

**ASSESSING MATHEMATICS AT SUNY FREDONIA: COMMUNICATION AND
COLLEGIAL RELATIONSHIPS**

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ABSTRACT

This presentation will describe the assessment of learning outcomes for Mathematics at SUNY Fredonia. This complicated task required us to assess the competency of students in five areas- arithmetic, algebra, geometry, data analysis, and quantitative reasoning-among those who were enrolled in 26 different courses taught by 15 faculty from 5 different disciplines. Our solution required planning, a pre-testing and evaluation of the assessment method, the implementation of the method, and the scoring, reporting and utilization of the results. Two factors that were essential to the success of this assessment: effective communication and the facilitation of collegial relationships will be described as well.

THE TASK: Assess student competency in arithmetic, algebra, geometry, data analysis and quantitative reasoning among those enrolled in 26 different courses taught by 15 faculty from mathematics and four different social science disciplines.

STEPS TO A SOLUTION

STEP 1- FALL, 2001

A multi-discipline assessment committee was formed. Its participants came from faculty in mathematics, mathematics education, political science and sociology.

STEP 2 – FALL, 2001

The feasibilities of alternative assessment methods were considered. Because topic and course material is not standardized over the included courses, both the use of a standardized test and course test grades were rejected. Instead the committee decided to examine student work on embedded test questions that required students to use the appropriate competencies.

STEP 3 – END OF FALL, 2001

The assessment method was pre-tested by requesting instructors in relevant courses to identify appropriate test questions and to randomly select un-graded examples of student work on these questions. All submitted work was to be anonymous. (see document 1)

STEP 4 – FEBRUARY 2002

The assessment committee examined a sampling of the submissions using a rough rubric that distinguished the work that **YES** did show competency from that work which contained a **PARTIAL** understanding of the skill and that work which contained **NO** competency of the skill.

To facilitate their decisions the committee formulated these definitions of each skill area:

1. Arithmetic: Computational fluency with numbers by being able to do the operations of arithmetic including addition, subtraction, multiplication, and division.
2. Algebra: The ability to express and re-express relationships in symbolic language and/or the ability to apply algebraic formulae appropriately.
3. Geometry: the ability to describe and interpret information presented graphically and/or spatially.
4. Data Analysis: The translation of observed information into a different representational system that includes numbers and symbols for subsequent decision-making.
5. Quantitative Reasoning: The ability to make decisions or to come to conclusions that are consistent with the information examined in the particular representational system.

STEP 5 – MAY 2002

From its evaluation of the methodology, the committee learned:

- A. Student work could be examined for competency in the appropriate skills.
- B. Students do show variation in skill levels across the skill domains.
- C. This method did provide information about student abilities across disciplines and courses.
- D. The findings could provide a basis for instructors to change and/or strengthen activities in their courses in order to better assist students to meet the standards.

STEP 6 – MAY 2002

Feedback to the faculty teaching these courses was done to inform them of the outcome of our analysis and to emphasize that their participation was both important and meaningful. (see document 2)

STEP 7 – FALL 2002

The implementation of the GEAR approved assessment of General Education in Mathematics began with a first letter to the appropriate faculty (document 3). This letter described the method, described the instructors' responsibilities including randomly selecting and copying 6 examples of student work prior to its being graded, and guaranteed anonymity as to student, course, and instructor. Approximately 2 months later a follow-up reminder letter was sent as the fall semester came to a close (document 4).

STEP 8 – JANUARY 2003

Data collection was very successful as student work was received from all sections of the relevant courses. The N of 162 represented twenty percent of all the students enrolled in these courses during the Fall semester.

STEP 9 – FEBRUARY 2003

Data analysis included the following:

- A. For their rubric the committee adapted the GEAR rubric of Exceeding, Meeting, Approaching and Not Meeting Standards (see document 5).
- B. Committee members worked in teams of two in order to evaluate each item of student work in relation to the rubric. An interval method was used to randomly divide all items between the two teams.
- C. Inter-rater reliability was examined by having each team cross-check a random selection of items evaluated by the other team.

STEP 10 – MAY 2003

The results of the assessment were reported to the Campus general education committee (the College Core Curriculum committee), the campus academic administration, SUNY Central Administration and to the faculty together with action plans for change across all courses in order to facilitate an improvement in student learning.

DOCUMENT 1

To: Those teaching CCC mathematics/statistics courses November 14, 2001

From: the CCC mathematics/statistics assessment subcommittee

This subcommittee was charged by the CCC committee to evaluate and choose an assessment process and procedures to evaluate student learning related to CCC goals for mathematics/statistics courses. The specific learning goals include arithmetic, algebra, geometry, data analysis and quantitative reasoning. At no point in this process will specific classes or instructors be identified or evaluated.

Our task was to consider a variety of methods that could be used to assess student mastery of these learning goals. We considered the use of standardized FIPSE type tests to be given to students after they had completed their course. This was rejected because the diversity of courses would make interpreting a common outcome difficult, if not impossible. Instead we opted for a variation of a common question(s) on student exams approach. We assume those who teach these CCC courses include requirements that students demonstrate mastery of these learning goals in a testing or project format that is relevant to each class. In short we assume, based upon examination of test questions from a variety of sources and upon discussions with various instructors of these courses, that each of you test for the same kinds of skills, but differently.

In preparation for the formal assessment of student accomplishment in these courses that will begin next year, and continue every three years, we want to "pre-test" our selected assessment method. We are seeking your cooperation for this purpose. We ask two things of you.

1. As they are known, please forward to us the specific question or questions you will use to test your students' competence in these skills.
2. After your students have completed the tests, but before you grade them, please send us a Xerox copy of only the completed problem(s)/question(s) from five of the "tests" that you have randomly selected.

We want to make sure that we will be able to collect the appropriate material, and we need to create scoring categories. Our goal, in this process, is to learn to what extent our students indicate they are able to do arithmetic, algebra, geometry, data analysis and quantitative reasoning. At no point in this process will specific classes or instructors be identified or evaluated.

Thank you for your anticipated cooperation,

CC:

DOCUMENT 2

To: Faculty Teaching CCC Mathematics/Statistics courses

From: The Math-Statistics CCC Assessment Subcommittee

Re: Report on assessment pre-test (May 1, 2002)

In anticipation of mandated assessment of the mathematics-statistics component of the CCC program next year, the subcommittee undertook a "pre-test" of our chosen method of assessment. This is a report of this activity and of our subsequent analysis of the data.

In November 2001 the subcommittee contacted all those teaching mathematics or social science statistics courses, which have been approved for inclusion in CCC. They were asked to provide anonymous Xerox copies of the relevant portions of five randomly selected and ungraded exams completed by their students in their courses. As a result of this call we received responses from approximately two thirds of the mathematics instructors and one half of the statistics instructors.

For the subsequent analysis we proceeded to examine a sampling of 27 cases selected from the exam questions submitted to us. We were careful to select items from the variety of courses that were submitted. Individually and collectively we proceeded to evaluate each example of student work for evidence of accomplishment in the areas of arithmetic, algebra, geometry, data analysis and quantitative reasoning. For each area we rated a student as "yes" if there was evidence of ability in one or another of these areas; "partial" or "limited" accomplishment if there was some evidence of ability in these area; or "no" if there was no evidence of ability.

We used the following nominal definitions of each of the requisite areas of accomplishment to guide our evaluations of the student work.

6. Arithmetic: Computational fluency with numbers by being able to do the operations of arithmetic including addition, subtraction, multiplication, and division.
7. Algebra: The ability to express and re-express relationships in symbolic language and/or the ability to apply algebraic formulae appropriately.
8. Geometry: the ability to describe and interpret information presented graphically and/or spatially.
9. Data Analysis: The translation of observed information into a different representational system that includes numbers and symbols for subsequent decision-making.

10. Quantitative Reasoning: The ability to make decisions or to come to conclusions that are consistent with the information examined in the particular representational system.

We report the following findings for the cases presented (in percents):

Topic Area	YES	PARTIAL/LIMITED	NO
Arithmetic	89%	4%	7%
Algebra	69%	23%	8%
Geometry	48%	33%	19%
Data Analysis	77%	8%	15%
Quantitative Reasoning	50%	38%	13%

After completing this work, we were informed that SUNY Central asks a college to evaluate levels of accomplishment in the various sectors of the CCC program according to the this rubric: "exceeds standards", "meets standards", "approaches standards" and "not meeting standards". In the above we could easily make a conversion such that a "YES" evaluation would convert to "exceeding or meeting standards", a "PARTIAL/LIMITED" evaluation would convert to "approaches standards" and a "NO" evaluation would indicate "not meeting standards".

It is the subcommittee's thinking that this assessment could be communicated to all the instructors of CCC math/statistics courses with the intention of informing them of those areas in which strengths are manifest across all the classes and those areas in which a diminished accomplishment is apparent. It is our hope that the instructors will use this information as they teach these courses in the future to change or strengthen activities in their courses with a view to helping students meet standards in the various areas. At no time during our review or subsequent report of findings were we aware of the identity of a particular student or a particular course from which an example of student work was taken. Further it is the intention of those who complete upcoming assessment to make a generic report in which no course or instructor would be identified.

Assessment of student learning in the math/statistics will occur on a three year cycle beginning with course work completed in Fall, 2002. Towards the end of this semester, those of you teaching a CCC math/statistics course will be asked to submit to the subcommittee, five randomly selected examples of student work without identifiers of either the student or the course. It is our hope all will be willing to cooperate in this assessment activity.

CC:

DOCUMENT 3

To: Faculty teaching CCC approved Mathematics/Statistics courses

From: CCC Math/Statistics Assessment subcommittee

SUNY has adopted a three-year cycle over which the various colleges will assess the ten curricular and two competency areas of their respective General Education programs. Assessment of the Mathematics/Statistics component of General Education (Fredonia's CCC program) is to occur in the first year of this cycle, that is, during this academic year. The timetable that has been established for the timely collection, analysis and reporting of this information asks for the collection of appropriate data from students by the end of this fall semester.

Therefore we are writing to you now to ask your participation in this assessment endeavor. From previous communications and the pre-test done one-year ago, you may know we are implementing an assessment method that relies upon course embedded test questions and student responses to those questions. The questions that are necessary for this assessment of student learning are those that require students to demonstrate ability all of the following: algebra, geometry, arithmetic, data analysis and quantitative reasoning. From the pre-test we have found that one or two test questions can provide students opportunities to demonstrate their abilities in these five areas. However, you are not limited because we need evidence of ability in all five areas.

As you near the end of the semester we ask that you create your own plan to forward to us (perhaps from a final exam or last test, or some other regularly required experience) a random sample of student work on this question (or questions). Prior to your grading of this work we ask that you randomly select six examples of such student work by placing all the tests in an unordered stack and choosing every sixth test until you have chosen six. Then make photocopies of this work and forward it to us with all student, course and instructor identifiers removed. Please send all student work to either Nancy Boynton or Peter Sinden by the end of the fall semester.

In the spring semester the four of us on this subcommittee will examine and evaluate student performance on the basis of Exceeds Standards, Meeting Standards, Approaching Standards, or Not Meeting Standards (this is SUNY's rubric). The percent in each category will be calculated and forwarded to the campus CCC committee for their report and dissemination to the larger campus. If you have any questions about this procedure or any concerns, please contact any one of us on the subcommittee.

For your information, the report on last year's pre-test is attached.

On behalf of our students, we thank you for your assistance and your participation in this endeavor.

CC:

September 9, 2002

DOCUMENT 4

November 12, 2002

To: Faculty teaching CCC approved Mathematics/Statistics courses

From: CCC Math/Statistics Assessment subcommittee

This letter is to remind you of the ongoing assessment of CCC objectives for mathematic/statistics courses. Once again we are asking for your participation in this assessment endeavor.

From previous communications and the pre-test done one-year ago, you may know we are implementing an assessment method that relies upon course embedded test questions and student responses to those questions. The questions that are necessary for this assessment of student learning are those that require students to demonstrate ability all of the following: algebra, geometry, arithmetic, data analysis and quantitative reasoning. From the pre-test we have found that one or two test questions can provide students opportunities to demonstrate their abilities in these five areas. However, you are not limited because we need evidence of ability in all five areas.

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Once again, on behalf of our students, we thank you for your assistance and your participation in this endeavor.

CC:

DOCUMENT 5

Score student work, for each competency (arithmetic, algebra, geometry, data analysis, quantitative reasoning) using the following rubric:

Score 1 if the student work shows both correct understanding of the process and correct calculations.

Score 2 if the student work shows an understanding of the process but contains errors in the calculations.

Score 3 if the student work shows partial understanding of the process combined with some accuracy in the calculations.

Score 4 if the student work shows no understanding of the process and errors in the calculations.

In terms of the GEAR form:

- 1 will refer to “exceeding standards”
- 2 will refer to “meeting standards”
- 3 will refer to “approaching standards”
- 4 will refer to “not meeting standards”

