houseboat company [local employment related to the tourist trade]. That's better than working at McDonald's. So we're trying to find ways to close those gaps to where our kids will have more opportunities and stay at home.

²⁰At nearly 1,100 students, Lafayette high school is neither a small, rural school nor a small high school nationally. It apparently exhibits the divisions that typically separate college-track and vocational-track kids. The report author had a track-trespass experience 45 years ago in a high school of the same size. *Plus ça change.*

Putting additional resources into the schooling of ordinary (i.e., not high-flying) students is the rural development strategy most strongly recommended by Carr and Kefalas (2009):

An obvious first step that many small towns can take is to equalize their investment across different groups of young people and to tie education and training for Stayers more closely to the demands of the modern global economy, which places a premium on technical computer-based skills. (p. 163)

Even with these authors, it seems that the word “vocational” is disparaged. Regardless of the wisdom of preparing students for hi-tech jobs that don’t exist locally, however, the overall strategy of investing in “stayers” is logical and bold.

Why “bold”? As Carr and Kefalas discovered, shifting educational investments toward those young people most likely to stay in Lafayette is far more difficult than it might seem. Schools, some education scholars have argued, are sorting machines (e.g., Spring, 1988) that run, and perhaps were designed to run, in ways that systematically advantage the most advantaged students, who are the ones coming from the most advantaged families. In rural places, these are the students most likely to leave, first for college, and then for distant cities and suburbs. In a quite real sense, this outcome is what the most influential patrons of local schools want—especially in a solidly middle-class town like Lafayette. When Carr and Kefalas (2009) pointed out the conundrum to residents of the rural Iowa town they studied, they discovered everyone was aware of the situation, and accepted it as proper and normal. A good deal of trespass is seemingly necessary to sustain rural communities.

Discussion

The preceding presentation of themes naturally includes a measure of discussion, but in this section it seems advisable to interpret, at least briefly, the four themes more holistically. Because this is a study of community connections with mathematics curriculum and instruction, the interpretation will attempt to relate the themes in that context.

One anecdote, contained in fieldnotes and not in the interview transcripts, bears telling at this juncture. The grandfather of one of the lutherie-class assistants, near death at the time and in a nursing home, asked that his grandson use wood from a fallen buckeye tree in his front yard to make something special before he died. The raw buckeye lumber became the ukulele displayed in Figure 4. At the time the researcher talked with the assistant, the grandfather was still alive. The ukulele is suspended on a makeshift hanging rack after having been sprayed with sealer.

This story speaks to the core of the previous theme, and strongly echoes the “life of its own” observation so reverently offered by a parent of one of the students. This ukulele, produced in the class by a community member (not

a professional educator and not a student) is a tangible link connecting land, family, community, and school. Such manifestations may or may not be very rare, but they are, at least in the experience of the lead authors, seldom honored or celebrated. It is well at this juncture to remember that this connection was enabled by a teacher of high-school mathematics.

FIGURE 4 // *Buckeye Ukulele*



True, little formal high-school mathematics is on view in the lutherie class. Students are not learning the content of *Algebra I*, *Geometry*, or *Algebra II* there. Possibly some of the students in the course are not even “taking” the full American triumvirate, or even any part of it. Nonetheless, the study heard convincingly from students that they learned a range of practical performances previously inaccessible to them. The most lofty of these practical performances was problem solving: not just the capacity to solve the problems materializing in the lutherie class, but, seemingly, an overall *disposition* toward problem solving as an approach to everyday life. It’s not clear that one could actually learn much that is more valuable, and certainly not in school; but the ghost of John Dewey surely nods approvingly at such learning.

What is one to make of the students’ confessions about *mere arithmetic* and incapacity with the use of *measurement tools*? Some mathematics teachers (a small minority, but evidently including Tony Perdue and his superintendent) do seem to regard arithmetical competence in everyday life as mathematical *per se* (e.g., measuring, computing proportions, reading blueprints, and perhaps a disposition toward problem solving). But many readers of this report would not be convinced. Indeed, mathematicians often regard school mathematics as easy math, and wonder what the big deal might be in teaching it (Robert Klein, personal communication). The reported mathematical connections would seem trivial to them. Mathematics

educators (professors of math education), for their part, also want high school mathematics instruction to move students well beyond arithmetic and computation to a range of “mathematical objects” and to a grasp of mathematical ideas, logic (i.e., proof), and problem-solving. These aspects of mathematics, however, are not logically the province of school math mostly or even in part, but *must* exist inherently (immanently) in everyday adult life,²¹ where they remain for the most part almost inexplicably hidden—as seemingly invisible there to math teachers as to everyone else. Flushing them into the open and exploiting them for instruction would seem to be excellent work for teachers in league with local adults, perhaps with some help from professors (Civil, 2005; Brenner & Moschkovich, 2002).

The story of the logarithmic scale underlying the layout of frets in lutherie work is of course an example: people mention it as *really existing*, but the making of instruments trumped engagement with the idea and the history of its application to music-making (see, e.g., Wardhaugh, 2008, and Isacoff, 2001, for the relevant mathematics and the musical context of *temperament*). The educators, however, seemed clear that the lutherie class was not a math class, but rather that math and science were implicated in the class, in much the same way in fact that significant mathematics remains implicated but hidden in everyday adult life. The class involved students, at least obliquely, in applications of math and science, and it was the applications *per se* and not instruction in math and science that had everyone’s attention. It’s also evident from transcript data that at least some, and probably many, students regarded the experience in the class as memorable and even influential, far beyond their other experiences in school, and the testimony deserves repeating:

*I’ll take the knowledge with me, whereas in other classes I won’t;
it’s just useless, another credit.*

Such testimony from students is itself significant (and much in line with what the study heard from students at other sites), and those concerned to see “significant mathematics” engaged in formal schooling should pay attention.

What does such testimony mean? Most of what it means is well represented in the progressive pedagogical literature of the past 100 years: the familiar learning-by-doing argument, and the many reports of students’ and teachers’ memorable experiences of such engagements. Jack Shelton calls it “consequential learning” (title of his 2005 book). It might help to state the principle of this sort of learning: *the ends dignify the means*. This aphorism works at several levels, as follows.

First, at the classroom level, the *ends* in the lutherie class were musical instruments, objects that commanded great respect locally: dulcimers, guitars, fiddles, and mandolins. The *means* were techniques, tools, and dispositions—

the most notable being those considered in the second theme: “frustration, patience, and problem-solving.” Implicit in the means lay significant math and science content. This content was not formally engaged, but the point is that in such a context, under the influence of such ends, *it could be*—and not that it wasn’t. As a project-based pedagogical project evolves, it harbors the immanent possibility of dignifying formal mathematical content incrementally as part of the evolving pedagogy. And why not? Inventive teachers don’t invent all their routines overnight from whole cloth.

Second, the resident dignity inheres (again: is immanent) in the relationship between context and content. “Decontextualized learning” is an oxymoron because authentic competence requires a context, not only as it emerges, but for its exercise. As a performance becomes increasingly competent, moreover, the line between the emerging-instructional phase and the competent-performance phase vanishes. The insight here is that the learning and the competence are one and the same: one doesn’t learn and then experience a transformation—say, during the flawless completion of the items on a valid and reliable test—that results in competence. No. The application is essential to the learning and the competence because they are the same thing. Schooling that banishes context banishes a great deal of learning thereby. The invisibility of this loss is quite similar to the invisibility of mathematics in the everyday: we’re used to it, we don’t much care.

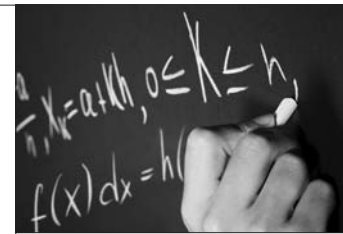
Third, the question of ends is momentous. The ends in the lutherie class may seem to have been (at one level) dulcimers and guitars. As with the parent who attributed “a life of their own” to these objects, however, these objects embody a meaningfulness widely acknowledged across the community. In this sense the lutherie class aimed at engaging a broad range of students in musical competence. But at a much higher level of abstraction, the ends of the lutherie class *as a high school course* may have been something like the meaningful participation of the school in sustaining local culture.

This observation brings the discussion to the topic of rural schools serving their communities. One might observe that the lutherie class, in its small way, could evolve as part of the strategy commended by Carr and Kefalas (2009), precisely because it helps middle-class youngsters get to know their equals from the “stereotypical redneck culture.” This is a strange observation to make of a contemporary comprehensive high school—the kind of high school that was intended to make such acquaintances normal (Conant, 1959), but didn’t. In any case, to continue to serve this larger purpose, of course, the lutherie class would have to be sustained, and similar courses would have to be added: as the superintendent worried, much remains to be done.

²¹That is, in order for any formal curriculum (even a dated one) to claim them.

CROSS CASE ISSUES:
a second interim reflection

▶ A deep cross-case report of findings awaits the further collaboration of the key members of the study team, underway for summer 2010. For this monograph, however, tentative reflections will again have to suffice (see Klein, Howley, & Howley, 2009, for a previous iteration).



Recall that the study addressed two broad research questions: (1) "How do rural schools connect mathematics education to local communities and places?" and (2) "What conditions enable and constrain their efforts?" This concluding section of the monograph responds to the questions reflectively and somewhat impressionistically, based on familiarity with the transcripts and fieldnotes, the themes in the individual site reports, and conversations to this point among members of the research team.

First Question

How do rural schools connect mathematics education to local communities and places? In this reflection, three considerations seem relevant: (1) the scale and scope of projects, (2) the purposes, particularly community sustainability, and (3) the issue of relevance. The discussion next takes up each consideration in turn.

Project Scale and Scope

Members of the study team kept asking one another, for each site, what the "case" was. Superficially, the site is the case. But in fact, at each site the answer is different in part because the scale and scope of what we studied was different. At four sites, the presenting "case" seemed, at least initially, to be the practice of a particular teacher (Green Mountain, South Valley, Lafayette, Meriwether Lewis). At other sites, an easy answer seemed out of reach. The most complex case was the work engaged by many educators and schools at the Confluence Collaborative. Here the case was seemingly the Collaborative, and its many related, sometimes contradictory, and evidently contested practices. But the boundaries of such a case are comparatively open. Eastcove Community School, however, may have been the case with the broadest scope, even though confined to a single very small school. There, place-based education and pedagogy were explicitly invoked as guiding principles, and many teachers—in some sense all of them—were engaged in the work, even when permitted by the culture not to practice the related pedagogy! The community was an island, and so the boundary seemed clearer than with the Confluence Collaborative. We are still thinking about these matters.

In any case, an evident partial answer to the first research question, on this basis at least, is that schools and teachers connect mathematics curriculum to local community variously. Always, at these sites, the connection rests on the insights and passions of particular educators. It's interesting, from the perspective of identifying "the case," that when researchers probed, they learned the antecedents of "the case." In general, we heard that teachers were inspired by prior experience or contact. Tony Perdue, at Lafayette, taught at the district's other high school for a time, where he observed a raptor-rescue program (aka "science"). The experience got him thinking. His conversations as a doctoral student, perhaps, helped affirm his thinking. Similar stories surfaced at Green Mountain and Meriwether Lewis.

The absence of compulsion must be judged a helpful circumstance, even if we cannot report mathematics instruction extensively and systematically practiced with the focal pedagogy. Indeed, no one really has defined, in a synoptic and credible fashion, what place-based mathematics pedagogy, nor a curriculum to be taught by any largely undefined mathematics-of-place pedagogy, might be.

There is, in short, nothing to compel or standardize. For this reason, then, invention, reflection, and the refinement of the activities that suggest themselves to teachers make a great deal of sense. In a recent meta-analysis of 800 meta-analyses, Hattie (2008) makes two happy observations relevant to this circumstance, based on his synthesis. First, he claims, nearly everything works to improve student achievement, and the few things that don't do less harm than one might suspect. Such an outlook flies in the face of reasonable skepticism, except that Hattie's meta-meta-analysis marshals the evidence needed to push back appropriately against wise skepticism. The second observation is more important. He insists that, overall, what "makes things work" well is attention, reflection, and feedback: what he calls *visible learning and teaching*. The testimony of students in this monograph is rather clear that the focal teaching and learning in the sites visited was visible, and sometimes, according to the interviews, especially vivid. The experiences, according to the testimony of students, did not accumulate into "just another useless credit."

In three cases—Confluence Collaborative, Eastcove Island, and Magnolia—the antecedents and the cases were more intertwined. At all three sites, administrators played catalyzing roles that generalized the activity,

though apparently with degrees of whatever one might want to regard as “success.” (We would cite all these cases as *successes*—the activities and engagement described were at least ongoing, and most were *clearly* thriving; during our site selection phase we learned that many nominated programs had actually disappeared.) The administrators played a familiar role—recruiting help from beyond the school or district organizational borders, facilitating interactions, sponsoring wide-ranging conversations, planning formal and informal professional development, and to some extent buffering their organizations from the machinations of accountability frenzy and the changeable fads of “best practice.”

Eastcove Island, in fact, enjoyed the most propitious circumstances and might be said to be most clearly thriving of the programs across all sites. It had been, as the site report notes, a defining struggle for the community, the school, and the principal: not an easy or simple victory. Magnolia enjoyed the least propitious circumstances in terms of local wealth, but the site retains a very active legacy of engagement that is a notable resource for the future (past accomplishment being the best predictor of future accomplishment). Confluence Collaborative took on an ambitious, even daunting, agenda—helping to sustain four small contiguous districts in a state noted for its recent attempts to close small districts. The efforts of the collaborative, not surprisingly, perhaps entailed the sharpest difficulties, with the place-based project seeming, ironically, to run somewhat counter to the prime objective of keeping all the districts functioning.

Purposes

The challenges facing the Confluence Collaborative bring the discussion of the first research question to the local purposes imagined for place-based education. A number of writers (e.g., Gruenewald, 2006; Haas & Nachtigal, 1998; Theobald, 1997) construe sustaining rural community as a superordinate purpose of place-based education. This purpose sets out, then, as a challenge to the predominating paradigms of American schooling, which for many decades now have, in fact, been to prepare individual children for corporate futures, with substantial disregard even for the idea of community (Carr & Kefalas, 2009; Theobald, 2009). Many critiques have been written about such dubious purposes (see the reference list for some—but the full list would include scores, possibly hundreds or even thousands, of works; the critique has largely gone for naught). For other evidence, consider that the corporate lingo of educational reform is relentless (“Race to the Top,” “Globally Competitive,” “World-Class,” and so forth). Therefore, to imagine and engage a *community* purpose, a local purpose, and a *rural* purpose simultaneously is certainly unusual, and predictably very rare in mathematics education.²²

Such purposes might even be easily characterized as a momentous betrayal of the interests of the chief sponsors and architects of contemporary American schooling. Additional consideration of purposes and community sustainability, or defense, appears in the “middle-class theory” sub-section in discussion of answers to our second research question, addressing there how such a strange purpose might come into being and even sustain itself.

Math, Natural Language, and the Natural Every-Day

Although this study aimed to access “significant mathematics” being engaged with rural communities, it is easy to confess that the aim was not realized, at least not as one might have imagined it might be realizable at the outset. We think, however, that across all sites we did see much that was significant given the challenges of conducting place-based education in general, and the sharp challenges of teaching school mathematics via local applications prospectively valuable to and valued by the community. And we believe that we did see some such applications that *were* mathematically significant—though this conclusion might be contested by many or even most of our colleagues in mathematics and mathematics education. From the perspective of the challenges in mathematics—for instance a Platonic view of pre-existing, placeless mathematical objects—the fact that the study discovered *any* math teachers (especially any high school math teachers) making community connections must be grasped as encouraging.

The study—as the background section explains—distinguished rather sharply among culture-, community-, and place-based intentions, with the aim of place-based education being the welfare of the local rural community, positioned in this way as a somewhat contrarian educational purpose. To find such a purpose underway anywhere in rural schools, given the hegemonic mainstream discourse in education (“Twenty-First Century Skills,” “World-Class Performance,” “First in the World,” “Globally Competitive”) is itself rather amazing, and perhaps miraculous considering the ubiquity of the rhetoric and the power arrayed to ensure compliance with such rhetoric. Fortunately, many observers do characterize the familiar rhetoric as nonsense (e.g., Crawford, 2009; Martin, 2009). From this vantage, however, the comparative weakness of the engagement of place-based efforts with mathematics is not a surprise, math and science figuring as the curricular darlings of the intentions of the corporate State (Crawford, 2009).

Well, the educators we studied, and the sites we visited were unusual, though not always aware of either their rarity or of how their actions positioned them “against the grain.” Maybe they were not heroic, and maybe they would not be happy with the mantle “contrarian.” Maybe they embraced the State’s “standards,” interpreting them according to purposes

²²High-profile reports in mathematics education find it convenient to repeat the common argument that a population with greater math capacity will restore or preserve American global economic hegemony. Those who read the cant uncritically come to believe it. For rather different alternative views of the threats to such hegemony, see Jacques (2009) and Crawford (2009).

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not exactly entertained by the accountants and enforcers of standards. Whatever was occupying their minds, however, what they were doing with mathematics instruction was unusual and risky from the standpoint of this study's understanding of the trajectory of place-based education.

While not necessarily "significant" in the sense of being deeply formal or self-consciously rigorous in the way of mathematical proof, the math instruction that we did see and hear about accepted apparently non-significant math as somehow significant. The confessions from the lutherie students, for instance, about not previously being able to use measurement tools or to grasp issues of scaling and proportion and comparative accuracy seem to us telling. Surely, no high school mathematics department, nor perhaps the NCTM, would regard this learning as significant (among high school juniors and seniors). But it nonetheless deals with "transfer of learning" from classroom to meaningful application, and the confessions demonstrate just how elusive transferability is. But in the new arrangement students seem to have mastered a variety of skills and, perhaps, even come to appreciate the strange relationship between school-time decontextualized instruction and the real-time contexts (that is, reality as simulated in the ag shop) where, nearly all agreed, much more was at stake than at school: visible learning indeed (Hattie, 2008).

To the lead authors, such manifestations in the study *are* pedagogically significant, *marvelously* ordinary, and the students identified them not only as educative but as *memorable*. Many of the adults interviewed for the study, across the sites, want to see much more of this significant learning in play in their schools, and probably in other schools throughout the land. One wonders, in retrospect, if such ardent popular aspirations might not be more dramatically out of step with those of the profession than even David Cohen (1988) so shockingly claimed. That is, in mathematics instruction, *both* the durable professional emphasis on calculation and automaticity (drill and kill) and the progressive insistence on knowledge construction seem to ignore the public interest in practical application. Indeed, the schools' oversight of mathematics as an *applied science* is difficult to fathom. School practice seems, in fact, more textbook-dominated than ever and possibly more textbook-dominated than other school subjects. One might doubt all the testimony in this study of so many adults who claimed that mathematics was a very practical subject—but we accept the outlook as helpful.

The distinction between the "language" of mathematics and natural language seems germane to such possible disjunctions. Frank Smith (2002), a reading educator and journalist, makes a good point about natural language and the difficulty of learning mathematics. There is nothing very "natural" about either mathematics (whether as a practice or as a set of truths about space and number) or its learning—as contrasted to the natural language of one's native tongue, in which one becomes miraculously far more proficient before Kindergarten than one is ever likely to become in a second "natural" language later on. To make mathematics more *natural* to the broad range of school students, then, local in-the-field application would arguably seem

pedagogically essential. And yet this work remains roundly ignored and perhaps systematically excluded, and certainly this assertion seems truest of *local* applications; this is arguably so even in *Everyday Math*, which addresses a national audience, thus raising the issue prominently but—as a textbook—by necessity leaving it unresolved locally.²³ School mathematics is a famously logical discipline, with a seemingly straightforward sequence of concepts that scaffold relentlessly *upward*, upward, that is, toward so-called advanced (school) mathematics ("upper math"). Part of the deep structure of the related pedagogy seems to be that a large proportion of students are left by the wayside, incompetent and insecure in their mathematical knowledge (Popkewitz, 2004). It's possible to suspect that such incompetence is intentional, perhaps inscribed in the "deep structure" of schooling (Tye, 2000). After all, mathematics is, on good authority, the most teachable of subjects (Hersh, 1997).

Reform of mathematics education, of course, is notable for its insistence that logic and problem-solving and proportional thinking can be taught simultaneously with such fundamentals as achieving automaticity with arithmetic facts. This position, however, does not sit well with many stewards of the discipline—professors of mathematics—or with the public, as excerpts from the transcripts demonstrate quite well. For this influential population (i.e., stewards of the discipline), then, access to advanced school math is through the mastery of mathematics content rigorously shorn of context or even application, and most especially, one might add, of local rural context and application. When fortunate and hard-working high school students, via this familiar route, finally *attain* advanced (school) math, the culture they are most likely to encounter anywhere in American public schooling is the one the study team encountered in the Confluence District (excerpted here at greater length than in the case report):

I teach upper math, so I don't know. I teach trig and calculus. So I doubt if we do any calculus in local places around here. I don't know how we have time to do that. I am not sure that the upper math classes—maybe a lower income average are going to need that—but not my upper math class... Because my kids that I teach now are interested "in the math," I don't have to make it flowery, I don't have to make it enjoyable, I don't have to make it fun, they just want to know, what's the math, the theory behind it.

The assertion here is the familiar one that mathematics is one realm of abstract value and its applications a distinctly different realm of utility. Transferability of mathematics knowledge, on this view, would not logically be presented as valuable. The excerpted passage contains a host of *other* assumptions and valences that remain problematic. The problem, as we say, is *huge*.

The rural problem is even worse. Few champions concerned to make local naturalness *rural* exist outside ACCLAIM and its network of interested scholars and practitioners. And the point of framing such applications to help sustain rural communities remains an educational aim that is

²³See Howley, Howley, Burgess, and Pusateri (2008) for a study that reports the adoption of this text in a rural school and community.

seemingly dangerous to appreciate since the related effort positions actors against a patriotic mission insistently repeated to educators (ensuring the continued global economic and cultural hegemony of the United States through higher achievement in mathematics and science).

Second Question

What conditions enable and constrain their efforts? The case reports demonstrate a wide variety of affordances and constraints in play. Chief among the affordances are alert and passionate teachers who think for themselves. They are apparently open to a range of productive provocations that goad them to action. They see opportunities and project them, their students, their schools, and their districts into action. Challenges are legion, by contrast: the likelihood that colleagues will embrace the mission is dubious; accountability frenzy is ubiquitous (though not likely significant at Green Mountain); changeable professional norms dictate one-best “best practice” or even miseducative purposes (e.g., global American hegemony); the organizational culture of the school or district might not be propitious for community engagement... and so forth. In these sites, of course, the affordances found a variety of ways past the challenges.

Enumerating such challenges precisely across the sites is a project that awaits further planned attention, but at this juncture, we identify three overarching conditions that seem to govern the emergence of such activity: (1) the imperative to develop community-focused math education, (2) approaches to developing place-based math education, and (3) insights from “middle-class theory.”

The Imperative to Develop Community-Focused Math Education

One might phrase the underlying question in this way: “Do we really *need* to teach ratios and proportions, elementary and intermediate algebra, geometry, trigonometry, and calculus with any significant connections (e.g., field work) with people or organizations outside the classroom?” If the answer is “yes,” an imperative exists; otherwise not. At the elementary and middle school level (see, e.g., *Everyday Math*), an affirmative, even in the foregoing cases, was far more likely than at the high school level. What the study seemed to have observed (with the distinct exception of the emergence of the lutherie class at Lafayette) is a consistent negative for “upper math.” The position of the upper-math high school teacher just quoted frames this issue culturally for us (but by no means pedagogically, since the study aims to open up the pedagogical question).

Why is secondary school math so impenetrable, pedagogically speaking? The answer is speculative, a matter of interpretation; one response follows. *Upper math* is allocated, via the typical mechanisms of American schooling, to *deserving students* who have proven their capacity for contemplating (Platonic) mathematical objects with patience and forthrightness if

not always curiosity or passion—students for whom the *imminence* of mathematics is happily associated with just enough fear to keep the intellect alert, and for whom the *immanence* of mathematics remains unacknowledged, at least until later, when the luckiest will prepare for, and then enter STEM-related careers.

Who might these fortunate math students be? Carr and Kefalas (2009) call them the *high-flyers*, those most likely to leave a rural community and never return. (Some, like the retired teacher’s son in Lafayette, do, of course, return—as notable and perhaps locally puzzling exceptions.) Almost as a matter of principled local educational practice, then, the local community becomes irrelevant to the probable destinies of such high-flying students and the aspirations that their usually influential parents cherish for them (Carr & Kefalas, 2009). These families want similar destinies for their children as upper-middle class families anywhere else around the nation: footloose professional careers that take them wherever the most lucrative jobs may be; many others have observed that schooling, even rural schooling, seems organized to this end, which is so counterproductive to sustaining the sponsoring community (e.g., Carr & Kefalas, 2009; DeYoung, 1995; Spring, 1988; Theobald, 1997, 2009). True, these students are not *always* the sons and daughters of local elites, but they generally are (Carr & Kefalas, 2009; Duncan 1999). Thus, engagement with place-based approaches tends to be limited to K-8 settings or, of course, and strongly, to vocational, technical, and agriculture programs—precisely, one might argue, because these settings and programs *do not* cater to the cadres of high-flyers and their families (Carr & Kefalas, 2009). Seemingly across America, then, the imperative to connect “upper” school mathematics to people and organizations in the community hardly exists,²⁴ not as an oversight, but cleaving ardently to the prevailing purposes of schooling—sorting students, conveying privilege across the generations, and ensuring widespread powerlessness among the losers (e.g., Anyon, 2005; Bowles & Gintis, 1976; Brown, 1991; Duncan, 1999; Spring, 1988).

A psychological prejudice is associated with the social prejudice. The Lafayette case provides evidence that considerable fear surrounds getting local, everyday mathematics *into the open*. Whereas math indeed may be everywhere, it remains largely unrecognized—what we consider “locally *immanent*” (indwelling). Few educators anywhere (a few that includes the champions we visited at each site), seem willing to take on the project of disrobing the everyday-ness of mathematics, possibly because it seems an offense to the discipline of mathematics itself, at least as characterized above. One might speculate, then, that the institution of secondary schooling operates so as to *widen* distance between the curriculum of school math and the applications, including especially the local applications, that affirm math’s utility. It’s too much, on these terms, to expect that bridging the widening chasm would claim any legitimate attention, that is, except from those stalwart teachers *thinking otherwise*.

²⁴Except, of course, as the cheer, “Math is everywhere!” At this writing that phrase yields over 10,000 hits in Google searches. A typical connection follows: “Hundreds of students from Western New York middle schools compete in ‘Math is Everywhere,’ a math-based contest initiated to raise student awareness about the many applications of math to their every-day lives.” At this event, middle-school students competed in teams, using written problems. (Source: http://www.eng.buffalo.edu/mathiseverywhere/Math_Is_Everywhere_Intro.htm).

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Such speculations help explain the strange claim that “the side of math you don’t see every day is the everyday math.” Given (non-educator) adults’ testimony that more application is desirable, empirical investigations into the possible ways and reasons that the practice of school math obscures the utility of mathematics (everyday math, and mathematics in biology, sociology, history, and engineering) would surely be a fruitful realm of inquiry. Perhaps the central challenge for a place-based math practice is in the “seeing” of applications rather than the “connecting” of curriculum to community.

Developing Place-Based Math Education

The truly daunting challenges of practicing community-based mathematics instruction *per se* explain why readers might judge the results of this study disappointing. An appreciation of the purpose of place-based efforts can help readers understand the challenges much better.

Once again: Place-based education concerns the sustainability of rural places—rural communities, whether towns or informally existing enclaves. Place-based mathematics is by no means a quaint or backward cousin to project-based learning or culturally responsive pedagogy. It harbors an educational agenda as fine as culturally relevant pedagogy and community-based learning, and surely the preservation of community itself, as a practice and as an ideal toward which neighbors strive is an aim worthy of struggle (Theobald, 1995).

A great deal of rural education research suggests rather strongly that the *sine qua non* of sustainability in rural places is the continued existence of a school, and the most accessible study of this relationship is the late Tom Lyson’s (2002) study of rural towns and villages in New York. Places where schools had closed did less well. Less generalizable quantitative studies show that rural people attribute their towns’ sustainability to the continued existence of the school (DeYoung, 1995; Peshkin, 1982), and contributing authors to this study have reported this finding from their other qualitative work as well (e.g., Howley & Howley, 2006).

The stories we heard in the present work also included examples of sites where sustaining the rural community *was* foremost in the minds of formal and informal leaders: Eastcove, Confluence Collaborative, Lafayette, and Magnolia. But had we dug deeper (going outside the research mission of the study), we would probably have found such claims and concerns at every site. Remarkably in a study of mathematics education, however, the concern surfaced in these four sites without prompting. This eventuality is perhaps an indication that this study’s outlook on place-based education is about right.

At any rate, in these four sites educational leaders and practitioners shared a collective priority that had little to do, on the surface, with mathematics education—especially not mathematics education as typically practiced and conceived at the secondary level (as we heard in Magnolia, with self-deprecating irony: “I’m the typical, shut-in math teacher.”).

If the interpretations in this concluding section have some truth, then, an additional challenge of developing a place-based mathematics education might concern “seeing” the mathematics *of* the everyday (or injecting the mathematics of, say, differentiation, *into* the everyday) in combination with envisioning the future role of locally possessed mathematical knowledge in sustaining the local rural community. This sort of application of mathematics²⁵ might strike even applied mathematicians as peculiar; after all, it’s rather like using music to reinforce school spirit—an analogy that also suggests that the seemingly peculiar application is not actually arcane. Are these misuses of music and mathematics? Perhaps; one doesn’t know about the music, but since mathematics is indeed applied to produce all sorts of good (including great private wealth, as for instance in the derivatives market), the collective usage for the public good would be more than arguably legitimate, but necessary—unless rural community were not, indeed, regarded as legitimate. One must wonder, here in America.

Can *high school* math teachers be found or cultivated to embrace this mission? We have at least the examples of Eastcove and Lafayette as existence proofs. Moreover, it’s clear from the Magnolia, Confluence, and Eastcove sites that formal and informal arrangements do support place-based education efforts to good effect on qualities related to community sustainability.

These reflections about community-based mathematics instruction have shown where one challenge lies—simply *seeing* the local math and the possibilities for mathematizing the local everyday. Addressing that challenge well seems a logical first step on the way to developing a real praxis of rural (place-based) mathematics education.

Middle-Class Theory

Although the selected communities certainly exhibited some variability, it seems that all of them enjoyed substantial or considerable local resources. In this sense, perhaps, the Green Mountain case (our one private-school site that accepted public-sector tuition students) appears *not* to be the outlier one might otherwise judge it to be (i.e., as a New England private school): Household income distributions for all sites are given in Figure 5 (US Bureau of Census, 2000). The data displayed in Figure 5 for five sites represent *school-district-level data* from Census’s school district tabulations. Green Mountain data are also from the 2000 census, but represent the *town* in which the school is located and obviously not any public school district. Magnolia, the other exception, is part of a district with several high schools whose circumstances varied, and it seemed more accurate to use the available separate 2000 census data for the *town of Magnolia*.

On the basis of these data, Magnolia seems to be by far the least well-resourced site in the study. The work in Magnolia, however, benefitted from a long association with a leading place-based education program that specifically designed its assistance for small, remote, and impoverished

²⁵Apparently a *modus operandi* for Engineers Without Borders (<http://www.cwb-usa.org/>).

Alabama schools. This work has been reported impressionistically in the national literature, and is widely admired, but has never been formally studied according to the program's founder.

Magnolia's involvement in the relevant work was as seemingly durable as that at Eastcove Island, though a Maine island and a southern Alabama rural town are in many ways polar opposites in terms of local economy, history, and culture. Race relations, for instance, do not manifest themselves in the Maine transcript data, nor do the Census statistics provide evidence of racial diversity there. Evidently, however, they do share commitments and a legacy of action on behalf of local place.

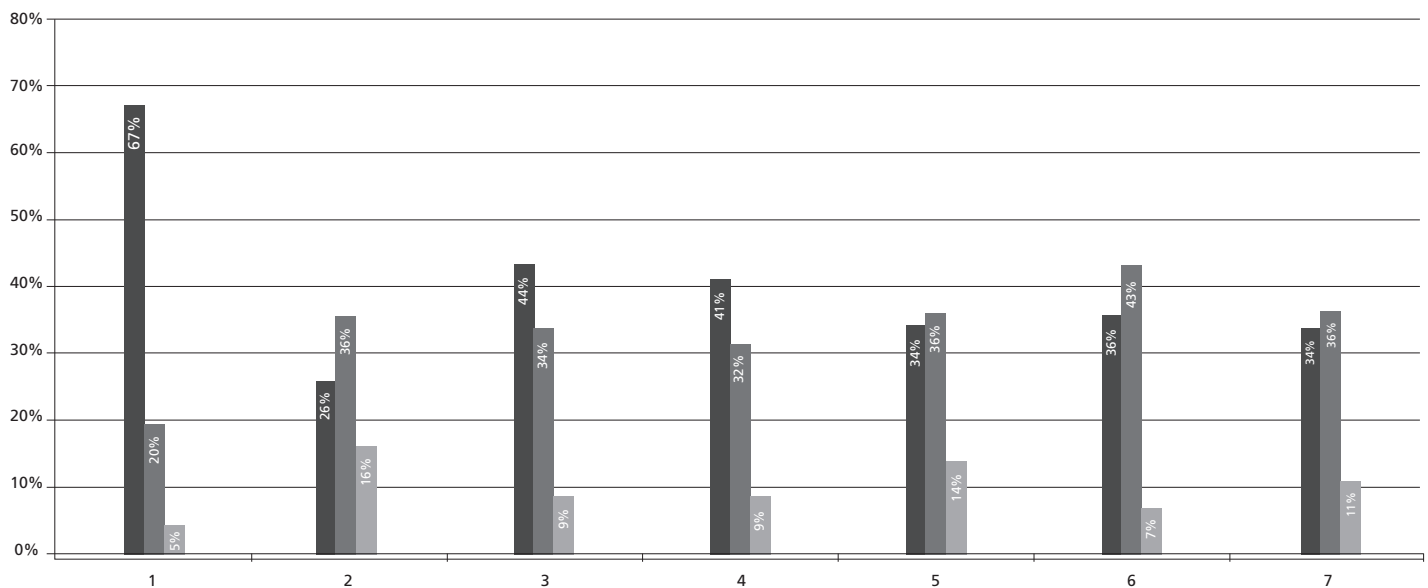
Figure 5 also shows a couple of other things. First, on the basis of household income data, none of these communities can be called affluent. Green Mountain is the predictably most affluent, but not by much (16% of households reporting incomes above \$75,000 as against Meriwether Lewis's 14%). Except for Magnolia, all the districts exhibit middle-income bands (2000 household income from \$25,000 to \$74,999) varying from 32% to 43% of households. Second, in four of these seven sites (Green Mountain, Confluence Collaborative, Meriwether Lewis, and Eastcove), the middle-income band is the modal band.²⁶ Such a shared circumstance might be merely fortuitous, but it's worth observing that sociologist Cynthia Duncan (1999, 1996) holds that a prevalent middle class helps sustain rural communities politically, economically, and culturally. The influence of the

middle class is regarded, in this view, as salutary both in the schools and in the community. The income distribution tables in *Worlds Apart* (Duncan, 1999) very clearly illustrate this principle, and we offer Figure 5 to suggest this theory, which we both appreciate and find doubtful.

Doubts stem from our appreciation of the distinction between the fading petty-bourgeois "middle class" and the now more common corporate-professional "middle class." Citizens, politicians, and scholars alike too rarely distinguish what they really mean by the term, but as Flora, Flora, Spears, and Swanson (1992) have suggested, the interests and commitments of these two sorts of "middle classes" are very, very different. In rural places, in particular, it seems that a devotion to place might linger a bit longer even among *local-origin* inductees to the more corporate-leaning professional middle class (e.g., teachers). This issue cannot be addressed adequately in this study, but readers should be aware of its salience. Perhaps in most of these towns, both the necessary material conditions and the sufficient professional interest co-existed. The case of Magnolia, however, would seem to demonstrate that being largely "middle class" is not actually a necessary condition but only a helpful one. Whether or not a corporate-professional middle class is *unhelpful* must await other studies, but the negative influence of corporate orientation is actually well known from a half-century of study in agriculture (e.g., Goldschmidt, 1947; Green, 1985; Lyson, Torres, & Welsh, 2001).

FIGURE 5 // Household Income Distribution Across All Sites

SITES 1 :: Magnolia, 2 :: Green Mountain, 3 :: Lafayette, 4 :: South Valley, 5 :: Merriweather-Lewis, 6 :: Confluence, 7 :: Eastcove



Note. US household averages (Bureau of Census, 2000): 28.6%, 48.8%, 22.5% for these cut-points. Percentages do not sum to 100 due to rounding.

²⁶With 67% of households reporting incomes less than \$25,000, only Magnolia might be judged "impoverished." On their visit to Magnolia, the lead authors drove through the surrounding countryside and around the town of Magnolia on several occasions. The town and the local countryside could be described as much healthier than many rural towns in the remote and not-so-remote parts of Appalachia with which the lead authors are familiar.

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Retrospective Caveats by Way of Conclusions and Recommendations

Three cautions seem warranted in understanding the interpretations just presented. We briefly consider each in turn.

Three Cautions

First, examples of rural schools connecting mathematics to education are promising but rare, so the data and results presented here are a detailed picture of a small subject. We suspect a larger picture of such practices would be difficult to access at present, though the research team is attempting a survey, as noted previously. An additional answer to research question one (what they did) is this: “because of and despite answers to research question two.” In that light, the two questions can’t be considered independently. Affordances and constraints, on this view, are ontologically prior and influential in some empirically unknown way; but because this work is difficult and dynamic, an interaction effect is likely in the view of the lead authors.

Second, conditions that enable and constrain place-based approaches, as evidenced by the presenting issues, were far easier to see than the intricacies of how such connections were made or might be made. Evidence of *how* they were made nonetheless seemed to us to bear the scars of a negotiated creation—interactions with colleagues, community, friends, and the initiators’ own context-saturated limitations and aspirations.

Third, “connection to local community” proved a difficult concept to sort out on the ground, since (as in most studies) we, too, discovered that it begged many other questions: Connections of what? To what (what is “community”)? In what way? To what extent? To what aspect of community? When is a connection a disconnection? Neither *connection* nor *community* point to material objects; like all concepts, they remain problematic in the face of any analysis.

A deeper level of cross-site (cross-case?) comparison is already underway to address such issues. This ongoing cross-site comparison is motivated by acknowledged limitations in the first and second iterations of data analysis. Such limitations are inherent in qualitative analysis, especially one conducted by a large team at many sites, and they reflect the difficulties inherent in understanding community practice and everyday life in light of issues focused on *schooling*. Such challenges are well noted in writing about method—and are reflected in team members’ concern to define the “case” at each site (or the phenomenon across sites). The individual site reports do already read, in an ordinary sense, as case studies, but the fact remains that the study team still has some questions about what constitutes, and not just characterizes, the “cases” thus seemingly studied.

The making of connections, of whatever sort and on whatever terms, rested in nearly every instance on the insights and passions acted upon by particular educators. Moreover, these passions and insights seemed to have been activated, as already mentioned, by an inspirational antecedent

experience or contact (often figuring, as research team members heard, as a response to a challenge or frustration). Further analysis and team discussion will involve clarifying the research case, quite likely in terms of themes that emerge in the deeper cross-site consideration. Possibly, some “cases” lie in the intersections between sites (rather like latent variables in structural equation modeling).

What Is To Be Done

Tom Green (1980) recognized that education research is a matter of practical argument, and that “the conclusion of a practical argument is a proposition of the form ‘Do X’” (p. xx). The lead authors are wary, however, of dramatic prescriptions...wary, really, of all prescriptions, including their own.

For this reason, then, the recommendations here are brief, cautious, and couched as caveats. In our experience, some of the best prescriptions concern what not to do. We offer the following recommendations, then, with caution and some regret:

For school and community leaders:

- 1:: Read a lot more about the tensions between the local and the global; be suspicious of the claims of those who say they can predict the future. Part of what one does in such work as described by those interviewed is to remake the possibilities lurking for the future.
- 2:: Don’t put the quest for small gains in accountability test scores at the center of school culture. Decide what you will do instead. Place-based education (or simply place-consciousness) is an appropriate alternative in rural communities.

For all teachers:

- 1:: Look for opportunities to organize your teaching around local phenomena; let your intellectual passion and attachment to place be your guide. Honor such attachments, especially if they are professionally disparaged in your place.
- 2:: Ignore all standards you cannot make your own; they won’t help you or your students.
- 3:: Be skeptical of the sort of teaching recommended to achieve “accountability objectives,” and don’t be fearful that good teaching will undermine student achievement.
- 4:: Make contact with others doing this work, including organizations that understand rural place, and help convince friends, neighbors, and colleagues to support and expand such connections.

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It's an erroneous impression: no one can reliably predict the future, least of all the current authors. On the other hand, many of those we interviewed seem to have been motivated, perhaps spottily and perhaps in part, by such principles. Perhaps it's most important to remember that all of this work—the making of connections between community and mathematics education and the doing of research about such projects—is a mostly a matter of invention and mostly not a matter of following prescriptions.

For teachers of mathematics:

- 1:: Keep the points for all teachers in the forefront of your thinking.
- 2:: Start slowly, and small. Realize that you're a pioneer.
- 3:: Talk to community members about their work in order to "see the math."
- 4:: Allow yourself to invent the math applications that apply to what you see.
- 5:: Hook an initial project to the curriculum you already teach.
- 6:: Applications for algebra, geometry, trigonometry, functions, calculus, and statistics exist in abundance in all rural communities. Mathematical objects *do not* depend on a local STEM employment base for you to make connections to place. The trigonometry in the lutherie project is a good example of the immanence of such connections.
- 7:: It bears repeating: Whether or not anyone in the community "uses higher-level math" is beside the point; you can insert higher-level math into what they already do and are concerned about.
- 8:: If you teach higher-level math, find a couple of such opportunities and exploit them in your teaching. In mathematics, you're not just a pioneer, but a courageous explorer.

For community members especially:

- 1:: Look for teachers to help share what you know, especially where you work or live.
- 2:: Recognize the importance of helping local children to stay put as adults; make sure you challenge those who say that a child's only hope for the future is to leave the community for good.
- 3:: Help the school find ways to devote more resources to the children most likely to stay; read *Hollowing Out the Middle* (Carr & Kefalas, 2009) in order to appreciate how important this counsel is.

Once again, such lists make the lead authors uncomfortable. On one hand, these lists give the impression that those who make them can guarantee the effects of following the recommendations. It's an erroneous impression: no one can reliably predict the future, least of all the current authors. On the other hand, many of those we interviewed seem to have been motivated, perhaps spottily and perhaps in part, by such principles. Perhaps it's most important to remember that all of this work—the making of connections between community and mathematics education and the doing of research about such projects—is a mostly a matter of invention and mostly not a matter of following prescriptions.

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