Core Assessment Report 2011-12: Mathematics

In 2011-12, Learning Objective 1.4, one of the four learning objectives pertaining to the Mathematics area of the Core, was evaluated as part of the ongoing assessment of student learning in the Core.

> ***Learning Objective 1.4:*** Demonstrate an understanding of mathematical content (including the limits to its application) that goes beyond mere fluency in using mathematical symbols, language, and formulas.

Assessment Method:

All students enrolled in Fall 2011 sections of Core Math classes were asked to sign a consent form permitting the confidential review of an assignment for the purposes of evaluating student learning in Math Core classes. Consent forms were returned from 21 of the 25 sections, with 67 percent of the students providing consent. Six students of those who gave consent were selected at random from each of the 21 sections of Core Math classes.

Faculty members teaching the Core Math classes identified problem sets or exam questions that would demonstrate student learning for LO 1.4. They submitted the assignment or test prompts and the completed, ungraded work of the sampled students. Work was received for a total of 100 students.

Four faculty members from the Mathematics and Computer Science Department met for approximately three hours during spring quarter to score the student work. The faculty members reviewed and discussed the assessment rubric and then rated two pieces of student work. The agreement of scorers on the first sample of student work was 58%. This rose to 71% for the second sample. Following each scoring, the faculty discussed the reasons for their scores to come to agreement on how to apply the rubric. Then each faculty member independently scored sets of student work. In addition, thirty-two percent of all student work submissions were scored by more than one reviewer. If different, the scores were averaged together, but in no case did the scorers differ by more than one point on the rubric.

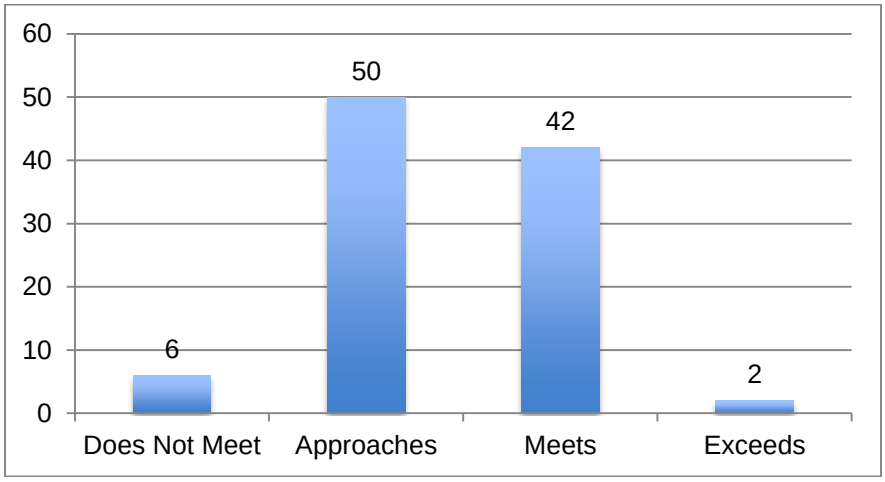
Faculty rated the student work on a 4-point rubric for the learning objective under review, with a score of "4" indicating the work exceeds expectations for student learning, "3" meets expectations, "2" approaches expectations, and "1" does not meet expectations. The faculty provided a rating for each component part of

the learning objective separately (knowledge of mathematical concepts, use of that knowledge to frame and solve the problem in an efficient and sophisticated manner, and ability to communicate a deep understanding with clarity and precision). The scorers also provided a single holistic rating for the work. If Core Math faculty members provided more than one exam question or assignments, the scorers considered multiple pieces of evidence, unless they deemed it more appropriate to select only a subset of student work. This decision was made in consultation with others.

Findings

Most student work received a "2" (n=50) or a "3" (n=42) on the rubric, indicating that it approached or met expectations in terms of demonstrating an understanding mathematical content going beyond mere fluency in using mathematical symbols, language, and formulas. The mean rubric score was 2.37, with a standard deviation of .577.

Percent of Student Work Meeting Learning Objective



There were very few differences among the scores given for the three individual components. The mean score for the first component (knowledge) was 2.33, the second component (use) was 2.35 and the third (communication) was 2.42.

Conclusion

The goal set for Core courses is for 80 percent of student work to meet or exceed the learning objective. This assessment shows that we have not reached that goal for this learning objective.

The faculty who scored the work felt that some problem sets were better aligned with the learning objective than others. Particularly, they felt that in a number of cases the problems did not ask the students to

demonstrate an understanding of mathematical content (including the limits to its application) that went beyond mere fluency in using mathematical symbols, language, and formulas. Thus, the assessment might not reflect the *actual* level of student mastery of this objective. The faculty scorers expressed interest in having future conversations about problem designs that would better reflect the goals of the type of learning represented in this learning objective. In general, follow-up discussions among faculty are one of the most important outcomes of the assessment process. They often lead to a clarification in the understanding of the learning objectives, as well as new ideas for teaching strategies and assignments that better elicit the kind of complex learning embodied by many of the Core learning objectives.

The faculty scorers also recommended that future assessments encourage faculty to choose one or at most two problems that correspond to the learning objective. Too much material submitted was found to be unwieldy. Generally, the rubric worked well as a guide for assessing student learning, though the faculty scoring seemed to think that a single holistic rating, taking into account the ideas from all three categories, would have been sufficient (rather than producing three individual scores, in addition to a holistic rating).

Over the past year, we have considered whether the aspirational goal for 80 percent of students to meet or exceed the learning objective is realistic (especially considering the often complex and multi-dimensional learning objectives). Most of the Core assessments to date have yielded results showing student learning falling between the "approaches" and "meets" levels. We now have some empirical evidence that shows that the degree of alignment of the assignment is indeed correlated with observed levels of student learning. In the most recent Core assessment of a STS learning objective, faculty scorers assessed the correspondence of the assignments or test prompts and the learning objective on a three-point scale (in addition to assessing student learning), finding that when assignments aligned well with the learning objective, student learning came much closer to the rating of "3" (showing it met the learning objective). This suggests that the target goal may be reasonable if the work provided is based on assignments framed on all dimensions of the learning objective. We welcome further thoughts on this matter from those teaching Core classes.

Core assessment involves a collaboration among the Faculty Core Committees who write the learning objectives under review, the faculty teaching Core courses who select and provide appropriate student work, SCU students who provide consent for their work to be evaluated, the faculty who participate in scoring student work, and the Office of Assessment which coordinates the assessment. We are especially grateful to the participating faculty from the Math and Computer Sciences Department for their assistance and insights.

We welcome comments and feedback on this assessment. Please contact Chris Bachen by phone (551-3000, x6607) or email (cbachen@scu.edu).

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--Core Curriculum Implementation Committee: Phyllis Brown, Eileen Elrod, Phil Kesten, Barbara Molony, Kathleen Schneider

SCU Core Curriculum **Mathematics Evaluation Rubric** **Work Sample #: _____**

Points to keep in mind when using this rubric:

1) Determine the overall evaluative score (1-4) for **each row** based on the level that best characterizes the performance demonstrated in the student work for that row. SCORES MUST BE WHOLE NUMBERS– no decimal points. Write the score in the box provided at the end of each row.
2) Determine the overall evaluative score (1-4) for this **objective** based on the level that best characterizes the performance demonstrated in the student work overall (i.e., across all rows). SCORES MUST BE WHOLE NUMBERS– no decimal points. Write the score in the box provided in the last row of the rubric.
3) Work samples were collected from different courses with differing assignments (varied formats, requirements, lengths, etc.). Because of the variation, work samples should not be compared to one another – each should be independently evaluated using this rubric. The scores for any given work sample should not be influenced by other student works already reviewed.
4) When applying this rubric to students' work samples, it is important to realize that some of the descriptors may not be addressed because they were not elicited by the course assignment. **You should determine the rubric score based on what the student has written. Do NOT adjust your score as a result of reading the assignment description!**
5) Remember you are NOT *grading* the student works as one would for a class. You are evaluating the student work based solely on the criteria that appear on this rubric.
6) Please feel free to write notes or marks on the rubric or work sample. Should it be necessary to discuss a score with a colleague, these notes can help you recall why you selected a particular overall evaluative score.

Notes:

SCU Core Curriculum **Mathematics Evaluation Rubric** **Work Sample #: _____**

LO 1.4 Demonstrate an understanding of mathematical content (including the limits to its application) that goes beyond mere fluency in using mathematical symbols, language and formulas.

	Exceeding (4)	Meeting (3)	Approaching (2)	Not Meeting (1)	Row Score
KNOWLEDGE	The student demonstrates a deep understanding of the appropriate mathematical concepts and the information necessary for the solution of the problem(s).	The student has a satisfactory understanding of the major concepts necessary for the solution of the problem(s).	The solution is not complete, indicating that the student has a limited understanding of the major concepts necessary for the solution of the problem(s).	There is no solution, or the solution has no relationship to the task indicating that the student has a little to no understanding of the major concepts necessary for the solution of the problem(s).	
USE	The student uses knowledge of mathematical concepts in an efficient and sophisticated manner to frame and solve the problem(s).	The student appropriately uses knowledge of mathematical concepts to frame and solve the problem(s).	The student demonstrates inconsistent use of mathematical concepts to frame and solve the problem, leading some way toward a solution, but not to a full solution of the problem(s).	The student demonstrates little or inappropriate use of mathematical concepts to frame and solve the problem(s).	
COMMUNICATION	Student communicates a deep understanding of mathematical concepts with clarity and precision, including appropriate use of mathematical terminology and notation in the explanation of work.	Student effectively communicates understanding of mathematical concepts including appropriate use of mathematical terminology and notation in the explanation of work.	Student struggles to communicate understanding of mathematical concepts including the inappropriate use of mathematical terminology and notation in the explanation of work.	Student is unable to communicate understanding of mathematical concepts. There is no appropriate use of mathematical terminology and notation in the explanation of work.	
WRITE OVERALL SCORE (1, 2, 3 or 4) FOR OBJECTIVE 1.4 IN THIS BOX:					

Notes: