A Review of High School Mathematics Programs

Introduction

In the winter of 2005, a grant was written entitled ***Making the Transition from High School to College*** (**MaTHSC**). The grant began as a collaboration of ten high schools, three colleges from the University System of New Hampshire, and the seven schools from the New Hampshire Community and Technical College System. The primary goal of the MaTHSC project was to help students make a successful transition from high school to institutions of higher education in NH. One of the primary objectives for the grant was to review some of the more widely used and recommended high school mathematics programs and rate them on a set of criteria which was to be developed by the Curriculum Committee of the MaTHSC grant. This is their report on the curricula reviewed.

The Curriculum Committee met throughout the Academic Year, 05-06. In order to do its work, the Committee reviewed several evaluation forms and discussed the attributes of programs that should be rated. They selected the form attached in Appendix A, which is a modified version of forms developed in Montana and Massachusetts. See the acknowledgement at end of form. While all criteria are rated on a scale of 1 to 5, not all criteria were considered of equal value, thus, as might be expected the Overall Rating for a program, which is on a scale of 1 – 10, took that fact into account.

The Overall Rating for a program is meant to provide a "global" picture of the program and not merely an accumulation of the item scores. Items relating to the content and process standards carried more weight than items such as "incorporating the achievements of historically important mathematicians" or "having students reflect on their own performance, behavior and feelings." Similarly, items relating to the pedagogical aspects of the program were considered more important by some reviewers. In particular, the Committee felt we should advocate all students taking courses through Algebra II. Thus, Committee members felt that many teachers may need help in addressing those needs, and therefore the supplemental materials available also became a critical factor for some members. Also, we found very little field test data available for some of the programs. While traditional programs may not need to offer additional training for implementation, most, if not all the NSF programs and some other programs, are different enough that we felt providing training was necessary.

The findings of the Committee do not reflect the beliefs of any one member of the Committee, nor do they reflect the views of any people involved in the MaTHSC Project, nor of any of the institutions involved in this project. The findings are meant to serve as a guide to help school districts as they review programs for courses to be offered within

their districts. For more information about these programs, you should go to the websites for the publishers of the programs. Many of these programs were also reviewed by the US Department of Education and the American Association for the Advancement of Science. Information about the US Department of Education's document entitled ***Exemplary & Promising Mathematics Programs*** may be found at http://www.ed.gov/PressReleases/10-1999/mathpanel.html . Information about the AAAS Project 2061 Algebra Textbooks Evaluation may be found by visiting http://www.project2061.org/publications/textbook/algebra/summary/ .

The Committee wants to formally thank the publishers of the textbooks reviewed for their cooperation and help in sending materials for the Committee to review. Without their aid, it would have made this project more difficult. We were given access to the latest editions of each curriculum. In some cases we did not have access to extra materials available from the publishers.

Members of the MaTHSC Curriculum Committee

The Curriculum Committee members were selected by the participating high schools and universities. They formed a well balanced Committee with many veteran teachers and administrators, comprising over 200 years of mathematics teaching experience. Various Committee members are serving or have served as the Mathematics Curriculum Leaders for their school district and as Mathematics Department Chairs. One of the College faculty members of the Committee was a member of New Hampshire's team that developed the Grade Span Expectations for NH.

The members of the Curriculum Committee consisted of the following teachers and administrators from participating high schools and two faculty members from Plymouth State University.

Dr. Brian Beaudrie, Mathematics Department, Plymouth State University
Richard Bond, Mathematics Department Chair and Assistant Principal, Colebrook Academy
Cecile Carlton, Interdisciplinary Curriculum Specialist – Mathematics, Nashua School District
Harvey Champigny, High School Mathematics Teacher, Timberlane Regional High School
Jocelyn Conley, High School Mathematics Teacher, Salem High School
Marc Corriveau, Mathematics Department Co-Chair, Laconia High School
Richard Davis, High School Mathematics Teacher, ConVal High School
Joshua Mulloy, High School Mathematics Teacher, Winnisquam Regional School District
Jeff Nielson, Mathematics Department Chair, Littleton High School
Ellen St. James, Mathematics Department Co-Chair, Laconia High School
Dr. Natalya Vinagradova, Mathematics Department, Plymouth State University

Dr. Fernand Prevost, Co-Director of the NH-IMPACT Center at Plymouth State University, served as the Chair of the Curriculum Committee.

Dr. Richard Evans, Co-Director of the NH-IMPACT Center at Plymouth State University and PI for this grant, served as an ex-officio member.

Textbook Programs Reviewed

After agreeing on a form and a set of criteria on which to rate the programs, the Committee then selected the programs that would be included in the review. First, it was agreed that the five 'standards-based' programs created through funds from the National Science Foundation would be included. These are:

Math Connections: A Secondary Core Curriculum (formerly the Core-Plus Project) published by It's About Time, copyright 2000 – 2006;
Contemporary Mathematics in Context: A Unified Approach published by Glencoe/McGraw-Hill, copyright 2003;
SIMMS Integrated Mathematics: A Modeling Approach published by Kendall/Hunt Publishing Company, copyright 2003.
Mathematics: Modeling Our World (formerly the ARISE program) published by W. H. Freeman and Company, copyright 1998 – 2000; and
Interactive Mathematics Program: Integrated High School Mathematics (IMP) published by Key Curriculum Press, copyright 1997 – 2000;

Additionally, the committee chose the following programs to review because of their wide usage across the country or because of their ratings by the U. S. Department of Education and the American Association for the Advancement of Science.

Algebra I, Geometry, and ***Algebra*** II, published by Glencoe/McGraw-Hill, copyright 2003
College Preparatory Mathematics (CPM) published by CPM Educational Program, copyright 1998 – 2002;
McDougal Littell Algebra, Geometry and Pre-Calculus program published by McDougal Littell, copyright 2004; and
Discovering Algebra, Geometry and Advanced Algebra published by Key Curriculum Press, copyright 2003 – 2004;

Each program was reviewed by two teams of three committee members, working independently. After completing all the reviews, the committee chair reviewed the ratings and brought the teams together to address major discrepancies in ratings. (The ratings had to vary by two or more points to be discussed.) Discrepancies between the two teams were discussed and the two teams sought a common rating or at least ratings that differed by less than two points.

Finally, the attached Excel summary was prepared and the comments about strengths and weakness for each program were appended.

Criteria for Evaluating Instructional Materials in Mathematics

Directions: Circle one number on each scale below. The higher the number the better the text meets the philosophy, goals, and objectives of the NH GSEs and the NCTM's Principles and Standards.

Rating Scale: 5 = high 1 = low

I. Mathematical Content: The mathematical content of the program reflects the mathematics found in the *New Hampshire Grade Span Expectations* and in the National Council of Teachers of Mathematics *Principles and Standards for School Mathematics*.

- **Mathematics as problem solving is integral to the program.** Problem solving situations are used to introduce and develop mathematical concepts. The problem situations are "realistic" and relevant to students, involve a variety of mathematical domains, and are open and flexible to the methods used to solve them.

  1 2 3 4 5

- **Mathematics communication is emphasized in the program.** Students are provided many opportunities to express mathematical ideas by making conjectures, defending their ideas, and explaining their work orally and in writing.

  1 2 3 4 5

- **Mathematics as reasoning is built into the program.** Students are asked to explain and justify their thinking, question other students and the teacher when they don't understand or disagree, and create informal and formal arguments to support conjectures. They are provided opportunities to apply inductive and deductive reasoning and reasoning by analogy.

  1 2 3 4 5

- **Mathematical connections are made throughout the program.** Students encounter instructional activities designed to connect mathematical concepts, procedures and processes with different mathematical topics, other content areas, and to life situations.

  1 2 3 4 5

- **Mathematics as representations plays a prominent role in the program.** Students are encouraged and required to represent mathematical topics and organize their work and data in a variety of ways, including language, tables and charts, graphs, and algebraic expressions and formulas.

  1 2 3 4 5

- **The mathematics presented is comprehensive and includes the mathematical content emphasized in the High School GSEs.** Students have opportunities to learn the mathematical concepts from number, algebra, geometry, measurement, and data and chance.

  1 2 3 4 5

II. Organization and Structure: The program is coherent, focused on important mathematics, organized into cohesive units, provides multi-day lessons, and connects topics across subject areas.

- **The program exposes students to important mathematics as identified in the High School Advanced mathematical GSEs, and the mathematics is mathematically correct.** Students are provided activities to learn the mathematical concepts contained in the advance GSEs in mathematics. These activities are well grounded and mathematically correct.

  1 2 3 4 5

- **The program asks students to work on worthwhile mathematical tasks.** They do not separate mathematical thinking from mathematical concepts or skills. The tasks are relevant to students, ask them to make conjectures, and to prove or disprove those conjectures. Many tasks are open ended, have more than one solution, and more than one way to solve the problem.

  1 2 3 4 5

- **The program is organized into units or a similar structure so that students have time to explore and investigate in-depth major mathematical ideas.** Many lessons, activities, and projects require multiple days and emphasize making mathematical connections between concepts and promote the attainment of several objectives. These coherent units build both conceptual and procedural knowledge.

  1 2 3 4 5

- **The program appropriately incorporates calculators, computers, and other technology as tools for students to do mathematics.** Technology is used to explore mathematical ideas and to minimize tedious work.

  1 2 3 4 5

- **The program is appropriate for ALL students.** All students are exposed to important mathematics through problem solving situations. All students will participate in the core program, with explicit differentiation in terms of depth and breadth of treatment. There are ample opportunities to challenge the best and brightest students and the resources to help those who need extra help.

  1 2 3 4 5

- **The program incorporates the achievements of historically important mathematicians.** The history of mathematics is an integral part of the program and fosters the belief that mathematics is a "human endeavor."

  1 2 3 4 5

- **The program is reflective of the diverse society in which we live.** Illustrations of people from different races, genders, and beliefs are prominent throughout the texts.

  1 2 3 4 5

- **There are ample resource materials available.** Those resources provide clear instructions on how to use equipment and materials. Teachers' manuals, test banks, and other resources are readily available for the teacher's use.

  1 2 3 4 5

- **The program highlights connections within mathematics and with other disciplines.** Applications of mathematics are incorporated throughout.

  1 2 3 4 5

- **The program materials are "user friendly."** The program has an appropriate reading level for students and the materials are well organized and attractive.

  1 2 3 4 5

III. Student Experiences: The program emphasizes the active engagement of students doing mathematics instead of memorizing mathematics. The activities in the program accommodate different abilities and paces by providing students different entry and exit levels. The program advocates the use of manipulatives and technology so that all students can learn mathematics.

- **Students are active learners.** Students are encouraged to explore, hypothesize, reason, problem solve, and communicate mathematics. Having students read, write, reason, and discuss mathematics is the norm. Students are expected to work individually and in groups on projects and assignments.

  1 2 3 4 5

- **Students are expected to construct their own understanding of mathematics and to engage in mathematical discourse.** The program builds on prior student knowledge and encourages students to construct their own understanding by providing opportunities to discuss and reflect on their work.

  1 2 3 4 5

- **Students use manipulatives, technology and the Internet to explore mathematical ideas, model situations, analyze data, calculate numerical results, and solve problems.** A variety of manipulatives and tools (e.g. graphing calculators, dice, geoboards, square tiles, rope, etc.) are commonplace and are frequently used by students as they actively engage with mathematical ideas.

  1 2 3 4 5

- **Students are expected to determine when they need to calculate in a problem, whether they should use mental math, paper and pencil, or a calculator, and whether or not they need an exact answer or an estimate.** Estimation is an important skill used frequently by adults. Estimation is needed even when using technology to see if the answer makes sense.

  1 2 3 4 5

- **Students are expected to reflect on, make judgments about, and report on their own behavior, performance, and feelings.** Students are asked to do self-assessments on selected aspects of their experiences as one method of evaluating student performance and disposition.

  1 2 3 4 5

IV. Teachers Role and Instructional Materials: The instructional materials provide suggestions to help teachers create vibrant mathematical communities where students are engaged in doing mathematics.

- **The instructional materials provide suggestions to teachers so that they can help students to:**
  -- work together to make sense of mathematics
  -- rely more on themselves to determine whether something is mathematically correct
  -- reason mathematically
  -- learn to make conjectures and solve problems
  -- connect mathematical ideas and applications to other topics within mathematics and to other disciplines

  1 2 3 4 5

- **The instructional materials provide suggestions for teachers to initiate and orchestrate mathematical discourse.** The materials suggest questions that elicit, engage, and challenge student thinking. Teachers are encouraged to ask students to explain their thinking and reasoning and to ask “Why?” or “What if” questions.

  1 2 3 4 5

- **The instructional materials provide assistance to teachers to facilitate learning by all students by adapting materials for students with different levels of achievement.** Teachers are encouraged to accept and respect the thinking of all students by providing examples of how to probe students' thinking and encourage students to understand each others' approaches and ideas.

  1 2 3 4 5

- **The instructional materials provide suggestions for establishing a classroom environment focused on sense making.** Teachers are provided suggestions on how to:
  -- structure time so students can grapple with significant mathematical ideas
  -- use physical space and material in ways that facilitate students' learning
  -- use pedagogical strategies, such as open-ended questions, cooperative learning, and
  direct instruction
  -- assist students to work together collaboratively, as well as independently.

  1 2 3 4 5

- **The instructional materials provide suggestions to teachers to help them reflect on what happens in the classroom so that they can adjust or adapt their teaching plans.** Teachers are provided suggestions on how to observe, listen to, and gather information so that they can assess and monitor student learning. The materials should include a variety of assessment approaches such as portfolios, journals, projects, and tests.

  1 2 3 4 5

- **The instructional materials provide suggestions for how parents can be involved and kept informed about the program.** Many parents want to help their sons and daughters, but may need assistance in doing this.

  1 2 3 4 5

- **The teacher's guides are "user friendly."** The program is easy for the teacher to use and offers guidance in the use and integration of student materials and technology.

  1 2 3 4 5

V. Assessment: Instructional materials should include student assessments that provide teachers with information about what their students know and understand.

- **Student assessment is integrated into the instructional program.** Assessment activities provide evidence about what students have learned, their ability to apply it to situations requiring reasoning and creative thinking, and their ability to communicate it.

  1 2 3 4 5

- **Multiple means of assessment are used, informal as well as formal.** Suggestions for assessing students individually or in small groups, through observations, oral and written work, through student presentations, and student self-assessment. The use of manipulatives and technology is built into assessment activities.

  1 2 3 4 5

- **The assessments contain a balance among activities that assess conceptual knowledge, procedural skills, and problem solving ability.** It is important to assess both procedural and conceptual knowledge and to provide activities that assess a student's ability to solve problems, which often takes time outside of class.

  1 2 3 4 5

VI. Program Development and Implementation: Research about the effectiveness of the program should be available and done by both internal and external evaluators. Many programs are significantly different from more traditional programs; thus, they may require professional development to implement properly.

- **The program has field test data showing positive effects on student learning.** This data should include comparisons to other programs and some evidence provided by outside evaluators.

  1 2 3 4 5

- **The program offers initial training and long-term follow up for teachers.** Teachers need to have training in new programs that differ significantly from more traditional programs.

  1 2 3 4 5

OVERALL RATING

Considering the philosophy, goals, and objectives of the NH GSEs and the NCTM Standards, what overall rating would you give this program?

1 2 3 4 5 6 7 8 9 10

Low Rating **High Rating**

Strengths to remember for later discussion:

Weaknesses to remember for later discussion:

This form has been adapted from ***Mathematics Materials Selection Criteria*** published by the Missoula County Public School, in Missoula, Montana and from ***Mathematics Curriculum Framework*** published by the Massachusetts State Department of Education.
The criteria were further influenced by the draft versions of the NH Grade Span Expectations (GSEs) for grades 9-10 and the NH Advanced Mathematics GSEs.