Appalachian Collaborative Center for Learning, Assessment and Instruction in Mathematics

Working Paper Series

Mathematics Education in Rural Communities in Light of Current Trends in Mathematics Education

Working Paper No. 1

James E. Schultz
Ohio University
October 2002

ACCLAIM's mission is the cultivation of *indigenous leadership capacity* for the improvement of school mathematics in rural places. The project aims to (1) understand the rural context as it pertains to learning and teaching mathematics, (2) articulate in scholarly works, including empirical research, the meaning and utility of that learning and teaching among, for, and by rural people, and (3) improve the professional development of mathematics teachers and leaders in and for rural communities.

ACCLAIM Research Initiative

Address: 210A McCracken Hall
Ohio University
Athens, OH 45701-2979

Office: 740-593-9869
Fax: 740-593-0477

E-mail: howleyc@ohio.edu
Web: http://acclaim.coe.ohiou.edu/

Funded by the National Science Foundation as a Center for Learning and Teaching, ACCLAIM is a partnership of the University of Tennessee (Knoxville), University of Kentucky (Lexington), Kentucky Science and Technology Corporation (Lexington). Marshall University (Huntington, WV), University of Louisville, and Ohio University (Athens, OH).

This material is based upon the work supported by the National Science Foundation Under Grant No. 0119679. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Mathematics Education in Rural Communities in Light of Current Trends in Mathematics Education

by Jim Schultz
Ohio University

September 2002

Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics
ACCLAIM Research Initiative
Ohio University
Athens, OH

Mathematics Education in Rural Communities

in Light of Current Trends in Mathematics Education

Introduction

It has been said about the sculpture of Henry Moore, characterized by its holes and notches, that it's what *isn't* there that makes the greatest statement. Perhaps the same could be said about mathematics education in rural communities. There is currently considerable focus on efforts to improve our nation's mathematics education, "grounded in the belief that all students should learn important mathematical concepts and processes with understanding" (National Council of Teachers of Mathematics, 2000). This call was broadened in the Congressional Act "No Child Left Behind," signed into law by President Bush in January 2002. Yet there is evidence that students in rural settings do not seem to garner their share of attention. This paper considers school mathematics in rural communities in the larger context of current reform from a number of perspectives, including curricular materials, selected recent publications, achievement data, and a teacher enhancement project.

According to the U. S. Census, about one-fourth of the nation's population lives in rural areas, including 6,843,000 people below the poverty level (U. S. Census, 2000). But a sampling of current curricular materials, topics of a recent mathematics education research conference, and the National Council of Teachers of Mathematics' (NCTM) yearbook dedicated to diversity suggest comparatively little attention has been given to rural settings.

The rest of this paper consists of six sections: A Sampling of Current Attention to Mathematics Education in Rural Settings; National Assessment of Educational Progress Data; Mathematics Education Reform; The Backlash Movement; "Teaching and Learning Mathematics in Poor Communities" (NCTM, 1999); and The Moving on Mathematically Project.

A Sampling of Current Attention to Mathematics Education in Rural Settings

An informal examination of lessons from middle school and high school programs begins to tell a story. This pilot study of current text materials included three new reform-oriented curricula with a contextual approach

Britannica (1997), Mathematics in Context	
Number Strand (4 booklets)	Grades 5-6
McDougal-Littell (1999), MathThematics, Course 1	Grade 6
Everyday Learning (1998) Core-Plus Mathematics,	
Course 1, Part A	Grade 9

and two popular, more traditional texts

Scott-Foresman- Addison Wesley (1998), Middle School Math,	
Course 1 Volume 1	Grade 6
Glencoe (1997), Algebra 1	Grade 9

The texts were first selected then examined for rural settings. The following is a complete list of what three examiners found in more than 3,000 pages:

A 6-page lesson in a farm setting

A problem about pigs and sheep among 20 animals whose life span was given

A grain elevator photo in a “real-world problem” about shipping grain upstream and downstream

A problem about Aztec agriculture

A problem about chickens and pigs on a farm

A problem about Native American teepees

A problem about a windmill in Southern Utah

A problem that mentions an agricultural scientist

A problem about breeding pigs

In contrast, there were numerous urban settings, including the following:

A 52-page module called "Heart of the City"

A 6-page lesson in a city setting

A 6-page lesson about parking structures and parking lots

A 4-page lesson about big cities

A 2-page lesson about landscaping a residential area, including a pool, hot tub, and deck

Problems about structures and about population in metro areas

As a second illustration, examination of the 28 article titles of the NCTM 1997 Yearbook dedicated to diversity revealed two articles about urban needs and none about rural needs. Perusal of the articles themselves yielded eleven references to urban settings, and only two to rural settings – with both of these referring to Native American cultures. As a final illustration, the program for the NCTM 2002 Research Presession included two presentations with the word "urban" in the title and featured 11 sessions with presenters from urban school districts. Correspondingly, there was little representation from rural areas, with no mention of rural issues and just one session that included presenters from both urban and rural districts (NCTM, 2002).

In what may indicate an emerging awareness of the rural needs, the National Science Foundation in its support of four new Centers for Learning and Teaching funded two projects with a rural focus, the Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics (ACCLAIM), (serving a four-state Appalachian area) and the Center for Learning and Teaching in the West (serving sparsely populated areas in the west). Perhaps the National Science Foundation has taken note of what has *not* been there when responding to the needs of all students.

<u>National Assessment of Educational Progress Data</u>

So how do students in rural America perform in comparison with their urban and suburban counterparts? The Web site of the National Assessment of Educational Progress (NAEP), offers this information:

> In 2000, NAEP administered the latest mathematics assessment at grades 4, 8, and 12 to approximately 47,000 students in the nation. The national sample assessed 742 schools at grade 4, 744 schools at grade 8, and 558 schools at grade 12. The assessment was administered to approximately 212,000 students in individual states at grades 4 and 8.. The state sample assessed 4,239 public schools at grade 4 and 3,594 public schools at grade 8. (retrieved from: http://nces.ed.gov/nationsreportcard/)

The report provides data according to the type of location of the schools, using three mutually exclusive categories derived from U.S. Census categories: central city, rural/small town, and urban fringe/large town. Because the definitions changed from earlier surveys, direct comparisons with previous years are not possible.

The tables and graphs that follow compare performances across three grade levels. Note in Tables 1, 2, and 3, that the performance of urban fringe/large town students consistently leads the performance of students in rural and small-town schools, which in turn consistently leads those in central- city schools. However, if "above basic" is divided between "advanced" and "proficient, " the percentage of students considered "advanced" in rural schools is less than or equal to the percentage in both urban fringe/large town (suburban) and the central city schools (see Table 4). These results are similar to those reported by Secada (1992) using 1982 NAEP data for 9-, 13-, and 17-year-olds across all skill levels (knowledge, skills, understanding, application). Secada also cautions that 12^{th} grade data may not reflect the most accurate picture due to higher dropout rates among certain groups.

Table 1. Grade 4 math performance by location

%	Central	Fringe	Rural
Below Basic	39	26	30
Basic	40	42	47
Above Basic	21	32	23

Table 2. Grade 8 math performance by location

%	Central	Fringe	Rural
Below Basic	44	29	33
Basic	33	40	41
Above Basic	23	31	26

Table 3. Grade 12 math performance by location

%	Central	Fringe	Rural
Below Basic	40	32	35
Basic	45	48	52
Above Basic	16	19	13

Table 4. Percent of Advanced Students

%	Central	Fringe	Rural
Grade 4	2	4	2
Grade 8	5	6	4
Grade 12	2	3	1

Figures 1, 2, and 3 graphically show the information of Tables 1, 2, and 3 respectively.

Figure 1. Grade 4 math performance by location.

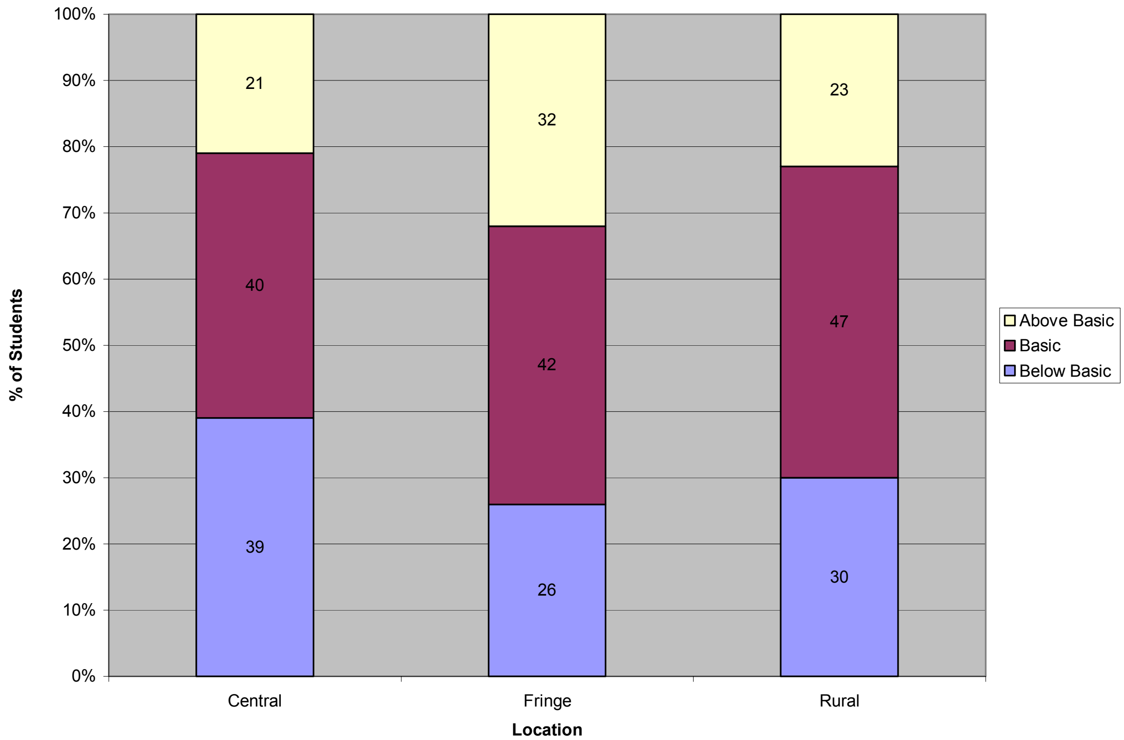


Figure 2. Grade 8 math performance by location.

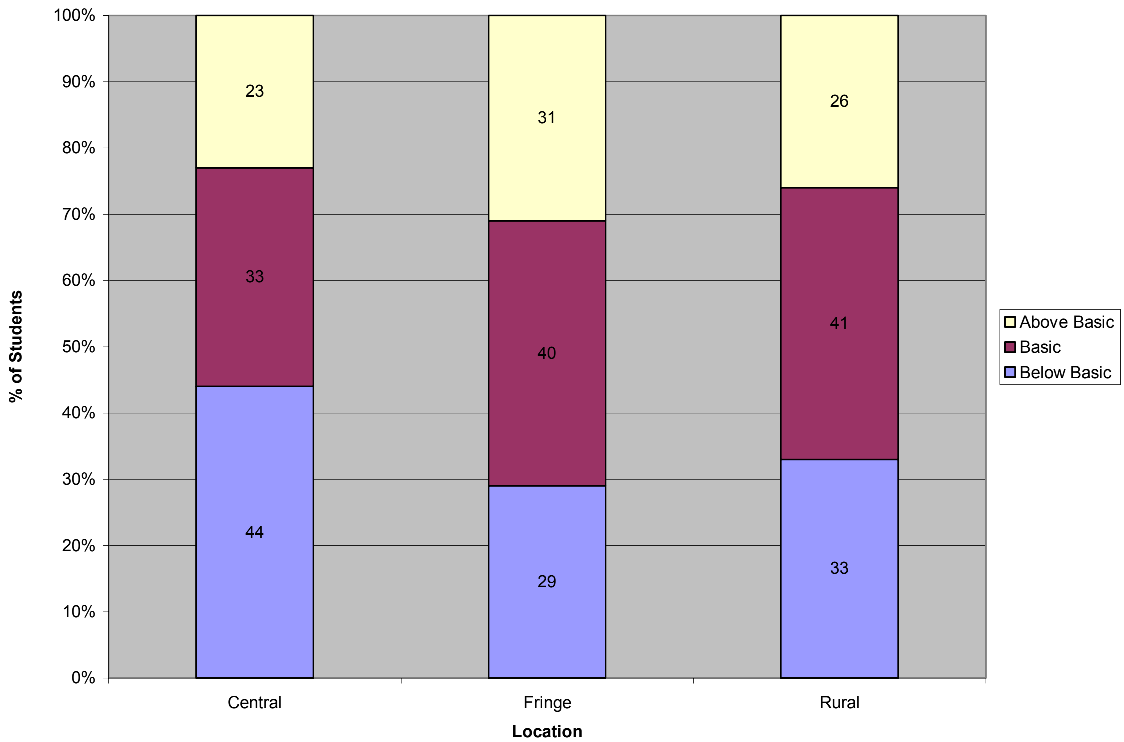
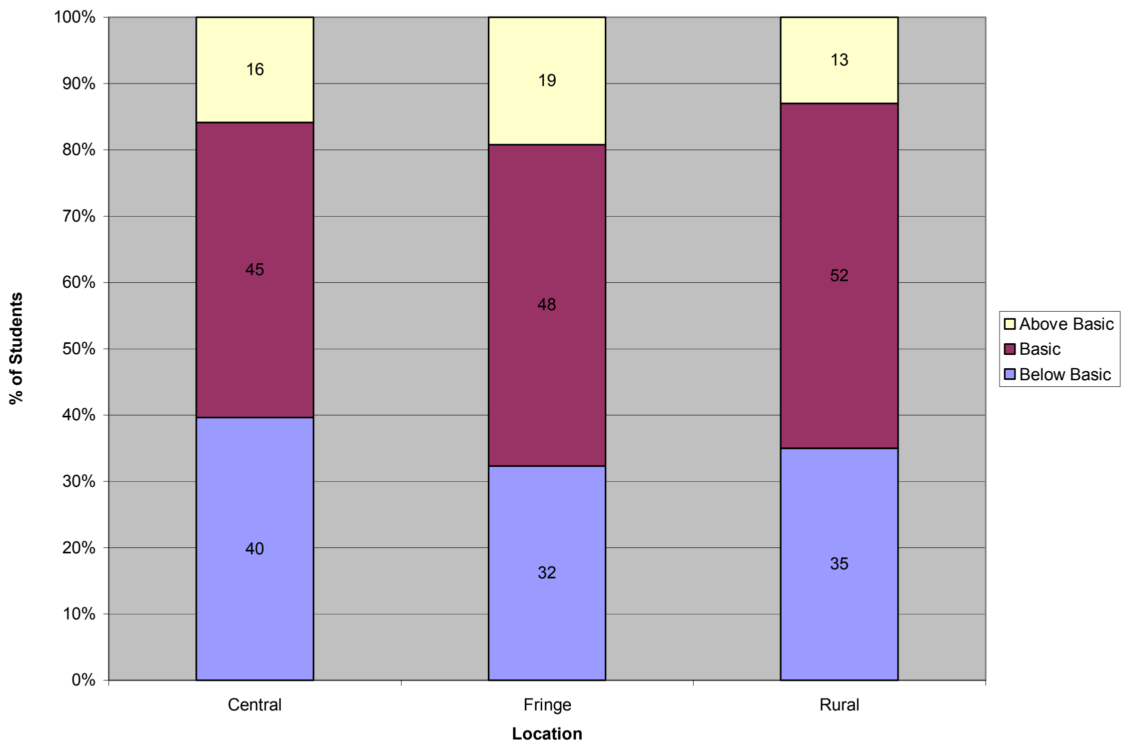


Figure 3. Grade 12 math performance by location.



Mathematics Education Reform

Current efforts to reform mathematics education in order to better serve all students can be traced back two decades to the report, Agenda for Action, produced by the leading professional group of mathematics teachers in North America with approximately 100,000 members. Agenda for Action (NCTM, 1980) called for a focus on problem solving in an effort to make mathematics more relevant and meaningful for students. A key report alerting the nation to problems with the U. S. educational system was A Nation at Risk (National Commission on Excellence in Education, 1983). The Second International Mathematics Study discussed in The Underachieving Curriculum: Assessing U. S. School Mathematics from an International Perspective (McKnight, 1987) specifically spoke to mathematics. NCTM responded by issuing a series of standards documents.

First among these was the Curriculum and Evaluation Standards for School Mathematics, which called for "a vision of mathematical power for all [students] in a technological society" (NCTM, 1989, p. 255). This report insisted on intellectual "opportunity for all," with particular emphasis on women and minorities, observing that "mathematics has become a critical filter for employment and full participation in our society" (NCTM, 1989, p. 4). The core of this document was a series of four process standards (problem solving, connections, communication, and reasoning) and a list of topic standards, such as algebra and geometry.

The 1989 standards were followed by a series of other documents that amplified and extended them, including Professional Standards for Teaching Mathematics (NCTM 1991), Assessment Standards for School Mathematics (NCTM, 1995), and The Nature and Role of Algebra in the K–14 Curriculum: Proceedings of a National Symposium (NCTM, 1997). The NCTM also released the Curriculum and Evaluation Standards for School Mathematics Addenda Series, a series of 15 topic-specific books and 7 Grades K-6 books to provide classroom examples of the vision articulated in the Curriculum and Evaluation Standards for School Mathematics (NCTM, 1991 to 1995). According to John Goodlad,

> The National Council of Teachers of Mathematics was a forerunner in publishing standards for the restructuring and improvement of mathematics education in the educational system of the United States. The concept has caught on; today the development and assessment of standards in all the subject fields of the curriculum is on the front burner of discourse, planning, and action at all levels of the political interest in school improvement. (Goodlad, 1995, p. 275)

It is interesting to note that Goodlad, citing Hannaford, agrees that the way mathematics is taught has moral implications. If it is taught as a personal adventure of intelligence and discipline, it contributes to the development of self-confidence, freedom, respect, and generosity – desirable characteristics among citizens of a democracy. But if taught as a closed structure, the result is more akin to subordination and obedience – characteristics of totalitarianism (Goodlad, 1995, p. 287).

In an effort that paralleled the work of the NCTM, the Mathematical Sciences Education Board (MSEB) of the National Research Council issued Everybody Counts, which focused on teachers to bring about needed change in mathematics teaching and learning (Mathematical Sciences Education Board, 1989). From the title on, it called for relevant mathematics for all students in a world of changing demographics. It, too, focused on issues of gender and race. A textbook problem featuring a Hispanic female doctor living in a typical residential area determining where to place her hot tub (see first section of this paper) illustrates the direction diversity has typically taken in the new curricula.

A new generation of international comparisons emerged in 1996 with the widespread dissemination of reports from the Third International Mathematics and Science Study (TIMSS), the largest and most comprehensive international study ever undertaken of mathematics and science education. The study considered both curricula and achievement for children aged 9, 13, and in the last year of high school (4th-, 8th- and 12th-graders in the U.S.), although the achievement data received the most attention. Among the findings of a curriculum study are the following (TIMSS United States, 1996):

- Currently, U.S. standards are unfocused and aimed at the lowest common denominator. In other words, they are a mile wide and an inch deep.
- This unfocused approach reflects the fragmented nature of the educational system in the U.S. – with the authority for education distributed among federal, state and local bodies – and the lack of common standards on what to teach and how to teach it.

In three separate achievement studies U.S. performance showed a dramatic decline across grade levels (TIMMS, 1997, 1998):

- 4th graders scored above the international average in mathematics and science compared with the 26 nations in TIMSS.
- 8th graders scored below the international average in mathematics and above the international average in science compared with the 41 nations in TIMSS.
- 12th graders scored below the international in mathematics and science compared with the 21 nations in TIMSS.

The National Council of Teachers of Mathematics renewed its stance with Principles and Standards for School Mathematics (NCTM, 2000), which served to update, codify, and unify the previous standards documents. PSSM updated the earlier standards with regard to technology and emerging research. Some of the elements of the 1989 standards, including equity and technology, were presented as principles in the new document. Assessment appeared as one of the principles in bringing together the three earlier documents. Uniformity across grade levels also served to unify the newer standards. While PSSM for the most part is consistent with the earlier standards, it takes a softer stand on technology, using words like "when appropriate" rather than "at all times."

The addenda to PSSM are called Navigations. They give related in-depth and grade-specific information, activities, and advice about implementing PSSM. The Navigation documents, analogous to the addenda series of the earlier standards, are organized around topics and grade level, with titles such as Navigating through Algebra in Grades 3–5. A complete listing of the 34 proposed books can be found at http://nctm.org/standards/navigations.htm. The books include a companion CD-ROM that features electronic examples related to concepts developed in the book and additional resources such as selected articles from other sources. The NCTM has also created Illuminations, a separate Web site (http://illuminations.nctm.org/index2.html) that shows what Principles and Standards can look like in the classroom and gives interactive activities and other resources.

In an effort to assist in providing curricula that embodied the 1989 NCTM standards, the National Science Foundation supported a number of curricular projects. This resulted in three new elementary programs, five middle school programs, and five secondary programs. Everyday Math, Connected Mathematics, and Core-Plus Mathematics are popular respective examples. A complete listing can be found at http://mathematicallysane.com/links/nsfprojects.asp.

The Web page of the Eisenhower National Clearinghouse describes the creation of panels that were created to evaluate new curricula: "Expert Panel for Mathematics and Science Education sought out programs that exemplify the high level and challenging mathematics called for in the National Council of Teachers of Mathematics (NCTM) standards and the American Association for the Advancement of Science (AAAS) benchmarks." This panel identified certain programs as being "exemplary" or "promising," giving high marks to curricula supported by the National Science Foundation.

The view of the interaction of mathematics with social values has been elevated more recently by Robert Moses to a level of a civil right. In "Radical Equations: Math Literacy and Civil Rights" Moses argues that "math literacy – and algebra in particular – is the key to the future of disenfranchised communities." (Moses, 2001, p. 5). He adds: "I believe that the absence of math literacy in rural and urban communities throughout this country is an issue as urgent as the lack of registered Black voters was in Mississippi in 1961." (Moses, 2001, p. 5). He provides the interesting note that ENIAC, the world's first electronic computer, was contracted for development the year before the first cotton was picked by machine in Mississippi (p. 7). Using much the same rationale for change as the NCTM 1989 standards, Moses speaks of the impact computers and technology have on the teaching of mathematics for all students.

Mathematics education reform has been consistently supported by the National Council of Teachers of Mathematics, the Mathematical Sciences Education Board, the National Science Foundation, and the American Association for the Advancement of Science. It has, however, encountered vocal opposition, discussed in the next section.

The Backlash Movement

Mathematically Correct, an organization visibly critical of the sorts of reform sponsored and supported by NCTM, sees the reform movement as aggravating, not ameliorating, the problem of low mathematics achievement in the U.S. The organization describes the reform led by the NCTM in these terms: "Their focus is on things like calculators, blocks, guesswork, and group activities and they shun things like algorithms and repeated practice" (see http://mathematicallycorrect.com/). Mathematically Correct quotes a Wall Street Journal editorial of January 4, 2000, saying, "New Math will take its casualties, especially among the poor, adding to the already mounting costs of the decline in national educational standards." In calling for a "truce," the group differs strongly from the NCTM on several points and argues that math educators should:

- admit that weak programs have resulted from following NCTM guidelines,
- refrain from promoting heterogeneous grouping or repudiating homogeneous grouping,
- include symbolic skill-building, abstract mathematics, and repeated practice, and
- indicate that calculators and computers should be used sparingly.

The so-called "math wars" have escalated. In a May 6, 2002, posting, Mathematically Sane, a group that identifies itself as receiving no support or endorsement from any businesses, dues-collecting organizations, government agencies, or foundations (See http://mathematicallysane.com), states:

> Over the past month it has become increasingly clear that the National Science Foundation's [NSF] Directorate for Education and Human Resources is under attack by people who dislike, in particular, the mathematics curriculum projects funded by the NSF. These people argue that the EHR directorate should be discontinued. (Mathemantically Sane, 2002)

The Mathematically Correct group, which includes distinguished mathematicians, continues to be a vocal force in its stand against math reform.

"Teaching and Learning Mathematics in Poor Communities" (NCTM, 1999)

The Task Force on Mathematics Teaching and Learning in Poor Communities was created to address issues of mathematics education in areas of poverty. The report "Teaching and Learning Mathematics in Poor Communities" was written by Pat Campbell and Ed Silver (NCTM, 1999) and is available on the Web at nctm.org. It discusses three types of poor communities: urban, rural, and Native American. This section of the paper highlights some of the findings about poor rural communities, showing how they are similar to and yet different from poor urban communities with regard to mathematics education. (References cited in this section are cited in the report itself.)

The report gives this breakdown of the poverty in the United States, showing that it is not merely an urban problem:

- More than 40% of the poor live in urban inner cities
- About 35% of the poor live in metropolitan areas outside of the inner city.
- More than 25% live in rural or small town settings (Dalaker, 1999). (p. 14 footnote)

One finding is that parents expect schools to support their children's culture, but that in both urban and rural settings there may be conflict, which can be resolved if the student changes to conform or if the school changes to value and accommodate. If the school expects the student to conform, student learning may be curtailed and alienation or resistance may occur. (Gordon and Yowell, 1994). In this case student learning is influenced by the student's capacity to adapt. If it is the school that accommodates the student, it is the school's facility to change that influences student learning.

In both urban and rural schools the report indicates less opportunity for students to enroll in advanced mathematics courses (Oakes, 1990) and (Ballou and Podgursky, 1998). The report concludes:

> It is evident that the mathematics content that is taught in schools is an important and critical factor impacting the future success of students in mathematics. School mathematics content must be worthwhile in nature, have mathematical integrity and rigor, and provide options for students. … It is critical that schools in rural areas and schools that do not have sufficient enrollments in advanced mathematics courses learn how to effectively tap the potential of distance learning and the Internet. (NCTM, 1999, p. 6)

Both intrinsic and extrinsic factors can affect mathematics programs. In speaking from the view of the student, the report says:

> In rural communities, adolescents frequently experience conflict between career aspirations and their preferences for a future residential location. This is because both adolescents and adults in rural communities recognize that the economic benefits associated with a college diploma may only be accessible at locations removed from the parents and family who reside in a local area. Indeed, a recent study indicated that, by age 25, half of all rural college attendees had not returned to their home community (Gibbs, 1995). It is not unusual for rural adolescents, particularly male adolescents, to decide there are substantial risks associated with "too much education" leading to lower educational aspirations, hesitancy or delay in

> pursuing college entry, lessened motivation for secondary schooling, and worry or anger regarding the future options (Hektner, 1995). (NCTM, 1999, p. 5)

In addressing the view of programs from outside sources, the report cites differences in the source of and motives for scrutiny of student success on standardized assessment measures. In urban areas there is scrutiny from both state and local sources, often from politicians and the business sector, which view education as something for which the public pays. But "in rural settings, there is little local academic scrutiny because of a lack of knowledge by parents."

Teachers in both urban and rural schools face enormous challenges. Both urban and rural teachers address constraints within their schools that limit their instructional choices, such as working with inadequate resources and accessing limited professional development opportunities. Similarly they confront common limitations from outside their schools that hinder their students' readiness for instruction, such as inadequate health care or nutrition. Yet there are differences. Urban teachers may work in dangerous neighborhoods with highly mobile students who are culturally diverse and speak a cacophony of languages. Rural teachers may work in schools that are the central focus of the surrounding community with students who have lived in that region all of their lives, as have their parents and grandparents. Whether in an urban or rural setting, however, it is highly likely that a high-poverty classroom will challenge a teacher's own culturally based perspectives of what it means to teach and of what students should do to learn. (p.8)

Though earlier efforts bypassed rural America, in 1987 Congress undertook a "rural education initiative" focusing on improving instruction and building the capacity of state and local district personnel. This national interest grew in 1994, when NSF instituted the Rural Systemic Initiatives, subsequent to the earlier launch of its Urban Systemic Initiatives. Both sets of initiatives promoted a similar vision of educational reform in mathematics and science.

Another contrast drawn out by the report concerns follow-up instructional support. In urban areas it has been on-site, while in a few efforts in rural areas the Internet has supported collaboration with colleagues and experts (Rogan, 1995; Yap, 1997). The report calls for more studies "to characterize the nature and longevity of the implementation of mathematics reform efforts in classrooms serving poor communities, particularly in rural areas, and to examine the implications of that reform on student achievement in mathematics" (NCTM, 1999, p. 10).

Yet another comparison is the matter of scale. "In urban areas, scale refers to the large numbers of schools and teachers eligible for enhancement, with associated high mobility within both the instructional staff and the student population. In rural areas, scale refers to distance, with isolated teachers and schools raising issues of access to enhancement and follow-up support" (NCTM, 1999, p. 10).

Lower student performance and depressed economic conditions are factors in both urban and rural poor communities. Among the differences cited are the following:

- Due to the economics of scale, it is more costly to provide equal educational opportunities in rural locations as compared to urban districts.
- Rural districts have to pay higher costs per course because funds are typically determined on a per-student basis.
- Rural states typically have inadequate cost equalization formulas based on population density, so local taxes are critical for funding education. The resulting lack of funds decreases access to quality mathematics and advanced placement course offerings.
- High school dropout rates are higher in rural areas than in metropolitan areas.
- Teacher turnover is higher in some areas depending on cultural, economic and geographic conditions.
- Rural communities face the added challenge of geographic isolation, which limits access to community resources and support systems that enhance student and teacher performance.
- Schooling that promotes individual achievement as necessary for economic success seems in many cases to undercut the importance of a sense of place and the kinship bonds of rural families.

On a positive note, the report concludes that the rapidly growing capabilities of high-speed networks and telecommunication systems give rural regions their first real potential to overcome the persistent isolation and lack of opportunity resulting from geography and poverty (NCTM, 1999).

Moving on Mathematically Project

The Appalachian Collaborative Center for Learning, Assessment, and Instruction in Mathematics (ACCLAIM) Project builds upon several earlier efforts. One of the projects that preceded ACCLAIM was the Moving on Mathematically (MOM) Project centered at Ohio University from 1997 to 1999. This teacher enhancement project, funded by discretionary funds from the Ohio Department of Education and directed by the author of this paper, was charged with improving mathematics teaching in some of the state's lowest-performing districts on the Ohio Proficiency test. The MOM Project, together with two Ph. D. dissertations that grew out of it, provided insights into school mathematics in rural and urban settings.

Project MOM brought together 28 teachers from four rural school districts, including one vocational school, in southeastern Ohio and two urban school districts in central Ohio. Activities focused on issues involving curriculum, technology, and assessment, which anticipated three of the principles in the NCTM's Principles and Standards for School Mathematics (2000). Following a preconference to help determine the goals of the project, teachers met in four all-day sessions in the spring, a two-week summer workshop, and an all-day follow-up session in the fall.

In a paper that presented the rural perspective on teacher enhancement projects at the preconference, Hatfield (1997) advised that projects be especially attentive to teacher beliefs and values, be present in the unique world of the teacher, and be aware of the isolation that teachers can feel and help them to overcome it. At the same time, Hatfield maintained that "in most ways today's 'rural' is no longer such a different world." He further suggested that traits of rural school districts will be mostly similar to urban contexts, a view borne out over the duration of the project. Nevertheless he said that teachers in rural contexts may believe that their students are less able, less deserving, and less likely to achieve excellence; that teachers may hold similar beliefs about their own potential for growth and leadership, feelings that may be so ingrained as to be difficult to overcome; and that these factors could result in a self-fulfilling prophecy. Such attitudes might well be reinforced by lower salaries and less resources. Among his recommendations, Hatfield suggested that technological tools could play an important role in overcoming the problems of distance that rural districts face.

During the project itself, teachers were queried about their views on various issues. For example, when teachers in six groups were asked what they saw as the most pressing issues for schools in rural areas, they gave the following responses. The numbers in parentheses that follow each item indicates how many of the six groups mentioned the issue.

- low parental/community support (5)
- school funding (including unfunded state mandates) (4)
- attendance (3)
- lack of resources, especially technology (2)
- poverty (2)
- prejudice, low tolerance of others (2)
- family break-ups
- high pregnancy rates
- out of touch with developments in education
- motivation

Evaluations also showed that teachers most valued learning about technology, assessment activities, and techniques to enhance teaching from traditional texts. Teachers least valued looking at new text materials and discussions of the rationale for mathematics reform.   Moreover, teachers generally disdained reform-oriented curriculum materials that they reviewed before project activities fostering their use, and especially lacked interest in those materials that appeared most different from traditional textbooks.

Two extensive studies were conducted during and after the project. In a study using surveys, technology inventories, interviews, and lesson plans, Almekbel (2000) reported with respect to curriculum that, in comparison to baseline data, teachers used more cooperative learning, challenging activities, real-life applications, connections, new resources, and critical thinking, and that both teachers and students developed more positive attitudes toward the non-traditional activities. Obstacles to curriculum reform that teachers cited were large class size, preparation for the Ohio Proficiency Test, and insufficient class time. Regarding technology, he reported that teachers used graphing calculators and calculator-based labs more frequently, and that teachers and students developed more positive attitudes towards using technology. Obstacles were insufficient funds, training, and time. Regarding assessment, he reported that teachers used more rubrics, open-ended questions, questioning techniques, and student projects, with the same obstacles reported above.

Among the findings of another study, Al-Shawa (2000) reported that twelve teachers who implemented a project activity judged to be equally balanced in addressing skills, concepts, and problem solving in their classrooms focused more on skills, spent more time on acting out the activity, and spent correspondingly less time in discussing it.

Conclusion

In summary, rural communities in general and poor rural communities in particular have not benefited their fair share from efforts to improve mathematics education in the United States. Rural communities face problems in many ways equal to or greater than those of other groups, especially due to lack of parental support, adequate funding, and student populations spread over widely isolated areas. Much attention is being paid to context and diversity in learning and teaching mathematics, but for the most part this does not seem to apply to rural settings. This does appear to be improving in recent times with new directions in government funding, an NCTM publication addressing the needs of rural and other poor communities, and strong statements on behalf of the nation's disenfranchised rural and urban poor. Such efforts may make it less likely that *what isn't there* will constitute the strongest statement about mathematics education in rural communities.

References

Almekbel, Abudullah. "The Impact of a Teacher Enhancement Program on 7th through 12th Grade Mathematics Instruction with regard to Curriculum, Technology, and Assessment".. Ph. D. dissertation, Ohio University, Athens, OH, 2000.

Al-Shawa, Hala. "An Investigation of the Effectiveness of Modeling a Mathematics Activity for In-Service Teachers with Respect to Mathematical Content an Accuracy, Students' Involvement, and Instructional Goals". Ph. D. dissertation, Ohio University, Athens, OH, 2000.

Ballou, D., and M. Podgursky, "Rural Teachers and Schools." In *Rural Education and Training in the New Economy: The Myth of the Rural Skills Gap*, edited by R. M. Gibbs, P. L. Swain, and R. Teixeira, pp. 3-21. Ames, Iowa: Iowa State University Press, 1998.

Bush, William. "Culture and Mathematics: An Overview of the Literature with a View to Rural Contexts" Acclaim Research Initiative Working Paper #2. Retrieved from http://acclaim.coe.ohiou.edu/rc/rc_sub/pub/3_wp/BB_WP1.pdf.

Gibbs, R. M. "Going Away to College and Wider Urban Job Opportunities Take Highly Educated Youth Away from Rural Areas." *Rural Development Perspectives*, 10 (3) (1995) 35-44.

Harmon, H., and R. Blanton. "Strategies for Improving Math and Science Achievement in Rural Appalachia." Paper presented at the 89th annual meeting of the National Rural Education Association, Tucson, AZ, 1997.

Hatfield, Larry. "Helping Mathematics Teachers: Perspectives on Professional Growth through Teacher Enhancement Projects." Paper presented at the Moving on Mathematically Project Preconference, Athens, OH, 1997.

Hektner, J. M. " When Moving Up Implies Moving Out: Rural Adolescent Conflict in the Transition to Adulthood." *Journal of Research in Rural Education* 11 (1995): 3-14.

Goodlad, John. "Schooling U. S. A." in Prospects for School Mathematics Yearbook of the NCTM, Reston, VA, 1995.

Mathematical Sciences Education Board. Everybody Counts. Washington, D. C., National Research Council, 1989.

Mathematically Sane (2002). [Web site]. (Retrieved September 6, 2002 from: http://www.mathematicallysane.com/home.asp).

McKnight, Curtis. The Underachieving Curriculum" Assessing U. S. School Mathematics from an International Perspective. Champaign, Ill., 1987, Stipes Publishing Company.

Moses, Robert P. and Charles E. Cobb, Jr. Radical Equations: Math Literacy and Civil Rights. Boston, Beacon Press, 2001.

National Assessment of Educational Progress. The Nation's Report Card: Mathematics, 2000. Washington, D. C., National Center for Educational Statistics, 2001.

National Commission on Excellence in Education. A Nation at Risk: The Imperative for Educational Reform. Washington, D.C.: U.S. Government Printing Office, 1983.

National Council of Teachers of Mathematics. Curriculum and Evaluation Standards for School Mathematics Addenda Series (a series of 15 topic-specific books and 7 Grades K-6 books). Reston, VA, NCTM, 1991 – 1995.

An Agenda for Action: Recommendations for School Mathematics of the 1980s. Reston, VA, NCTM, 1980.

________. Assessment Standards for School Mathematics. Reston, Va., NCTM, 1995.

————. Curriculum and Evaluation Standards for School Mathematics. Reston, Va., NCTM, 1989.

————. Teaching and Learning Mathematics in Poor Communities. prepared by Patricia Campbell and Edward Silver Reston, Va., NCTM, 1999.

————. Professional Standards for Teaching Mathematics. Reston, VA, NCTM, 1991.

————. The Nature and Role of Algebra in the K–14 Curriculum: Proceedings of a National Symposium, 1997, Washington, D. C., National Academy Press, 1997. Available on the Web at books.nap.edu/books/0309061474/html/R1.html

————. Principles and Standards for School Mathematics. Reston, Va., NCTM, 2000. Available on the Web at nctm.org

————. Program for the Research Presession of the 80th Annual Meeting of the NCTM, 2002.

Oakes, J. Multiplying Inequalities: The Effects of Race, Social Class, and Tracking on Opportunities to Learn Mathematics and Science. Santa Monica, Calif.: Rand Corp., 1990.

Secada, Walter G. "Race, Ethnicity, Social Class, Language, and Achievement in Mathematics" in Handbook of Research on Mathematics Teaching and Learning, New York, MacMillan Library Reference (available from the NCTM), 1992 (pp. 623-666).

Third International Mathematics and Science Study United States. ustimss.msu.edu United States National Research Center ,1996.

Third International Mathematics and Science Study. available at www.enc.org/topics/assessment/timss/kit/ (4th and 8th grades)1997, (12th grade) 1998.

United States Census www.census.gov/ftp/pub/hhes/poverty/poverty00/tables00.html