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ABSTRACT

This document contains papers presented at a mathematics and science symposium. The purpose of the symposium was to provide a forum for the interchange of the state-of-the-art mathematics and science education activities taking place within a South Dakota National Science Foundation State Systemic Initiative project within Southeast Area Cooperative schools. Papers presented include: "Science Opening Address: Telling vs. Tilling: Paradigm Problems" (James A. Shymansky); "Mathematics Opening Address: A Summary Mathematics Education" (Mary Jo Aiken); "Kindergarten Mathematics: Hands-On Learning" (Linda Good, Brenda Hauff); "Effective Use of Children's Literature in Hands-On Science" (James A. Shymansky); "Science in Kindergarten: A Sense of Wonder" (Linda Good; Brenda Hauff); "River Quest Project" (David A. Broadwell); "Enriching Mathematics through the Development of a Shoebox Kit" (Constance L. Hoag); "CU-SeeMe K-12 Science and Mathematics Eisenhower Symposium" (Michael Farland; Dale Farland); "The Hands-On Universe (HOU) High School Astronomy Project" (Vivian Hoette); "Velocity: An Integrative Tool" (J. A. Richardson); "Mathematics + Children's Literature = Integration" (Maurine Richardson); "From University to Classroom; From Classroom to Office" (Steve Cain; Kathy Sassman); "An Historical Review of Mathematics Reform: 1944-1994" (Roger Ray Parsons); "Hands-On Science Activities and Demonstrations" (Janet Erickson); "The Minnesota New Country School: A School without Textbooks" (Ron Newell); and "The Promise and Perils of Performance Assessment" (James A. Shymansky). (MKR)

The University of South Dakota Mathematics/Science Symposium

First Eisenhower Focused Initiative

K-12 Mathematics and Science

Symposium Conference Proceedings

University of South Dakota

Vermillion, South Dakota

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SYMPOSIUM PREFACE

The University of South Dakota Mathematics and Science Symposium was conducted on January 13 & 14, 1995 in the Delzell Education Center on the campus of the University of South Dakota. The symposium began on the evening of January 13th with an opening address by Dr. James Shymansky from the Science Education Center at the University of Iowa. The remainder of the evening activities was filled with presentations by mathematics and science educators. The Saturday portion of the symposium was begun with opening remarks by Ms. Mary Jo Aiken, the NCTM Regional Service Representative from Edina, Minnesota. The remainder of the day was filled with individual presentations and ended with a summary panel discussion by Mary Jo Aiken, Linda Baloun, President of the South Dakota Science Teachers Association, Craig Sherman, President of the South Dakota Council of Teachers of Mathematics, Rocky Von Eye, South East Area NSF-SSI Project Facilitator, and Paul Otto, symposium project director (substituting for Dr. James Shymansky who became ill).

The purpose of symposium was to provide a forum for the interchange of the state of the art mathematics and science education activities taking place within a South Dakota National Science Foundation (NSF) Statewide Systemic Initiative (SSI) project within Southeast Area Cooperative schools. The symposium participants were also privileged to have a presentation by a member of the NSF-SSI River Quest Project. NSF-SSI teachers were invited to make presentations designed for the sharing of activities in their classrooms which have taken place as a result of NSF-SSI activities. Several outside persons were invited to make presentations as were a number of the University of South Dakota faculty.

The symposium was viewed by the participants as an outstanding success. The formal evaluations of the symposium were quite high and personal comments indicated a desire to hold a similar symposium during the ensuing academic year.

The director of the project expresses appreciation to all of the presenters and participants. Special thanks to Ms. Betty Donohoe for typing the manuscript. Also, thanks go to Mr. Robert Jenson and Dr. Sandra Melchert for arranging outside talent. The project was funded by a South Dakota Board of Regents Eisenhower Focused Initiative grant for the 1994-95 academic year.

Paul B. Otto, Ph. D.
Project Director

SCIENCE OPENING ADDRESS

TELLING VS. TILLING: PARADIGM PROBLEMS IN CURRICULUM REFORM

James A. Shymansky
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Introduction

I'd like to begin this talk by reviewing the title for the session. Let's start with the last part - "curriculum reform." We are in the midst of the largest reform movement in science and math education since the post-Sputnik era. In many ways the current reform is much larger. Leading the way in the current reform are the AAAS Project 2061 publications, Science for All Americans and Benchmarks for Science Literacy and the NRC National Science Education Standards - we have curriculum reform, assessment reform; we have "state systemic initiatives" and "urban systemic initiatives." In other words, we have a whole new generation of "acronyms" to learn in science and math education!

Let's turn for a moment to the second part of the title: "Paradigm Problems." Thomas Kuhn in his book Structure of Scientific Revolutions is credited with applying the term to "patterns of ways that groups of people view some part of the world." Thinking about it another way, paradigms have more to do with "assumptions" in problem solving rather than the "solutions" per se. But we all know that the assumptions we make definitely impact the solutions we seek - Aristotelian vs. Newtonian physics sets up very different pictures of how the world works.

Finally by way of introduction, a note about "Tellers and Tillers." What happens when a prevailing paradigm fails to yield solutions to persisting problems or when two paradigms clash in a community of practicing professionals? The "teller vs. tiller" is a metaphor which symbolizes the paradigm problem which I believe is at the heart of the current curriculum reform in science and math and will ultimately determine the success of the reform.

The Problem

There may be some or many in this room who feel there are no major problems in science education in South Dakota-at least not any which require a "paradigm shift"-a major change in thinking about what and how science and math are taught. Rather than debate at this point what constitutes a big or trivial problem or a paradigm shift, let's look at what I believe has been a major driving force in the current reform movement.

Science and mathematics education research has been dominated of late with references to "alternative student frameworks," more commonly referred to as student "misconceptions." In the past 15 years there have been literally thousands of studies reporting examples of students harboring unconventional ideas about various phenomena in science.

These alternative explanations are not to be confused with what Art Linkletter talked about when he noted that "kids say the darndest things" or the humorous statements often found in sections of popular magazines, e.g.: *"The pistol of a flower is its only protection against insects."*

"Vacuum is a large empty space where the Pope lives."

"If you smell an odorless gas, its probably carbon monoxide."

"To prevent conception, wear a condominium."

Certainly definitions and terms can create confusion in a young student's mind. But explanations about electric charges "clashing" in a light bulb or the seasons being caused by the nearness of the sun to the earth are special because they represent more than an isolated definition of some esoteric science term; they serve as functioning models and theories of how the world works.

The idea of an elementary student explaining how charges clash together in a light bulb is not especially surprising or disturbing by itself-such a student probably hasn't done much with the topic of electricity in school yet; and the student still has lots of time to learn about simple circuits.

But what about college graduates who still think the seasons are caused by the nearness of the sun? Their problems aren't simply vocabulary related. How important is it that they understand what causes the earth's seasons? Their misconception may not affect their lives one way or the other. But does their not knowing what causes the seasons portend a greater, more contentious and pervasive problem for the science education community? A growing number of educators thinks so.

Constructivist Theory

The misconceptions literature is more than a set of amusing anecdotes. It serves to illustrate and support the basic tenets of a learning movement which has captured center stage in recent years-I'm referring to "constructivist learning theory"-a theory which states that "meaningful learning is an active process of imposing personal structures on ideas and experiences."

The theory is very simple and really not all that new. Its epistemological roots are centuries old and the basic elements of the theory-assimilation, equilibration and accommodation-are shared with Piagetian theory which has been researched and promoted for more than 70 years.

Moreover, science and math educators are late-comers in the application of constructivist theory to classroom learning and teaching. The "whole language" movement in reading is a constructivist theory-based movement-a movement spawned by the inability of bottom-up models of reading to explain and predict reading comprehension.

Applied to science learning, constructivist theory yields several fundamental learning principals:

**Prior to any formal instruction students develop ideas and explanations for many scientific phenomena;*

**Student ideas are usually different from those of the scientific community;*

**Student ideas and explanations are sensible and coherent from the student's point of view and are resistant to change.*

Constructivist theory explains not only the ideas which students bring to class but the apparent failure of most students to learn better science. The theory explains and predicts these outcomes of classroom instruction:

**The undisturbed conception*
**The reinforced misconception*
**The in-class and out-of-class conception*
**The confused conception*
**The scientifically more valid conception*

Returning to the examples of elementary students with their clashing charges theories about electricity and the college grads with their ideas about the seasons, constructivist theory suggests that students, young and old, in a way, concoct their own ideas and explanations and that they will likely carry these explanations the rest of their lives unless they see a need to restructure their thinking.

Paradigm Clash

These ideas are not that controversial. There is general agreement that kids have a lot of wild ideas about science and most college graduates don't understand much about science or math. Arguments do not surface until we start to discuss what we should do with the students who are still in elementary school and what we should do differently with the college grads. It is at this point that paradigms clash!

At the risk of oversimplifying the debate and the competing paradigms about how science should be taught, I believe there are two groups into which science and math teachers fall: There are 'tellers" and there are "tillers."

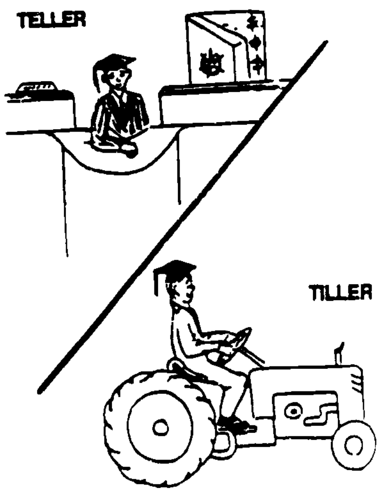

Figure 1: Tellers vs. Tillers

By far the larger of the two groups, the tellers figure that students will learn if a teacher explains things clearly and often enough. It's that simple. The tellers see learners as blank slates or empty vessels and teachers as dispensers of knowledge-much like a teller in a bank.

How do tellers account for misconceptions? No problem-students just haven't learned what they need to know-misconceptions simply provide a target for the telling-the student just has to be told what the proper conception is!

Research Base

But is good science teaching merely a case of telling students what we want them to know? And even when we tell them, do they understand it the way we intended when we told them? Research suggests that learning with meaning and understanding is not quite that simple. When the learning of children and adults is monitored carefully across time, some interesting patterns are revealed.

Learning of science concepts does not progress in a smooth fashion; rather, for almost all learners, it moves along in a herky-jerky pattern, going generally forward, but often time backward!

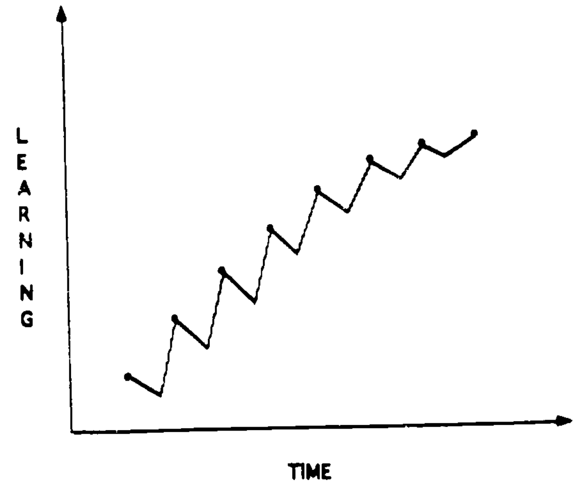

Figure 2: Science/Mathematics Learning Curve

Tellers would probably say these points of regression are probably just "noise;" that as long as a learner continues to move forward in the net, it doesn't matter what happens in between. Learning is about time on task, hard work and practice.

How do the "tillers" explain this pattern of learning over time? Tillers are constructivist. Tillers believe that a teacher can plow the ground for learning, plant the seeds of new ideas and nurture the development of understanding, but that the learner must construct meaning for him or herself. Tillers believe that no amount of telling alone will result in meaningful learning and understanding for most students. Tillers are much more tolerant of learner confusion and advocate "criss-crossing" the major ideas of a topic many time over "coverage" of material. The criss-crossing metaphor is one way to interpret the "less is more" notion of Project 2061.

Tillers explain the saw-tooth graph of learning over time this way: At the down-turns or points of regression, learners are experiencing disequilibrium, a kind of confusion-not because they aren't being told properly or enough times, but because they are trying to sort out their thoughts and construct meaning; trying to better understand the topic.

Looking Back

At this point, I'd like to put some of the current discussion of reform into perspective by looking briefly at the post-Sputnik period of reform. Lil e today, telling and tilling paradigms effectively clashed then as reforms were underway. If we believe what Harry Truman once said, that "The only thing new is the history you don't know," or what Gorge Santayana said, "Those who cannot remember the past are condemned to repeat it," we're probably wise to look back on the 60s.

Most of us in this room were around as a student or a relatively young science educator for some part of the post-Sputnik reform. Reformers from the scientist ranks such as Jerrold Zacharias and Bentley Glass were "paradigm pioneers" who set out to reshape science education on the premise that *"it would be inherently more interesting and meaningful if students learned science in ways that scientists do science."*

But the programs never really did "catch-on" all that well. The BSCS programs were probably the most used of the 60s programs and they made it into only 20% of the biology classrooms in the county. By 1975 only remnants of these new programs could be found in a small number of classrooms K-12.

Why did so few teachers ever try tilling strategies of "inquiry" teaching, and why did those who tried, back-slide to more traditional telling strategies of lecture-recitation? The main problem was not with the new course materials. Many of the programs contained very good activities and instructional strategies which are used piecemeal today.

I contend the main reason the reform movement of the 60s stalled and died was that reformers failed to recognize that "*Teachers are Students Too*"-If you are want to change teachers from tellers to tillers, you have to be ready to "practice what you preach" in your teacher preservice and inservice programs.

Closing Remarks

As any farmer knows, creating good growing conditions is hard work and there are many things beyond the farmer's control. Most importantly, you can't hurry-up the crop; they all grow in their own good time. So too is teaching by tilling. Learning seems at times to be painfully slow. There is the constant danger of backsliding into a telling mode. But when students or teachers are allowed to construct meaning, a bountiful harvest of meaningful learning is in store.

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MATHEMATICS OPENING ADDRESS
A SUMMARY
MATHEMATICS EDUCTION

Mary Jo Aiken
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A wake up call was issued by studying the "Lessons From The Geese" stressing the common direction and sense of community that educators need to share Like geese who take advantage of the "lifting power" of the bird in front, teachers need to step in formation with those headed in the same direction. We need to rotate the leadership positions, share the leadership and recognize our interdependency. Just as the geese honk to encourage those up front to keep up their speed, we need to make sure our honking from behind is encouraging and supportive, not something less helpful. We need to stand by each other and show support for fellow teachers who are having trouble. We are a community with a common interest and we have much to learn from watching the geese.

The challenge of the day was to think about change and to support each other as we encountered it. We will cause change, move with change or be run over by change. We have a clear choice, although it is not always a comfortable one. The implementation of change, even when we view it as necessary and good, is often difficult. There is the fear of doing something radically different, the fear of not having all the components necessary for successful implementation, the fear of failure and probably, the biggest fear of all......the fear of being successful and having to change our entire approach to teaching. Change will be the least painful when we learn to listen, to learn, to help and to lead.

Criticism always accompanies change. Historical references from 1703 to the present were cited. If you believe a change is right, you must communicate the rationale to your public, and then give it your heart and soul. If you fear to do anything which will bring criticism, you will never do anything which will bring success.

The biggest changes in our teaching careers will probably be in technology. Since the early '70's, we have moved from slide rules to calculators to computers. Our computers are stamped obsolete by the time we bring them home. The explosion is wonderful and exciting, especially if we take history into account. We need to value both history and progress. Where we've been certainly influences where we are going. Teachers must learn about the new things, help each other master the new things and never forget to ask students for help. They move into new technologies faster and easier than most of us.

A dozen new dreams were posed with the expectation that in ten...maybe even five years....these, too, would be history. We are the change agents in American education. You cannot take the whole world on in one day but change a little at a time...every day, a little bit....inch by inch, centimeter by centimeter.

The talk ended with a "colorful" quote for our quiet and robust moments of thought borrowed from Frances Hodgson Burnett's "Secret Garden"................

> *At first people refuse to believe that a strange new thing can be done, then they begin to hope it can be done - then it is done and all the world wonders why it was not done centuries ago."*

KINDERGARTEN MATHEMATICS: HANDS-ON LEARNING

Dr. Linda Good and Ms. Brenda Hauff
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The focus of this workshop was viewing the video Kindergarten Mathematics: Hands-On Learning that had been produced by Dr. Good. This 25-minute video invites the viewer to encourage emergent numeracy and to promote the National Council of Teachers of Mathematics' standards by exploring a variety of topics in kindergarten mathematics that include number sense, measurement, patterns, graphing, categorization, shape recognition, addition and subtraction, and communication.

The video features five kindergarten teacher in their classrooms in Iowa and South Dakota as they demonstrate developmentally appropriate mathematics activities.

Mathematics is a part of Betty Mortenson's opening exercises in her kindergarten class. Taking daily attendance offers the opportunity to count the number of boys and girls present and permits the teacher to introduce concepts such as "fewer". Ms. Mortenson's bulletin board includes a birthday cake with candles for each child's birthday that month. When a birthday is celebrated, the children practice subtraction as they remove a candle and figure out how many birthdays have been celebrated and how many remain to be celebrated that month. During calendar activities, the teacher has the children count up to certain special days. She also employs a pattern with different combinations possible to add to seven, the number of days in a week. A daily tally of the number of days in the month is written on the board and played on the xylophone. She also employs a domino pattern for the first nine days of the month. Children use counting sticks to count the number of days in school such that they learn to count by 1s, 10s, and 100s. Concepts such as yesterday, today, and tomorrow and more and less are also incorporated into the opening exercises. A graph of the weather integrates math and science. The viewer observes the children in a number sense activity as children are grouped to explore addition combinations for the number five. One group of children uses red and white beans; another group uses pattern blocks; a third group uses two colors of ceramic tiles; a fourth group uses unifix cubes in two-color combinations to produce "five"; the final group uses jewels. A Math Their Way approach is used.

In Gera Jacobs' classroom, children explore mathematics in learning stations during choice time. We observe children working with unifix cubes to develop their number sense. We also observe children measuring with rulers and with centimeter cubes.

A classroom aide assists Dianne Blankenship with her mathematics center during centers time. A computer with math games is one part of this center. Ms. Blankenship encourages problem solving during snack time as children decide how to cut the fruit so that each child will receive a fair share; this represents the beginning of the function of division. Mathematics and reading are incorporated as Ms. Blankenship reads Lois Ehlert's Fish Eyes to the group and points out shapes.

A mathematics textbook is used as a resource by teacher Judy Feekes. Her mathematics curriculum is activity-based with very little use of worksheets. Her objectives in mathematics include: classification, patterns, shapes, sizes, weights, non-standard measurement, addition and subtraction, fair sharing, fractions, counting by 5s and 10s, estimation, and money. We see the children exploring money under magnifying glasses and then discussing the value of the money. During playtime, the children are seen playing store and manipulating money.

While we observe Ellen Bollig's class, we see how to properly use manipulatives with children. During a money unit, children are given individual workmats and some real coins. The first step in working with manipulatives is exploration, so children are given time to play with the coins and make noise with them before the actual lesson begins. Three-two-one learning is explained by Dr. Good, the producer of the video. Then Ms. Bollig's class demonstrates these stages. The first stage demonstrated is that of hands-on learning with manipulatives which is referred to as 3-dimensional learning. We see children using coins to add up to specified amounts to pretend to buy an item that Ms. Bollig offers for sale. The second stage, or 2-dimensional learning, takes place when Ms. Bollig gives the students a paper and crayon task of coloring pictures of money and then cutting the pictures out. The final stage of learning, or 1-dimensional learning, is demonstrated as the children discuss the value of the coins and count by 5's. We also observe the students in a measuring task as they use string to measure cut-outs of their bodies and then make a graph with the strings. The concept of time is demonstrated when the children construct a clock out of 12 notecards and use an arrow to point to the hour. Using a kinesthetic approach to teaching about patterns, Ms. Bollig and her students illustrate using snaps and claps to hear a pattern as she points to a pattern on a calendar. Math Their Way is the basis of the kindergarten mathematics program.

After viewing the video the participants discussed the National Council of Teachers of Mathematics book Curriculum and Evaluation Standards for School Mathematics. Kindergarten Book. Addenda Series Grades K-6. The importance of hands-on activities as related by Sue Bredekamp in the book Developmentally Appropriate Practice in Early Childhood Programs Serving Children From Birth Through Age 8 from the National Association for the Education of Young Children was also discussed.

Participants shared the advantages of joining professional organizations like the National Council of Teachers of Mathematics and the National Association for the Education of Young Children. Membership benefits include publications, information about conferences, and networking among professionals.

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National Association for the Education of Young Children (NAEYC)
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National Council of Teachers of Mathematics (NCTM)
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EFFECTIVE USE OF CHILDREN'S LITERATURE IN HANDS-ON SCIENCE

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Science Through Literature

Despite an increasing support base for science education and a wave of new blueprints for reform, two hard facts have not changed significantly on the K-6 curriculum scene: 80-90% of the teachers continue to fear science and 60% or more of the teaching day is spent on the language arts. Recommendations to do more "hands-on" activities and to plan instruction around student ideas are adding to the teacher fears and the squeeze on reading and writing time. Teachers feel there is simply not enough time in the school day or school year to all the things being asked of them. Most teachers want to teach more science--do more hands-on activities and use student ideas, but they don't want to do it at the expense of the language arts.

Teachers are open to programs which integrate science with language arts. Programs such as Scholastic's Science Place, Silver Burdett's Horizons Plus, and Macmillan's "K-6 Science" have been very successful with prominent literature features. "Recommended reading" lists are no longer seen as a perfunctory frill in programs which are considered hands-on; off-the-shelf trade-books and special literature pieces are now seen as essential elements in programs and are being embraced enthusiastically by the language arts-oriented K-6 teachers. While science textbooks are being bad-mouthed in the science education and teaching community, almost *any kind* of science literature is now considered "pedagogically correct."

Analysis of Different Samples

The problems with much of the extant literature or current attempts to use stories in science programs:

Most are still expository (read like a text)
Story characters usually acquiesce to authority:
Many stories perpetuate misconceptions.

Hands-on activities are usually "appended" to the stories rather than integrated--in the worst case, the activities might not even get done (no different from reading the text without doing the labs).

The Challenge for Science Education

Stories can be a good platform for science--a way to integrate science in the language arts curriculum at the K-6 level. The alternative ideas that students have are critical to instruction and hands-on activities are vital to meaningful student learning and scientific validity. What is needed is a genre of literature which captivates student interest and imagination, gives recognition to alternative student ideas and uses hands-on activity to challenge invalid or erroneous science ideas.

There is also a need for explicit teaching strategies to use hands-on activities to explore the validity of the alternative ideas at the time the ideas are raised--imbedded in the story as an integral part, not an exploration to be done later.

SCIENCE IN KINDERGARTEN: A SENSE OF WONDER

Dr. Linda Good and Ms. Brenda Hauff
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The nucleus of this workshop was viewing the video Science in Kindergarten: A Sense of Wonder that had been produced by Dr. Good. The introduction to this 13-minute video prepares the viewer to anticipate that both the teacher and the environment facilitate learning about science. Common science themes that are explored in kindergarten include colors, plants, animals, seasons, and senses. Young children in kindergarten are exposed to the scientific method when they observe, predict, experiment, record, and discuss.

The video features five kindergarten teachers in their classrooms in Iowa and South Dakota as they illustrate developmentally appropriate science activities.

In teacher Ellen Bollig's kindergarten, science is integrated throughout the year. One example of this is the daily graphing of the weather. At the end of the year, science focus units bring more emphasis to the subject of science. The viewer observes Ms. Bollig and her kindergarten students as they take plastic hangers outside and discover what kinds of animals live within the confines of the hanger when it is placed on the ground. Children delight when they observe worms, ants, and insects within the triangular space of their hangers. Ms. Bollig emphasizes that all living things need a habitat, water, food, and space.

Seasonal field trips to the park, caring for classroom pets and plants, engaging in sink/float experiments, observing and charting, and recognizing the children as "young scientists" are all a part of Gera Jacobs' kindergarten science curriculum. The viewer observes Dr. Jacobs as she demonstrates viewing crystals with a flashlight and demonstrating the use of pole magnets. During playtime, we see the children replicating and further exploring the materials that have been demonstrated. The science curriculum in Dr. Jacobs' kindergarten focuses around three major themes: Plants and How They Grow, Seasons and Changes, and Animals and Their Babies.

The science themes employed by teacher Judy Feekes include "seasons", "weather", and "about myself". The viewer sees the children engage in the fantasy of being young scientists by pretending to put on lab coats as they are shown magnet by their teacher. The children are given magnets and are asked to observe their properties, predict what magnets might stick to, experiment around the room, and then record on sheets of paper what magnets stick to and don't stick to. The final step of discussing the polar properties of magnets is demonstrated in a class discussion. This skillful kindergarten teacher demonstrates asking questions which she allows the children to answer as they observe the phenomena and offer explanations for it.

In Dianne Blankenship's kindergarten, the science curriculum focuses on nature. The viewers see young students exploring seeds and categorizing them. We also see a science table and observe young children using a balance scale.

Extending the whole language approach into the science curricular area, we observe Betty Mortenson's kindergarten students as they taste a variety of jams after reading the book Jamberry by Bruce Degen. We also see students planting seeds after reading Michael Bond's story Paddington Bear at the Garden. Ms. Mortenson tells us that her science curriculum consists of life science, physical science, and earth science. Units in her science curriculum include: adopt a tree and record the seasonal changes, homes and families, tadpoles and frogs, seeds and flowers, and weather.

Following the video presentation, Ms. Hauff informed participants of the list of outstanding science tradebooks that is located in the March issue of the journal Science and Children. Criteria for inclusion as an outstanding science book was also discussed. Several of Lois Ehlert's books were presented as examples of outstanding science trade books. Many of Lois Ehlert's books contain a glossary of information at the end of the story. One of the participants shared that Ehlert's Red Leaf, Yellow Leaf can be used a foundation for an integrated curriculum. For example, one teacher uses the book as a stimulus for creating a quilt such that science, art, and reading are integrated.

Sources for science curricula were also discussed. Free curriculum information can be obtained from Harcourt Brace Jovanovich, Publishers, Children's Books Division, 1250 Sixth Avenue, San Diego, CA 92101 by asking for their free Creative Curriculum Connections. Another resource is Insect Lore at 1-800-LIVE BUG. This company provides a free catalog of insects, science kits, science reference books, and children's science books.

The participants discussed the advantages of joining the National Science Teachers Association. Benefits include publications, information about grants and conferences, and networking.

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RIVER QUEST PROJECT

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The River Quest project is a NSF-SSI funded program initiated in response to the effort to find ways better to bring meaningful math and science learning into South Dakota classrooms. Dr. Steve Van Bockern, at Augustana College, invited school districts along the Big Sioux river to join together and plan ways to use the Big Sioux as a "learning laboratory." Representatives of seven of these districts, along with community representatives and several environmentally involved organizations, shared workshop experiences and ideas. Teachers in each of the original seven, and now several other, districts have now developed curricula that fit the characteristics of their particular classes within the general guidelines which define the River Quest program.

At the high school level, each district is to conduct water testing of the Big Sioux River near its community. The NSF funding has provided Hach kits and other test apparatus that allows all of the tests to be made by which a Water Quality Index, as used by the EPA, can be derived. Each district is expected to practice the testing at some time early in the school year, and then conduct "official" tests during a specified week in the spring.

A good number of the teachers initially interested in the River Quest program were from elementary or middle school classrooms. These teachers have adapted the water testing procedures, along with a variety of other learning activities, to their student level. The collection and identification of macro invertebrates found in the streambed, plaster casts of the tracks found along stream and river banks, measurements of stream depth and flow, as well as the writing of impressions of the waterside environment all become part of the study of aquatic systems which are part of the Big Sioux River.

In time, participants in the project hope to increase the sharing of scientific results and creative writing using computer/modem links among all of the districts. Production of an annual journal and an opportunity for participating students to join and present their experiences to others are part of the plan as well.

ENRICHING MATHEMATICS THROUGH THE DEVELOPMENT OF A SHOEBOX KIT

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A shoebox kit is a "learning center in a box" multiple activity tool created by the teacher for classroom use. Several shoebox kits were demonstrated during the Symposium and each was tied to the National Council of Teachers of Mathematics (NCTM) Curriculum Standards, the South Dakota Benchmarks, the learning cycle (concept application stage) and the constructivist philosophy of learning.

General Information: A mathematics shoebox kit can be designed to serve any purpose within a classroom situation. Each kit is a complete package of activities relating to a specific mathematics topic and designed on any grade level. It may be an integral part of a unit being studied, or have tutorial, supplementary or enrichment application goals. Then again, it may contain activities on topics of general interest or used to develop a mathematics appreciation theme. This activity can be used by an individual student, partners or even small groups. Normally shoebox kits are not required or graded assignments, but should be of high interest to draw learners to explore concepts or enjoy mathematical tasks.

The entire kit should fit into a small, stackable enclosure like a shoe/boot box, and ice cream bucket ar any hard sided container. The practical storage of several boxes on a shelf makes a rectangular container preferable. Each box must contain the complete instructions, all materials and evaluation (self-checking, etc) for all six projects.
Planning: Decisions must be made as to the specific NCTM Standards and South Dakota Benchmarks to be addressed, the topic, grade level, learning outcomes, and the materials needed for the activities. Next, identify or create six activities to be included in this kit. If you find or create more than six projects make additional kits. One method for each easy management and access is to place the six directions inside the lid (as well as in each envelope or baggie) and to color code or number this index to match the activities, directions and assessment procedures. Ideas for themes are unlimited, including a book, tactile projects, rod or pattern block tasks, tangrams, area, perimeter or geometry focuses.

Material Collection: The next step is to collect materials and develop a variety of activities needed for the learners to complete each of the activities. For example, mathematics/listening materials could include an audio tape and player with directions for the learner to independently complete (such as draw a circle around.., a square around...) on the enclosed activity sheet. A second example would involve partners who have a sight barrier between them and one person gives five step oral directions for the partner to complete (using manipulatives such as rods, pattern blocks, or cubes) a design. Never place developmentally inappropriate objects or potentially dangerous items in the box as this kit is designed to be completed without adult supervision.

Evaluation: Evaluatior can be as simple as a check off list recording the completion of each activity, partner checking or a product presented to the teacher. Each activity should have some type of evaluation procedure to encourage completion.

Box Construction: Cover the box/container with attractive mathematical designs (sketches, drawings, cutouts, wrapping paper) to entice usage. Place the theme title on the top and ends of the container to be easily visible during storage.

Epilogue: Teachers, let your shoeboxes represent your imagination and creativity, and focus upon those areas of the curriculum your students are having difficulty understanding. Complete one kit at a time. Enjoy this project, your learners will!!!

Example:

Tactile Mathematics K-3

Activity 1:	Enclosures:	Baggies with one color of play dough and a laminated drawing of a tree.
	Directions:	Use the play dough to make the numerals (3, 4, 5 and 6) and on the tree create three leaves, four birds, five butterflies, and under the tree make six blades of grass.
	Evaluation:	Show a classmate your numbers and your picture.
	Finale:	Return the play dough to the baggie.
Activity 2:	Enclosures:	9 by 12 inch tall and one inch wide numerals, washable paste and a baggie with 40 pieces of macaroni (one labeled for each child).

Directions: Choose the large numeral that tells me how old you are. Write your name on the back of your number. Glue the macaroni anywhere on your age/number.

Evaluation: When every piece of macaroni in a child's individual bag has been used, the activity has been completed.

Final: Put the cap on the glue. Put your macaroni number on the mathematics table.

Activity 3: Enclosures: Magazines, scissors, glue, oaktag on bulletin board labeled with appropriate numbers and list of children.

Directions: Look at bulletin board to determine the number of objects to be cut out. Cut out the appropriate number of objects and paste them on the oaktag.

Evaluation: Check your name off when you have added to the bulletin board.

Finale: Put the magazines, scissors and glue back into the baggie.

Activity 4: Enclosures: Shaving Cream, Paper towels for clean up.

Directions: Make a mound of shaving cream the size of a quarter. Make a square, and a triangle.

Evaluation: Ask a friend to make a circle and a rectangle, etc.

Finale: Use the paper towel to clean up the shaving cream and return the can of shaving cream to this box.

Activity 5: Enclosures: Little Critter Shape Book by Mercer Mayer, star wrapping paper, and a red marker.

Directions: Find the star page in the Mayer book. Count the stars on this page. Write the number of stars you counted on the back of the star paper with the red marker and put your name on the paper. Put your paper with the star on it on the right

		hand corner of my desk.
	Evaluation:	Completion of activity, with each child's paper on desk.
	Finale:	Put cap on maker and return maker to baggie. Return the book to the kit.
Activity 6:	Enclosures:	Cut out stencil shapes referred to in the Mayer book (circle, square, triangle, rectangle, diamond, etc) white construction paper cut into 9 x 9 square, a pencil, box of crayons and two thumb tacks.
	Directions:	Using all the shapes, paper and pencil found in #6 baggie make a collage on the construction paper using the shapes and overlapping them many times. Color in your collage, but remember each time you come to a pencil/fence line you must change color.
	Evaluation:	Thumb tack your design on the mathematics bulletin board. Completion is the evaluation.
	Finale:	Return the shapes and crayons to the baggie. Put two thumb tacks in the baggie for the next person to use.

For additional information and examples of other K-8 shoebox kits, contact: Dr. Constance L. Hoag.

CU-SeeMe
K-12 Science and Mathematics Eisenhower Symposium

Michael Hoadley
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(Disclaimer: InTEC, USD, and the School of Education have no stake or connection in any of the products mentioned below. Some acronyms and technical terms are used below and not explained. The implication is that if the terms are not familiar, it would probably be necessary to recruit the services of someone who is familiar with some of the more technical aspects of the network connections, e.g. a district computer network person.)

Video-teleconferencing equipment has been available for some time but has been very expensive (e.g. the South Dakota Rural Development Teleconference Network). Thanks to the Internet and contributed programming efforts by people at Cornell University (New York) and others, it is now affordable even if in a less sophisticated fashion.

What Is Needed

Two (or more) Macintosh computers (the more powerful, the better). The computers must support video and audio input. For a Macintosh that means any Macintosh (68020 or higher; System 7.+; at least 16-level grayscale; at least 4MB RAM) that has a microphone jack on the back and that has as NTSC video input (e.g. an AV Mac or one that has a VideoSpigot card). An alternative is to use the small, inexpensive (~100s) black/white video camera from Connectix (it is called QuickCam and is available from mail order catalogs). Even with the microphone included in the QuickCam, it is better to use the built-in Microphone that comes with many Macintoshes.

A Windows version of the software is in development (may be available by now). The computer would need to have a video and sound input board in the system.

If an AV Mac or a VideoSpigot card is being used for the video source, a camcorder or VCR (or videodisc player) is needed to provide the video source.

Therefore assuming that a school has at least:

two AV capable Macs (e.g. Mac 660/AV or a Mac 6100/AV or an LC III with a VideoSpigot card) connected to a

TCP/IP network

two camcorders that can be connected to the AV Macs

a network (preferably Ethernet) running TCP/IP (e.g. MacTCP)

the free CU-SeeMe software

one can do video conferencing for a startup cost of $0.00.

In order to do a video conference with another site, both sites must have their networks connected full-time to the Internet using a relatively fast connection. A modem connection (SLIP or PPP) would be marginal at best and would not support audio at all well. In this case, phones on another phone line could handle the audio.

To have more than two computers connected to a conference, a program called a "reflector" must be running on a UNIX computer (preferably a Sun) that is also attached to one of the networks or connected via the Internet. If you are using CU-SeeMe and want to try the reflector at USD, send email (with ample lead-time) to dfarland@charlie.usd.edu <Dale S. Farland>.

All of the CU-SeeMe software, including the rather minimal documentation and the software for the reflector, is available for downloading at "gated.cornell.edu" in the /pub/video/directory.

THE HANDS-ON UNIVERSE (HOU) HIGH SCHOOL ASTRONOMY PROJECT

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Background

The Hands-On Universe High School Astronomy Project allows students to use their personal computers to request, acquire, and study astronomical images taken with remote telescopes and Charge Coupled Device (CCD) detectors. Curriculum materials are being developed which are interactive and process-oriented which utilize original data sets.

Through the Hands-On Universe, emphasis is placed on the use of intellectual and physical tools to support inquiry to progress from the acquisition of basic concepts to the processes of science. Students are introduced to central mathematical and scientific concepts in a context of technologically-supported active learning. Networking and technology are utilized to link students and professionals in genuinely collaborative and apprenticeship style interactions. The Learning goals are shifted toward the processes of science through technological support and net working in the motivational contexts of collaborative professionally relevant research.

Development

During the past four years a consortium of teachers, network specialists, astronomy and physics researchers, and museum educators have worked to develop and test the Hands-On Universe system. The idea stated with some seed money from the Department of Energy Office of Science Education Programs, and Lawrence Berkley Laboratory's (LBL's) Physics Division along with additional funding from IBM. Curriculum units were begun which would utilize the technology routinely used in the LBL Astrophysics/Supernovae group's research for high school instruction. The curriculum units were designed to excite students, engage them and teach them science and mathematics while doing science. Preliminary field tests indicated that high school students could readily be taught to do image processing with PCVista, a PC version of a sophisticated professional image processing software package, and were exited by it. Five curriculum units were initially developed:

Introduction to PCVISTA
Rotation of the Earth

Weighing Jupiter
Supernova Part I
Supernova Part II

Four teacher training, evaluation, and materials development workshops were held to train high school science teachers on the use of the image processing system and to gather feedback on the usefulness of the system and how it could be utilized in their classrooms.Workshops were held in Hawaii, the University of maine in Orono, and Macon, Georgia. The fourth workshop was co-hosted by the Museum of Science in Boston, Massachusetts, July 26, 1994. The workshop was planned to be coincident with fragments of the comet Shoemaker-Levy 9 bombarding Jupiter. The Museum of Science in Boston plays a pivotal role in the dissemination of the Hands-On Universe secondary school program and expansion into the informal science arena. Work is currently being carried out to build the HOU infrastructure and the design of a system architecture for the expansion of the HOU. Efforts will concentrate on dissemination programs. The goal of the project is to train 2000 teachers during the ensuing three years.

Software Development

Four pieces of HOU software are being developed and tested:

1) Image Processing Software
2) Image Processing Installation Software
3) Image Request Software (facilitates the request for observations and archived images)
4) Electronic Database and Transfer Software (for downloading images)
5) HOU Telecommunication Software

Initially, several versions of WinVista, a PC Window-based image processing system was co-developed with the University of California Berkeley Astronomy Department. WinVista is mouse-driven and allows students to study and analyze images to extract the appropriate science, without being burdened with cumbersome operations that are intrinsic to normal image processing. Students pan, zoom, change gray scales, measure distances and brightness, make graphs and contour plots, and print out materials for incorporation into papers, reports, and log books. A new image processing program (IP) with the working title HOU/IPS, possesses all of the functionality and power of WinVista featuring a user interface which is a vast improvement over WinVista's. The IP package is written with a Windows Visual C++ development library and the functions are arranged in pull-down menus. Work is also being don on an image database and telecommunications software that has been integrated into the IP software version that was released in the fall of 1994.

Curriculum Units

Fourteen curriculum units have been developed in collaboration with the Technical Education Research Center (TERC) and some of the project core teachers:

1) Requesting and Retrieving Images
2) Planets Around a Pulsar
3) A Browser's Guide to the Universe
4) A Primer on Distance and Size
5) The Distance Ladder
6) Apparent Brightness, Luminosity, and Distance
7) Introduction to Photometry
8) The Magnitude Scale of Brightness
    Supplemental activities:
        Log Scaling, Comparing Magnitudes, and Finding Apparent Magnitudes in Another Image
9) Cepheid Variables
10) Introduction to Image Processing with Mini-Investigations
11) Galaxy Feature
12) The Actual Size of Features on the Moon
13) Jupiter and its Galliean Moons
    Supplemental Activity:
        Top View vs. Side View
14) The Mass of Jupiter

Four additional units were being developed and were scheduled to be in HOU classrooms in the Spring of 1995:

1) Color of Stars
2) The Hertzsprung-Russell Diagram for Stars
3) Age of a Star Cluster
4) Age of the Universe

Image Delivery System

The project is currently using the automated UC Berkeley Astronomy Department's Leuschner 20" and 30" telescopes outfitted with CCD detectors. They can presently deliver approximately 300 images per week to the core classrooms and museums. Due to anticipated overload, several other telescopes are planned to be brought on line during the next three years.

Further information about the HOU project can be obtained from the following sources:

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VELOCITY:AN INTEGRATIVE TOOL

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The purpose of this presentation was to provide teachers with one method of demonstrating the integration of various sciences--physics, kinesiology, mathematics and physical education. The assemblage of basically two groups of people--the assessor and assessee--could include a class of physics students, and one of physical education.

The integration of disciplines is not new or innovative, just seldom done. The use of velocity as a tool to bring more than two disciplines together will give prestige to the teachers and students involved.

When average velocity describes a moving object in terms of constant velocity, it is said to be in uniform motion. A constant velocity is defined as one in which equal displacement occurs in equal time and the direction of motion remains unchanged. In other words, the distance traveled in any other second is equal to that traveled in any other second.

Except in certain special cases, the velocity of a moving body changes continuously as the motion proceeds. The body is then said to have variable motion, or an acceleration. A body has a variable velocity when in equal intervals of time its displacements are unequal intervals of time or its directions of movement are different. Then it is customarily said to have an average velocity. Average velocity (V) is defined in the usual manner as what is the time required to travel the specified distance (d). The bar over the V signifies an average value. V=d/t.

Consider as an example of average velocity a skate boarder who skateboards 100s yards in 10s seconds flat. His/her velocity would be calculated as: Since his velocity is not the same at both the start and the finish, 10s yds/sec is only an average of the many different velocities he achieved over the 100s yd distance. V=d/t or V=100s/10s or 10yds/sec or 30ft/sec.

If the velocity of a body is known, the distance the body will travel in any given interval of time can be calculated by rearranging the velocity formula: V=d/t or d=Vt. Likewise, the formula can be rearranged to give the time at a given velocity. t=d/V.

When we are dealing with a known constant velocity, then, of course, the distance or the time can be predicted precisely. However, when we are dealing with a known average velocity, the distance or the time can only be approximated at any given point.

When the appropriate class--fitness, biology, mathematics, physics--are brought together, this can be rewarding experience for students and teachers alike.

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MATHEMATICS + CHILDREN'S LITERATURE = INTEGRATION

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The National Council of Teachers of Mathematics (NCTM) has encouraged teachers to let students do more than crunch numbers, work sheet or workbook pages. "Curriculum and Evaluation Standards for School Mathematics" (NCTM, 1989) advocates new goals for students. The goals included in these Standards are: 1) learn to value mathematics, 2) become confident in one's own mathematical ability, 3) become a mathematical problem solver, 4) learn to communicate mathematically, and 5) learn to reason mathematically. Therefore, the mathematics standards have opened the door for the integration of children's literature into mathematics. Research by Whitin and Wilde (1992) states the power of children's literature will help students achieve these mathematical goals. "Using children's literature as a springboard for mathematical experiences allows language and mathematics learning to grow naturally and imaginatively" (Radebaugh, 1981). To allow students to become confident in using language and mathematics, any literary work may be used in the classroom. As teachers start the integration process they need to consider the math concept, an appropriate literary work and the activity that will help the child. Counting books are usually the first ones introduced such as The M & M's Counting Book, Mouse Count or The lucky Bug Counting Book. Some books contain math concepts within the story line for example: Anno's Mysterious Multiplying Jar, and Bunches and Bunches of Bunnies. Some literary works include numbers in the titles like Millions of Cats, Ten, Nine, Eight, or The Three Bears. Books may be used to help students with various concepts such as origami with The Paper Crane; estimation introduced with The Popcorn Book and Sylvester and the Magic Pebble; geometric shapes with Eight Hand Round a Patchwork Alphabet, Color Zoo; measurement may include two types of books 1) ones that mention food such as The Doorbell Rang, Stone Soup and 2) recipe books including The Little House Cookbook, and Peter Rabbit's Cookery Book; symmetry could be included with Round Trip and books appropriate for the inclusion of word problems such as Caps For Sale.

As teachers plan to incorporate children's literature into the mathematics lesson, he/she may need some helpful hints as to activities and good literary works that would be appropriate for use in the classroom. Resources that are available include: Literature-Based Math Activities: An Integrated Approach, Literature-Based Math, Linking Math With Literature, and The Wonderful World of Mathematics.

Children are as curious about math and numbers as they are about good stories. Teachers will observe students being successful in solving mathematical problems and even enjoy creating some of their own based on the context of a favorite story (Richardson and Monroe, 1989). The wonderful world of mathematics can be introduced to children through literature at the same time meeting the NCTM standards in an enjoyable manner for both the teacher and the students.

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FROM UNIVERSITY TO CLASSROOM; FROM CLASSROOM TO OFFICE

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This session was designed to address the Mentor - Teacher relationship of the Professional Development Center project. The focal points of the session included explanation of the Professional Development Center concept and operation, the working relationship of the Mentor and Teacher, and the views of both participants on how the project is working in their situation.

The presentation stimulated many questions with much interest from the audience. Discussions in both sessions centered on the experiences of first year teachers, how the PDC could help improve teaching, course work involved in the program, and related experiences of audience members that could have been helped by a program such as the PDC.

AN HISTORICAL REVIEW OF MATHEMATICS Reform: 1944-1994

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The current reform movement in mathematics education started with the publication of the Curriculum and Evaluation Standards for School Mathematics (1989). The Curriculum Standards suggest that teachers find non-routine problems to help foster mathematical thinking and reasoning. This new emphasis on thinking and reasoning in the mathematics classroom should be accomplished through groups working together to solve a problem. For example:

> With a friend, make a mathematical problem that will yield the largest product using only the digits 0-9. You can use only four of the digits at any one time to make your problem

Mathematics Educational Reform

The Commission on Post-war Plans (1945) dictated the mathematics curriculum for the 50s. This Commission produced a list of topics that a mathematics literate person should know. Among these topics were estimation; square root; basic geometric definitions, axioms, hypotheses, conclusions; and computations with whole numbers. These topics would "guarantee functional competence in mathematics to all who can achieve it" (Beckmann, 1987).

The Cambridge Conference on School Mathematics ushered in the decade of New Mathematics (1963). Their recommendations were that 1) geometry be studied together with arithmetic and algebra from kindergarten on, 2) early experiences with numbers should be designed to give insight into the mathematical properties of the real number system, 3) teachers should use good formal logic so that their students could use it in everyday life, and 4) mathematics should be seen as a tool to be used in science. This program failed in our schools because the developers of the New Math did not take into account teacher training and the resources needed to implement this program into the K-8 public school system.

The National Mathematics Educators published a report that expressed the back-to-basic movement of the 70's. This report was a response to the failure of the New Math. These mathematics educators were able to identify the fifty-five skills that all people need to know. The first five skills are: make change, add and subtract whole numbers, add and subtract decimals, use a ruler in the metric and customary systems, multiply and divide whole numbers. The leaders of the back-to-basic movement felt that "a return to authoritarian discipline, religious fundamentalism, and the textbooks of the 50s would result in more mathematics being taught and thus higher standardized test scores" (Offerner, 1978).

The National Council of Teachers of Mathematics published the Agenda for Action (1980) and for the first time began talking about mathematics as problem solving, mathematics as communication, mathematics as reasoning. This document outlined the environment necessary to meet the objectives of problem solving, communication, and reasoning in the mathematics classrooms for the 80s. Among the recommendations where 1) every classroom will have ample sets of manipulative materials and supplies, 2) a four-function calculator will be available at all times, and 3) every classroom will have at least one computer available at all times for demonstrations and student use.

In 1989, The National Council of Teachers of Mathematics published the Curriculum and Evaluation Standards for School Mathematics outlining the curriculum for the 90s. The Curriculum Standards emphasized the need for students, as well as their teachers, to come to understand mathematics as problem solving, mathematics as communication, and mathematics as reasoning. Furthermore, mathematics should be seen as connecting everything in life. That is, that mathematics is in science, social sciences, reading, and language arts. In addition, students and their teachers need to make the connections between all areas of mathematics. That is, they need to recognize the relationship between addition and multiplication, between measurement and multiplication, between algebra and geometry. Besides the four broad categories of problem solving, reasoning, communication, and connections, the Curriculum Standards (1989) suggest that mathematical concepts be taught as students bring the questions to light. Thus, statistics, probability, and geometry should be taught in grades K-4, 5-8, and 9-12. Mathematics as envisioned by the NCTM's Teaching Standards (1991) would be taught in a room equipped with manipulatives, calculators, and computers. A teacher would create active learning by having a curriculum rich in problem solving where by student groups would be free to explore, predict, justify, discover, and construct mathematical meaning.

Conclusion

Since the 1950s, we have seen many efforts to reform mathematics education for K-12 students. Many teachers have become disillusioned with the seemingly endless shifts in direction of learning to teach mathematics for the good of all students. Do we have it right this time? Yes! The vision of the NCTM Curriculum Standards (1989) and the NCTM Teaching Standards (1991) is to teach students how to think in a society dependent on technology. New problems for your student will focus on problem solving, reasoning, communications, and connections. For example:

> A person has several ears of rainbow corn. Since the kernels are beginning to fall off, he decides to shell each ear. Upon completing the shelling of the first seven ears, he/she notices that there are three red cobs, one purple cob, and three white cobs. Using this information, what is the probability that the next three cobs drawn will be colored?

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HANDS-ON SCIENCE ACTIVITIES AND DEMONSTRATIONS

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The presentation includes demonstrations, activities, audience participation, science-related sayings by famous people, and a 25-page handout. The broad range of topics covered apply to middle school science classes in particular. Tik's fountain is described in this paper, but because of space limitations the other demonstrations and activities are simply listed.

Air pressure demonstration: Tik's fountain -- illustrated by boiling small amount of water in 500 ml flask, removing from heat and stoppering. Stopper has one hole with glass tube extending well into flask. Invert flask and insert long end of glass tube into 500 ml beaker of colored water. The colored liquid is drawn up into the flask in a strong stream until it is practically full.

Center of gravity: Bottle and holder, hinge and hammer, meter stick, center of gravity shapes, etc.

Inertia: Straw through a potato. The straw will go way through a potato -- use plastic or paper straws.

Rotation: Duco cement in water (on overhead projector)
The Duco cement drop continues to spin on water in the petri dish.
Water-filled stemware is placed on tray that will not spill;
Gyroscope and helicopter toys also illustrate rotation.

Chemistry: Potassium permanganate and glycerin (illustrates surface area);
Dragon's breath (use lycopodium powder); Whoosh bottle;
Candle observations (or inference?);
Color changes such as synthetic orange juice to strawberry soda,
Summer to winter, tea to water, etc.;
Models of elements, compounds, and mixtures using paper clips,
also a paper clip stringing "machine";
Bee bees in petri dishes to illustrate states of matter (on overhead projector).

If you plan for 1 year, plant rice. If you plan for 10s years, plant trees. If you plan for 100s years, educate children.

The most uncomprehensible thing about the world is that it is comprehensible. A. Einstein

You can observe a lot just by watching. Yogi Berra

THE MINNESOTA NEW COUNTRY SCHOOL: A SCHOOL WITHOUT TEXTBOOKS

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The Minnesota New Country School is located in LeSueur, MN. It was created by a group of educators dissatisfied with the inability of the present system to address the needs of all children. The school operates around a set of key changes and five cornerstones. The key chances include:

* Year round operation
* Extended hours and flexible scheduling
* Active learning environments emphasizing community accessible technology
* An advisor-advisee program for all children
* Higher standards and better results for all students
* A management system challenging all present roles and responsibilities
* Significant budget reallocation, governance changes, and evaluation procedures
* Non graded arrangement (Level I and Level II instead of 7-9 and 10-12)
* significance efforts in areas of service learning, youth apprenticeships, youth entrepreneurship, and school to work transition.

The Five Cornerstones:

Parent involvement

Parents are more heavily involved in the Minnesota New Country School than in most traditional schools in many ways. One is through governance on the board, but also in more volunteerism. Parents are also directly involved in decision making in the curricular areas, where traditionally parents are not involved. As all students have a personal learning plan, parents have a direct say in what is taught at all levels. As the curriculum is project oriented, and process-skill oriented, students and parents design projects to meet the curriculum. This allows for the students and parents to have more direct say in what is learned, how it is learned, and therefore are more aware of the metacognitive realm. Parents are empowered, knowing they can be more directly involved with their student's education.

Teacher/Student Accountability

In the Minnesota New Country School, teachers are more accountable for results than are teachers in the traditional system. This results from having to have a three year contract to show significant results, or the school and program may be terminated. Also, the teachers are directly involved in the board decisions, the administration of the school, and the delivery of the curriculum. They are entrepreneurs, and must live by their results. The students, likewise, are more accountable for what they learn than in the traditional system. They must meet requirements in the curriculum, but are given the freedom to design the method and means to achieve it. There is no credit for "seat time", or for "passing a class". Students are accountable eventually for demonstrating via authentic exhibitions mastery of the curricular areas. This changes the nature of the student/teacher relationship and strengthens the accountability of the student.

Community as a Place to Learn

MNCS assumes that students in the traditional system are too isolated from their communities, leading to distrust and misunderstandings between generations. The school encourages students to be a part of the community by requiring community service learning, and encouraging students to participate in internships, work-studies, and to develop entrepreneurship of their own.

Also, community members are used to help develop projects for students, and to help students directly as resource persons. Students are encouraged to seek out resources outside of the school, to develop closer ties to their parents and community operations.

Technology as a Tool for Learning

MNCS has placed a heavy emphasis on the use of computers. Because there are no classes per se, there is no "scheduling" of computer lab time. There is one mainframe Mcintosh Power PC for every four students, arranged so that they are accessible to all. There is also one Mcintosh Powerbook laptop for every four students, giving the school a ratio of one computer for every two students. Laptops are available at student work stations and can be checked out over night for use at home. Consequently, computer use by students has been a very powerful motivational tool, and many students have been able to learn skills heretofore denied many in traditional schools. The school is an internet hub, and access is easily gained by all students. This has allowed for a number of projects to be designed in new ways. Plans are to add new learning programs, add a video production studio, and to increase use of new technologies as they develop over time.

Ted Sizers Essential Principles

The school has adopted a number of Ted Sizer's guiding principles, among them the idea that "less is more", that each student should master a limited number of essential skills and not try to master a lot of content. Schools should attempt to guide students to using their minds well, not be comprehensive. Means of arriving at these goals may differ from one student to another, and learning should be personalize as much as possible. The school should function with the student as worker, and the teacher as guide. Teachers should be generalists first, then specialists. Rather than offer courses, learning is seen as interdisciplinary. The school should be a humane place, devoid of threats, yet keeping high expectations. The model of learning should be one of students actively constructing their knowledge in different ways, not be seen as empty vessels to be filled.

The Minnesota New Country School has already met with some successes, especially in the area of use of computers and students constructing their own learning experiences. It is too early in the experience to know if all the vision will be met.

THE PROMISE AND PERILS OF PERFORMANCE ASSESSMENT

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Introduction

Einstein once said, "Not everything that counts can be counted and not everything that can be counted counts." I use this quote because it eloquently and succinctly focuses the issues of assessment - are we counting only those things that can be counted easily or are we missing a lot of things that should be counted!

Pressure to Perform

Why the focus on assessment reform? A Nation at Risk (1983) focused attention on the deteriorating state of education in the U.S. and the 1991 "International Assessment of Educational Progress" on science and math show U.S. students lagging badly. Moreover, research repeatedly showing students continuing to harbor strange ideas about science and business and industry disenchantment with graduates not being able to do anything with what they've learned have shifted the focus of assessment to "finding out what students can know and do."

The Assessment Process

Margie Jorgensen in her book, Assessing Habits of Mind: Performance-Based Assessment, lays out a basic model of assessment with four elements:

Target:	What is valued
Evidence:	What will serve as proof or sign of that valued
Strategy:	How evidence will be gathered
Standards:	Level of quality to accept

Assessment vs. Instruction

The real work and power of constructing assessments lie in the development of scoring criteria. Lab activities are a logical place to look for performance assessments. **But it is the rubric and the standards that make a lab activity an assessment activity.** Let's review the steps of building a rubric at this point:

1. Define targets/expectations
2. Decide range of student performance

3. Set criteria for levels of performance
4. Identify/develop exemplars
5. Try out criteria on performance samples
6. Repeat and adjust until satisfied

Summary Points

Assessments are good or bad to the extent that you know what you want and they do what you want, e.g., multiple choice and short answer tests are very time efficient; they just don't always tell us all the things we want to know-what we think is important in learning science.

Finally, two quotes by Shavelson and Nolan sum up the current attention on performance assessment and its role in instruction:

"If it's good for teaching, it's good for testing. If it's good for testing, it's good for teaching." (Shavelson, 1994).

The idea of teaching to the test is a good educational practice if the tests are worth teaching to." (Nolan, 1994).

DEVELOPING SCORING CRITERIA

1. **Define targets/expectations**
2. **Establish range of performance**
3. **Set criteria for different levels**
4. **Identify/develop exemplars**
5. **Try out criteria on samples**
6. **Repeat and adjust until satisfied**

RUBRIC DEVELOPMENT

1. Assemble Content and grade-level experts.
2. Review purpose of the assessment.
3. Discuss the number of score points required.
4. Specify the elements of the performance to be evaluated.
5. Discuss the characteristics that determine score points for each element.
6. Identify real responses or write prototypes of each of the different score points.
7. Select or construct exemplar performances for use in training other raters to use the scoring rubric reliably.
8. Try out the scoring rubric.
9. Resolve discrepancies and revise the rubric or exemplars as required.
10. Develop and try out a training program with a focus on level of interrater reliability obtained with given levels of training.

ISSUES

*Is the target ... important? valued over other possible targets?

*Does the evidence ... tell the true story? give us the big picture?

*Are the standards ... set right? to high? too low?

*Is the test ... fair? does it match instruction?

PERFORMANCE ASSESSMENTS

Reflect valued outcomes

Are consistent with instructional practice

Incorporate creation of a product

Allow observation of behaviors directly

Involve collaboration and use of resources

Promote active investigation

Encourage multiple approaches

Permit multiple solutions

Require the use of integrated ideas

Demand higher order thinking

Emphasize big ideas

Are inherently interesting

Are developmentally appropriate

Are feasible and cost effective

Quote 1:

"If it's good for teaching, It' good for testing. If it's good for testing, it's good for teaching."

Richard P. Shavelson
University of California at Santa Barbara

Quote 2:

"The idea of teaching to the test is a good educational practice, as long as the tests are worth teaching to."

Kathy Nolan
New Standards Project

Quote 3:

"You get what you test."

Source unknown.

IDEAS FOR VARYING TEST FORMATS

Confidence Weighting

Standard multiple choice test can be made more revealing of what a student knows and understands by asking a student to assign a "weight" to their responses based on the confidence he/she has in their response. With this strategy students are given the chance to capitalize on what they know, but it also causes the student to be reflective during the testing--something good students (and good test-takers) do naturally.

The confidence weighting can be done within set limits or can be made more open-ended. Following is an example of directions where weight limits are set for a section of ten multiple choice items worth 40 points:

Directions: Each item in this section of the test is worth an average of 4 points. Place the letter of the best response to each item in the first blank in front of each numbered item and place a point value of 3, 4, or 5 points in the blank next to your response.

Your point total for the section has to equal 40 points. Assign higher point values to those responses about which you are sure and lower point values to those about which you unsure. You may assign no point values to any items in which case all items will count 4 points each.

Confidence weighting can be used with any kind of test format including multiple choice, short-answer, essay, matching, etc. The idea is to give students a chance to capitalize on their reflection of what they do and don't know and understand.

IDEAS FOR VARYING TEST FORMATS

Two-Part Multiple Choice

Information about a student's thinking and understanding can be obtained by modifying many multiple choice (MC) items and adding a second part in which the student is asked to "explain" or "defend" his/her response. Following is an example of a middle school two-part item on the topic of expansion and contraction:

> 1a. When heat energy is added to matter, the matter
>
> A. Expands
> B. Contracts
> C. Freezes
> D. Condenses
>
> 1b. Explain your selection in 1a.

Either choices A or B can be correct with proper explanation (all materials other than solid water (ice) at 4° Celsius do expand when heat is added). The two-part item can then be scored on a scale which reflects the student's awareness of the general behavior of matter and the uniqueness of water. For example:

Full cre[illegible] Student marks A or B, or A & B and explains the gen[illegible]l rule governing matter and the unique relationship for ice at 4° Celsius.

Half credit: Student marks A or B but explains only the general rule or the special case with ice at 4° Celsius, but not both.

No credit: Student marks A, B, C, or D but give no reasonable explanation of the general or specific rules.

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