

MEMORANDUM

To: Eric Witherspoon, Superintendent
From: Eugenia Brelas, Mathematics Department Chair
Judith Levinson, Director of Research, Evaluation, and Assessment
Laura Cooper, Assistant Superintendent of Curriculum and Instruction
Date: June 5, 2008
Subject: Report on Numeracy 2007-08

The purpose of this report is to address the school goal of numeracy. There are two aspects of this goal:

- Improve math achievement in academic courses;
- Achieve measurable academic gains in math.

Below is a summary of what was accomplished and what is planned for the next year.

Numeracy

Improve math achievement in academic courses.

- *Continue work on strengthening the regular level math program.*

Starting with 1 Algebra, we have been working on raising the level of expectations in regular level classes. This year we implemented the revised Geometry curriculum, which incorporates reinforcement of algebraic concepts and procedures; we also implemented a revised 2 Algebra curriculum. We piloted co-teaching with regular education and special education in a 1 Algebra class.

Table 1 below shows longitudinal data on grades for 1 Algebra classes from 2004-05 to 2007-08. (2005-06 was the first year of implementing the revised 1 Algebra curriculum, including *Agile Mind*.) The percentage of A/B grades has increased since 2004-05 and the percentage of D/F grades has decreased.

Tables 2 and 3 show baseline data for the 1st semester of this school year for Geometry and 2 Algebra. Since we implemented curricula for these two courses this year, we will monitor grades for improvement as we move forward.

Table 1. Semester 1 Grades - All 1 Algebra Classes

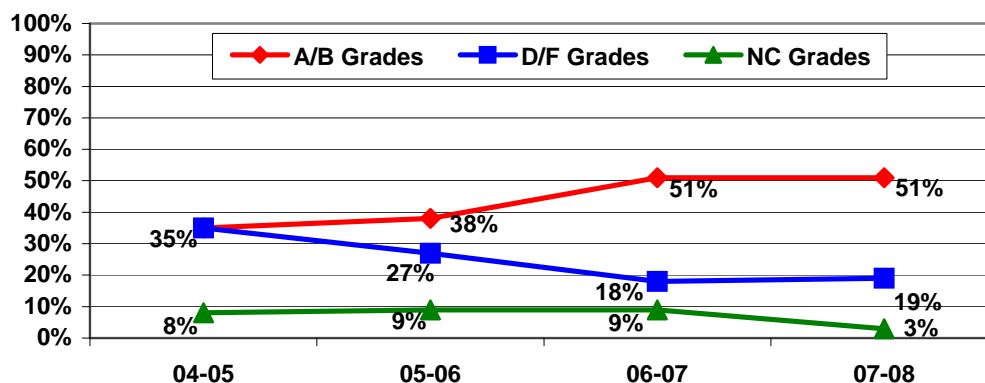


Table 2. 2007-08 Semester 1 Grades - All Geometry Classes

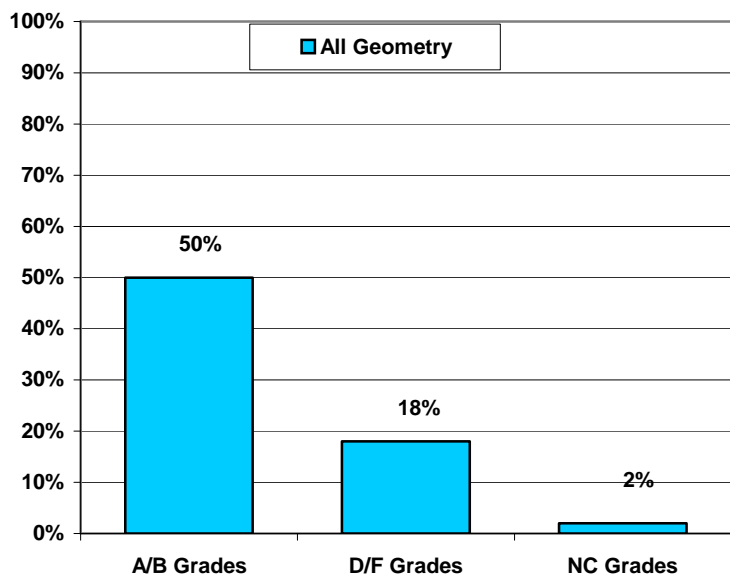
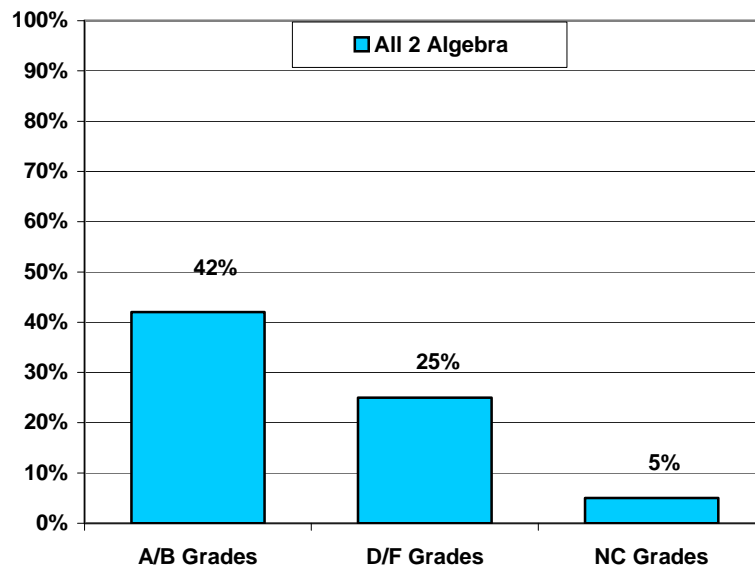


Table 3. 2007-08 Semester 1 Grades - All 2 Algebra Classes



- *Incorporate effective effort and the Academic Youth Development (AYD) curriculum in 1 Algebra classes.*

The AYD summer program, which was developed through the Dana Center and teaches students about effective effort, beliefs about intelligence and effective problem solving, was implemented in summer 2007 for 32 students; it was co-taught by two math teachers. We piloted teaching AYD in two 1 Algebra classes during the school year.

We are working with the Dana Center to design and implement an ongoing evaluation of the program; however, we are enthusiastic about the program because the feedback from teachers and students has been positive. One positive indicator has been that students who have been exposed to the AYD curriculum are more likely to move on to the accelerated summer Geometry program than other 1 Algebra students.

- *Design a program for incoming 9th graders who are below grade level in math.*

We took a different approach in our Pre-Algebra course this year to address the achievement of incoming freshmen who are significantly below grade level in math. Being able to better meet the needs of students through smaller class size, we retaught some pre-algebra content and skills but we also taught 1 Algebra to all students enrolled in Pre-Algebra, hoping that it would accelerate the academic progress of some of the students. We were very pleased that close to 70% of the students successfully completed the first semester and were moved into second semester 1 Algebra classes. In past years, these students would have moved into first semester of 1 Algebra after Pre-Algebra. Third quarter grades show that these students are holding their own; their performance is comparable to students who are in double period 1 Algebra.

Even students who didn't successfully complete the first semester of 1 Algebra, performed better on the Pre-Algebra exam than comparable students in the previous year. This pilot has reinforced the idea that students respond to a rigorous curriculum and teacher beliefs in their capacity to do high level work.

We also revised the curriculum for the Intensive summer course that serves students who will be placed in Pre-Algebra in the fall; the curriculum now focuses on preparing students for an accelerated experience that will include learning 1 Algebra.

- *Monitor student achievement over the course of the year at the PLC level.*

One of the most powerful examples of monitoring student achievement occurred at the PLC level using common assessments, examining student work, and discussing strategies for reteaching. Jon Saphier showcased the Pre-Algebra PLC as an exemplar for other PLCs to emulate.

Achieve measurable academic gains in math.

In addition to five days of intensive test prep preceding the PSAE, teachers embedded test prep in their 1 Algebra through Trigonometry-Analysis classes throughout the year using curriculum developed by teachers in the summer. We looked at test prep strategies at some department meetings. The Chair and Math Study Center Aide met with individual students of color who were close to meeting standards on the practice ACT (that students took in the fall on Assessment Day) to go over problems missed. More than half of the students responded to their scheduled appointments.

Well-Being and Literacy

In addition to our obvious responsibility for numeracy, we addressed the goals of well-being and literacy. We have large numbers of students attending the Math Study Center and AM Support. We have adopted a course (Topics in Math) for dual credit with Oakton for seniors next year. The Math Department is involved in school-wide planning around literacy with Regina Amour, our Literacy Coordinator, and others. We discussed literacy in math at department meetings and drafted the Math Department's Position Statement on Literacy. (See attachment.)

Initiatives to be Undertaken Next Year

- Work with consultants to focus on improving math teaching and learning and incorporating literacy strategies in math classes.
- Expand teaching AYD in summer 2008, each class to be co-taught by a math teacher and counselor or social worker.
- Implement assignments in 1 Algebra classes developed this year through an MSAN-SERP (Strategic Education Research Partnership) project in which ETHS and District 65 are participating. The project aims to improve algebraic understanding.
- Expand the co-teaching model for regular education/special education: two 1 Algebra classes, one Geometry class. Pilot the co-teaching model for regular education/bilingual education: two 1 Algebra classes, one Geometry class.
- Develop lessons/activities in the summer to increase student engagement and refine our electronic curriculum for 1 Algebra and Geometry. Revise 2 Algebra over the summer based on lessons learned this year and consult with the *Agile Mind* developer to better integrate *Agile Mind* with the 2 Algebra curriculum.
- Continue to work on the effective implementation of AM Support and better supporting students in the Math Study Center.

**MATHEMATICS DEPARTMENT
POSITION STATEMENT
DRAFT
ON
LITERACY IN THE MATH CLASSROOM
MAY, 2008**

In an effort to promote the ETHS School Goal of Literacy, the Mathematics Department, over the course of the last two school years, has participated in several workshops to look at what literacy means in a Math classroom. We invited outside speakers considered experts in the field of math literacy to conduct these workshops.

Based on our work during these last two years, the Math Department recognizes the following statements about why literacy is an important aspect in a math classroom, and seeks to implement these beliefs:

1. **Reading Mathematics is an important skill that students need in order to begin to solve a problem in class or on a standardized test, to read a textbook, or to interpret data and graphs they may encounter outside of class; explicitly teaching how to read mathematics must be part of the regular activities in a math class.** While reading mathematics requires some of the same skills as reading other types of material, there are significant differences that need to be addressed as well. Expecting students to reading a math problem to be solved, or a text book to gain understanding, requires that we keep in mind the following points:
 - First, as in other situations, students need to be prepared to understand the vocabulary. Some of this vocabulary is common across subjects, some is specific to math, and some has different meanings depending on which subject is involved. Reading a word problem in class or a paragraph in a math text requires a facility with the technical, academic language.
 - Reading a passage in mathematics often goes hand in hand with interpreting an accompanying diagram. Students must learn to be aware of and look for visual clues in these diagrams in addition to the verbal description. Moreover, diagrams themselves are in many ways like paragraphs. The individual parts of a chart, for example, have meaning, just as the sentences in a paragraph of text. Taken together as a unified paragraph, those sentences have a deeper meaning; so to, the parts of a diagram need to be read as a unified whole to really understand the diagram.¹ It should be noted, however, that when reading a paragraph of text, it is not always helpful to dwell on the details of the individual sentences. A diagram in mathematics, on the other hand, may need to be “mined” for important details in addition to the overall picture.
 - Finally, mathematical notation, if understood, can sometimes provide clearer ideas in a more concise manner than a page of description. The ability to read and understand standard notation is a crucial part of understanding mathematics.

The complexities of reading mathematics requires students to be tenacious – to re-read passages, to draw pictures, to ask questions – and requires teachers to provide opportunities and encouragement for active, careful reading.

2. **Communicating verbally and in writing are both important ways for students to develop and demonstrate their understanding.** Writing in math serves three important purposes: to help students think about abstract concepts; to provide an opportunity for demonstrating understanding; and to record work for later reference.² We need to explicitly teach what good mathematics

writing looks like, and encourage the use of specific and clear language, precise vocabulary, and detailed explanation. Students should be given the opportunity to write explanations of procedures, justifications for the steps in an example, and reasons why “anti-examples” contain incorrect work. Additionally, students should be encouraged and given opportunities to use good, clear mathematical notation, which can often relate an idea in a concise and elegant way. Verbal communication from students is also important providing the opportunity for students both to try out new vocabulary and to practice producing clear and precise explanations. Allowing students to give longer detailed answers, rather than short one word or numeric answers, to teacher-posed questions can also give the teacher lots of information about the student’s understanding of an idea, as well as the opportunity for immediate and useful feedback about the quality of the response. Additionally, verbal communication between students helps them to process and revise their ideas, and probe each other’s responses for clarity.

- 3. A deep understanding of mathematical ideas is dependent on the student’s ability to construct some mental model of the idea; teaching how to construct models from text is an important part of math literacy.**³ When reading passages of narrative text, students can often visualize the events described as a mental movie, using their own experiences to create each scene. When reading mathematical text, there is most often no “action” in the same sense as there is action in a narrative. As a result, students may be less likely to engage in the math text, unless they have some way of visualizing the “events”. When working word problems, students need to start seeing the moving trains, the path of the ball, the paper being folded into the box, or the line being rotated around the axis. When reading examples full of notation, students need to see the action of both sides of the equation being divided by -5 , the substitution of an expression for y , the polynomial being broken into factors. Showing animations and providing examples of these ideas is important, but so is having students produce pictures and written explanations on their own, thus practicing the construction of the models themselves.
- 4. Improving student literacy gives students the tools for taking more responsibility for their own learning.** A student who knows how to read a problem or textbook, how to clearly explain their reasoning, and how to relate their new learning to other ideas is less dependent on the teacher for “the answer”. Students who have experience and developed expertise in reading examples from a text should be able to do the same for their own work. Moreover, the confidence that comes with better understanding often motivates students to continue working, even when the material becomes challenging. Students become less dependent on the teacher’s explanations, because they have other resources from which to learn the material.

Implications

Based on the above belief statements, it is important for all math teachers to learn and practice techniques for developing literacy in their students, specific to the math classroom. The density of notation, specialized vocabulary, illustrating diagrams, and the need for mental models indicate the need for teachers to instruct students on how to read a math problem, how to read a text, and how to write and speak mathematically. Additionally, teachers need to give students the opportunity to practice their “literacy skills”, by asking students to answer more open-ended questions, to read about and explain ideas and skills, and to discuss complex ideas in the classroom. The added benefit of working on math literacy is that these kinds of activities better inform the teacher about what students are really learning. As teachers gain better knowledge of student learning, they can better adapt their instruction to target misconceptions that may be identified, or move forward knowing that the students do have a good understanding of the material. The deeper student engagement through a focus on literacy can have direct

results on student achievement, and the clearer view of student understanding can help teachers modify instruction to move the achievement even farther forward.

References:

1. Diagrams as paragraphs is an idea from Brian Rotman, *Mathematics as Sign: Writing, Imagining, Counting* (Stanford UP, 2000), as referenced by Byung-In Seo in the article "Opening the Dialogue: Inviting content-area teachers into the literacy discussion" from the *Illinois English Bulletin* (Spring 2008, v.95n.2).
2. The reasons for writing in the math class are from "Reading and Writing Mathematics" by Philip Daro, September, 2005.
3. The idea of constructing mental models for understanding mathematics can be found in both the article by Philip Daro referenced above and in *Mindstorms: Children, Computers, and Powerful Ideas*, by Seymour Papert (BasicBooks, 1993).