Assessment Plan Reporting Template (APRT)
Old Dominion University
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Quantitative Reasoning (2008-09)

PART A

1.0 Definition of Terms

1.1: ***Identify the core area to be assessed.*** Competency in Quantitative Reasoning was defined by the following five skills and abilities that were assessed across the four primary courses designed to meet this General Education requirement.

1. Logical Reasoning
2. Computational Skills
3. Data Interpretation
4. Problem Solving
5. Quantitative modeling

The Mission of Old Dominion University (ODU) specifies that "every Old Dominion undergraduate student follows a general education program that is designed to develop the intellectual skills of critical thinking and problem solving and to encompass the breadth of understanding needed for personal growth and achievement and for responsible citizenship." As stated in the *Old Dominion University Undergraduate Catalog for 2006-2008*, "the general education program at Old Dominion University represents the common core of the baccalaureate degree. It prepares students for pursuing a major, for broadening their views of life, and for understanding an increasingly global and diverse world. It provides students with the basic skills and intellectual perspectives to engage in the search for knowledge. The general education program develops analytical and critical thinking skills and the ability to make reasoned judgments. Students will also discover that learning is a complex, multifaceted, and lifelong endeavor" (p. 57). All six of the SCHEV competencies are part of the general education program at ODU. One of the goals of general education is to "develop mathematical and computer literacy," which was further defined by the five outcomes stated above and defined below in 1.3.

1.2: ***Identify the criterion or criteria that indicate competency in the core area***. Students who attain the quantitative reasoning competency at Old Dominion University will pass the course and score higher on the quantitative reasoning posttest exam than the pretest exam. The pretests are diagnostic, designed to determine the math knowledge, skills, and abilities students from diverse backgrounds bring to the course. Faculty used those results to ensure that students are provided an opportunity to learn the concepts related to the five learning objectives in order to pass the posttest exam and develop quantitative reasoning ability.

1.3: ***Describe the learning objectives for the defined core area***.

1. Logical Reasoning: Students will be able to interpret sentences that contain the logical connectives "and," "or," "some," "all," and "none." They will be able to use deductive reasoning to draw conclusions from a series of statements and to identify appropriate generalizations or trends.

2. Computational Skills: Students will develop facility in the language and symbols of mathematics and will be able to perform basic calculations and operations related to the application of mathematics or statistics.

3. Data Interpretation: Students will be able to read and interpret visual displays of quantitative information such as bar graphs, line graphs, pie charts, pictographs, and tables. They will be able to use them to make predictions and draw inferences from the data.

4. Problem Solving: Students will be able to read a word problem, set up the necessary equations that describe the problem, solve these equations using basic quantitative techniques, and interpret or draw a conclusion from the solution.

5. Quantitative Modeling: Students will be able to model physical and natural phenomena and assess validity of a model, make predictions from the model, and draw conclusions based on the model.

2.0 Methodology

2.1 ***Describe the value added analytic approach being used, with reference to the Guidelines***. At the beginning of the 2008 fall semester, a pretest exam was administered to all students enrolled in one of the four math courses designed to meet general education requirements (Math for Critical Thinking, College Algebra, Precalculus, and Elementary Statistics). The questions were developed by groups of faculty within each discipline who are responsible for designing and teaching the courses. The exam items were designed to test students' knowledge and skills related to the five outcomes. At the end of the fall semester, a posttest was administered as part of the final exam. A longitudinal approach was used to measure the value added to students' quantitative reasoning ability.

2.2 ***Explain how educational experiences at the institution produce student learning and reasons for choosing the analytical approach in 2.1***. All four courses address the goals of general education and, more specifically, are designed to teach knowledge and skills related to the five outcomes. Each course uses a common textbook in each section and all are packaged with software that provides opportunities for students to work problems, and receive feedback plus further instruction. Faculty offer in-class demonstrations of solving problems and monitor the use of the software. A course embedded, pretest/posttest design was considered the best method for documenting learning in this setting.

2.3 ***Elaborate upon the expected reliability and validity of the analytical approach mentioned in 2.1.*** Content validity is assured by asking faculty within each discipline responsible for one of the four math courses to design both the course and the exam to address the five outcomes. The exam measured students' knowledge and skills relative to the five outcomes. The Undergraduate Curriculum Committee in the department was asked to assess the exam for content validity. Item analyses and reliability estimates (Cronbach's alpha) still need to be calculated and improvements made in subsequent administrations.

2.4 ***Explain generally the student population from which samples, cohorts, or groups will be drawn***. The cohort consisted of all students (first year, transfer, and continuing) enrolled in one of the four math courses during the 2008 fall semester who completed both the pretest and posttest (N=1561). As a large and diverse university, ODU attracts both first year and transfer students with diverse backgrounds that may include extensive knowledge, skills, and abilities in math or little background. Their experience may have been recent or many years ago. The requirement is that all students who do not test into a higher level math course will develop a basic level of quantitative reasoning through one of these general education courses. The quantitative reasoning assessment is part of ODU's plan to improve math performance of our students.

2.5 ***Explain the technique used for data collection with reference to the Guidelines.*** A course-embedded method was utilized for collecting data. Both the pretest and the posttest exams were administered and the data were collected within a classroom setting.

2.6 ***Describe and explain measurement strategies to be applied during the pre assessment with reference to the Guidelines***. A required pretest was administered very early in the semester to provide a baseline for students' quantitative reasoning knowledge and skills.

2.7 ***Describe and explain measurement strategies to be applied during the post assessment with reference to the Guidelines***. A posttest was administered at the end of the semester, which provided the basis for measuring value added in students' quantitative reasoning knowledge and skills.

2.8 ***Explain the nature of value added given 2.6 and 2.7.*** Value added was demonstrated by calculating difference scores between posttest and pretest assessments. Students who did not pass the course did not fulfill their general education requirement and therefore were not included in the final analysis. They must repeat the course at which time they will be tested again. Normalized gain scores were calculated for the pretest and posttest scores of all students who passed the course. Normalized gain is defined as the amount the student learned from the course (the raw gain) divided by the maximum amount she or he could have learned (as measured by the test). Normalized gain is calculated by: g = (post test score minus pretest score) / (100% minus pretest score). Normalized gain is a

statistic often used in Physics where 23% is an average score for large lecture courses and 48% is the average for smaller, more interactive courses.

2.9 ***Estimate the academic year and term that pre and post assessments will be completed for this core area.*** Pre and post assessment were conducted during fall semester 2008. Pretests were administered during the first week of classes and posttests were administered as part of the final exam.

3.0 Process evaluation

3.1 ***Describe and explain how the results will be reported to institutional units, students, and external constituents***. Quantitative reasoning assessment results will be released through the same channels all assessment results are released at Old Dominion University: via the Provost's Council, meetings and presentations at the College and department levels, and through written reports of results. In addition, the University assessment team will meet with the math faculty and assistant/associate deans to evaluate assessment results and the methodology to ensure that a reliable and valid value added assessment process is in place. The Quantitative Reasoning Report will be forwarded to SCHEV who will post it on their website.

3.2 ***Describe how the results have been and will be used to improve educational experiences and advance the mission of the college or university***. Old Dominion University participated in the Foundations of Excellence in the First College Year sponsored by the Policy Center on the First Year of College in 2006-07. Among the findings from that assessment was that math was a common challenge for many students both at Old Dominion University and across the country. In 2007-08 a university committee studied the problem in depth and made recommendations for improvement, that were implemented during 2008-09. In addition, during that time a University committee was working on revising the general education curriculum. The assessment of quantitative reasoning informed that process as well. So, the assessment of quantitative reasoning in 2008-09 flowed from an ongoing process focused on improving math. Based on the results of this assessment, faculty members in each general education math course had the opportunity to reflect on the impact of each course on students' quantitative reasoning abilities and to identify needed course-based changes to help students to meet the desired learning outcomes.

3.3 ***Estimate the costs of the proposed assessment***. ***Provide a summary of the total Direct and Indirect costs with narrative of the process.*** The original plan included providing a workshop for faculty teaching the courses to help them write reliable and valid test items for the exams (approximately $3000) and an honorarium of $1500 each to develop the exams during the summer 2008 (approximately $6,000). Although no funding was appropriated, Institutional Research and Assessment paid faculty $6000 to develop the exams. The indirect costs of the time committee members and Institutional Research and Assessment staff spent on the assessment were estimated based on a SCHEV formula using median

salaries. The indirect cost for faculty was .3 of the median associate professor in the College of Sciences plus benefits which was $26,078. Similarly, the median cost for administrative time was .30 of the median administrative faculty in assessment which was $32,174. The total estimated indirect costs were $58,252 and the total estimated direct plus indirect cost was $64,252.

3.4 ***Describe and estimate the opportunity costs incurred by assessing this core area. (Optional)***

PART B

4.0 Data Presentation

4.1 Explain any challenges to data collection, and how they were addressed.
There were no major or unusual challenges to the data collection and/or methodology.

4.2 Describe the value-added (or competency) information/data that was collected. This information should include, but is not limited to, quantitative or qualitative summaries of the differences between pre and post assessments or any performance data
Value added was demonstrated by calculating difference scores between posttest and pretest assessments. Students who did not pass the course did not fulfill their general education requirement and therefore were not included in the final analysis. Normalized gain scores were calculated for the pretest and posttest scores of all students across courses (n = 1,561). Normalized gain was defined as the amount the student learned from the course (the raw gain) divided by the maximum amount she or he could have learned (as measured by the test).

Average Pretest	Average Posttest	Average Normalized Gain
7.61	15.02	59%

The average normalized gain in Quantitative Reasoning was 59%, which indicates the amount of knowledge, skills, and abilities that students gained in quantitative reasoning during the course beyond that which they already knew. An average normalized gain of 59% is significantly greater than the average for both large lecture courses (23%) and small, interactive courses (48%).

4.3 Describe any additional evidence of value added (or competency); this might include faculty testimony, student retention, or post graduation evidence.
As a result of this methodology, the Chair of the Mathematics and Statistics Department met with the faculty teaching the lower division math and statistics courses to review the testing methodology. During the spring 2009 and summer 2009 semesters, faculty revised the tests and developed Prerequisite-Diagnostic Tests (PDT), which are administered on the first day of class. This test will assess whether or not students possess the prerequisite knowledge required for successful completion of math and statistics courses. The PDT will alert faculty to

students' weaknesses and will direct students to online tutorials and modules to help them prepare for the course and enhance their chances of success. The PDTs were implemented in fall 2009.

The PDTs are a collection of problems from prerequisite topics. The PDT for College Algebra involves basic operations, working with fractions, etc. The PDT for Precalculus I involves topics in the current College Algebra course. Tests of the PDT revealed that almost all students showed minimal retention of prerequisite basic mathematical knowledge. Out of 6 different topic areas in the PDT, many students had to go back and work through the mandatory online tutorials for all 6 areas. Even the best students had to do 4 of the online tutorials. So the PDTs in Fall 2009 revealed a fundamental inability on the part of students to retain prerequisite knowledge over the long expanse of the summer. The plus side of all this is that we have a mechanism in place now for alerting students about course expectations, and providing them with tutorials to remediate their shortcomings. Students who take these online remedial tutorials seriously, give evidence of being much better prepared to handle the course in which they enrolled.