General Education Student Learning Outcomes Assessment Report Academic Year 2009.10

Academic Affairs
Student Learning Outcomes Assessment Office

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Executive Summary

Assessment of the General Education Student Learning Outcomes at RIT is guided by the General Education Student Learning Outcomes Assessment Plan and schedule approved by RIT's Academic Senate in 2009 and can be viewed at http://www.rit.edu/academicaffairs/outcomes/media/documents/general_educataion_assessment_plan.pdf

Faculty engagement is critical to the success of designing and implementing effective assessments. RIT faculty members serve as the architects of our assessment activities and process as facilitators, consultants, reviewers, statisticians, and mentors. In addition, rubrics are created, implemented, and rated collaboratively by faculty members. Approximately 32 faculty members participated at a variety of levels in the first year of assessing the General Education Student Learning Outcomes. Refer to Appendix A for a list of participating faculty.

To ensure thoughtful planning and implementation of the General Education Assessment Plan, faculty work teams were developed based on the five General Education Student Learning Outcomes themes:

1. Communication
2. Intellectual Inquiry
3. Ethical, Social, and Global Awareness
4. Scientific, Mathematical, and Technological Literacy
5. Creativity, Innovation, and Artistic Literacy

The 2009.10 assessment work focused on the outcomes in the themes of Communication and Scientific, Mathematical, and Technological Literacy. A major and ongoing challenge of any assessment effort is to provide evidence of student learning that is credible and meaningful to a variety of stakeholders (faculty, staff, accrediting bodies). The use of multiple assessment measures begins to provide a holistic picture of student learning. Direct methods are used to examine student learning through assessing work products or authentic proxies. Indirect methods are used to identify the perception of stakeholders regarding learning or characteristics associated with learning. At RIT, assessment instruments are being reviewed and developed (e.g. course assignment rubrics, surveys) by faculty throughout the assessment process. Refer to Appendix B for the current assessment timetable.

Transparency and sharing findings is critical to the improvement of our General Education Program and student learning. One of the key elements of an effective assessment system is the communication of findings to faculty and appropriate constituent groups on an annual basis. RIT's goal is to communicate the results of the assessment to appropriate audiences in an objective, understandable, fair, and timely manner. Based on the results of these assessments, appropriate actions are taken to improve the General Education Program at RIT.

Progress on Student Learning Outcomes Achievement 2009.10

Outcome Themes	Outcome	Performance Benchmark	Results
Communication	Revise and Improve Written and Visual Products	100% of students will demonstrate some form of revision intended to improve writing products.	Met (99.5%)
		Benchmark Established as a Result of Assessment	
		70% of students will use revision to use source information to support claims or thesis.	
		70% of students will use revision to address errors in editing and mechanics.	
		55% of students will use revision to improve organizational structure.	
		30% of students will use revision to show increased complexity of thought and audience awareness.	
	Express themselves effectively in common college-level written forms using standard American English	Graduating students will indicate RIT has helped them "quite a bit" in the area of writing clearly and effectively (mean score of 3 on a 4 point scale on NSSE).	Not Met (2.8)
Scientific, Mathematical, Technical Literacy	Explain basic principles and concepts of one of the natural sciences	The majority (more than 50%) of students will demonstrate a mid-developing to competent rating of 2.5-3.0 on a 4 point scale using holistic rubric.	Course 1 Biology Met (2.6) Course 2 Physics Met (3.0)
	Apply methods of scientific inquiry and problem solving to contemporary issues	The majority (more than 50%) of students will demonstrate a mid-developing to competent rating of 2.5-3.0 on a 4 point scale using holistic rubric.	Course 1 Biology Met (2.65)
	Comprehend and evaluate mathematical and statistical information	The majority (more than 50%) of students will demonstrate a mid-developing to competent rating of 2.5-3.0 on a 4 point scale using holistic rubric.	Math Course 1 Not Met (2.0) Math Course 2 Met (3.3)
	Perform college-level mathematical operations on quantitative data	The majority (more than 50%) of students will demonstrate a mid-developing to competent rating of 2.5-3.0 on a 4 point scale using holistic rubric.	Math Course Not Met (2.0) Physics Course Met (3.0 or higher)
	Describe the potential and limitations of technology	Not established	Not available
	Use appropriate technology to achieve desired outcomes	Graduating students will indicate RIT has helped them "quite a bit" in the area of using computing and technology (mean score of 3 on a 4 point scale on NSSE).	Exceeded (3.41)

Overall Recommendations and Next Steps

Recommendations and next steps by Student Learning Outcome (SLO) are provided in the full report. A summary of the recommendations is provided below.

Recommendations

1. Refine General Education Student Learning Outcomes based on student achievement results and faculty feedback from the assessment process as follows:

Communication

- Remove "visual products" from SLO: *Revise and Improve Written and Visual Products.* These types of products lend themselves to separate types of assessments.
  Refined SLO - *Revise and Improve Written Products.*
- Incorporate "visual products" into assessment of another SLO: *Express themselves effectively in presentations, either in spoken standard American English or sign language.*
- Revise SLO: *Express themselves effectively in common college-level written forms using standard American English* to make language parallel to other SLO's.
  Refined SLO: *Express oneself effectively in common college-level written forms using standard American English*.

Scientific, Mathematical, and Technological Literacy

- Modify SLO: *Comprehend and evaluate mathematical and statistical information.* Substitute "or" in place of "and" to broaden and provide more flexibility in learning and assessing the outcome.
  Refined SLO: *Comprehend and evaluate mathematical or statistical information.*
- Assess *Describe the Potential and Limitations of Technology* in the First Year Seminar Course rather than discipline-specific courses which have wide and varying definitions and uses of technology.
- Review where the SLO: *Use appropriate technology to achieve desired outcomes* is assessed as it was determined this SLO belongs at the program level due to the varying uses of technology by discipline. Review other options for this SLO which could be refined to focus on using technology for information literacy and be included in the First Year Seminar.

Ethical, Social, and Global Awareness

- Recommend removing the word "stakeholder" from the following SLO: *Identify contemporary ethical questions and relevant stakeholder positions.*
  Refined SLO – *Identify contemporary ethical questions and relevant positions.*

2. Given the new General Education Framework and Semester Conversion initiative, revise assessment timetable to provide additional time for increased planning and greater use of direct assessment measures. Refer to Appendix C for revised assessment timeline.

3. Review all assessment data with faculty to further determine what we have learned about student achievement.

4. Implement curriculum, instructional, and assessment recommendations as articulated in the full report.

Next Steps

1. With support from the Student Learning Outcomes Assessment Office in summer 2011, conduct a further review and analyses of the findings and use of results with the faculty who piloted the assessment and the original Scientific, Mathematical, and Technological Literacy Faculty Team.

2. Provide faculty development opportunities throughout the various stages of assessment process (beginning, implementation, interpretation of results, understanding how to use results to make improvement).

3. Discuss, implement, and iterate a common, consistent assessment approach in Science and Math courses.

4. Review all rubrics and refine as indicated by faculty recommendations.

5. Continue to balance direct and indirect assessment in order to sustain the implementation and provide meaningful data.

6. Continue to explore new ways to assess student learning.

7. Disseminate General Education Student Learning Outcomes findings and recommendations to colleges, departments, governance groups, and Board of Trustees.

8. Implement Intellectual Inquiry and Ethical, Social, and Global Awareness General Education Faculty Team plans in fall quarter 2011.

I. Implementation of the General Education Assessment Plan

Rochester Institute of Technology's (RIT) General Education Program is designed to provide students with a rigorous, engaging, and purposeful liberal education experience. The skills and knowledge derived from General Education and the individual program major are integrated into an effective undergraduate education. The General Education Program enriches the lives of the students as they acquire the knowledge, skills, and competencies to be successful in their chosen fields and as lifelong learners.

II. General Education Assessment: Phase 1

RIT is committed to comprehensive, systematic, and meaningful assessment practices. Outcomes assessment is more than the collection of data, and in order for our assessment system to work RIT must be purposeful about the information that is collected. After the data are collected, they must be examined and used to make improvements or changes.

The following General Education Student Learning Outcomes were part of the first year cycle of assessment (AY 2009.10):

Communication Outcomes:

- Express themselves effectively in common college-level written forms using standard American English
- Revise and improve written and visual products

Scientific, Mathematical, and Technological Literacy (SMTL) Outcomes:

- Explain basic principles and concepts of one of the natural sciences
- Apply methods of scientific inquiry and problem solving to contemporary issues
- Comprehend and evaluate mathematical and statistical information
- Perform college-level mathematical operations on quantitative data
- Describe the potential and the limitations of technology
- Use appropriate technology to achieve desired outcomes

III. Support for General Education Assessment

The General Education Committee (GEC) was established in December 2009 by the Academic Senate to study the general education curriculum and general education course proposals from a university-wide perspective and maintain appropriate inter-college relationships with regard to general education matters. The ongoing charge to the committee is to: assure that there is on-going monitoring and assessment of the general education curriculum; assure that there is an on-going review of the general education curriculum to determine any need for modification; consult with the ICC regarding procedures needed to initiate, review and approve a curriculum modification proposal; review proposed courses for inclusion in the general education curriculum; assure the maintenance and up-keep of a database of courses that are included as general education. A new General Education Framework was proposed and approved in

November 2010. For further information on the GEC please use the following link: http://www.rit.edu/academicaffairs/outcomes/gec.php.

The Student Learning Outcomes Assessment (SLOA) Office purchased TaskStream's Assessment Management System (AMS) in June 2010. The primary goal for the AMS initiative is to provide a technical solution to help showcase how RIT is meeting its goals and engaging in the process of continuous improvement at all levels of the institution as well as collecting General Education Student Learning Outcomes Assessment data. The SLOA office hired an AMS Coordinator who will maintain the General Education Program site and provide annual reports. This new integrated database supports the efficient collection and analyses of data on student learning outcomes. The database is totally functional and data will be entered for the initial year 2009.10. By improving the use of technology, the data collection, analysis, and reporting will become increasingly more efficient and effective.

IV. Key Findings and Use of Results

Summary of Key Findings 2009.10 General Education Student Learning Outcomes

For each General Education Student Learning Outcome assessed in 2009-10, the following information is provided: Identified Student Learning Outcome, Benchmark, Assessment Method, Key Findings, Use of Results, and Recommendations/Next Steps.

In order to determine how well our students did, we identified benchmarks to compare the achievement level against. Setting benchmarks helps determine what the data means and helps guide the use of the results. Below is a table outlining the progress to date on the eight outcomes that were measured in 2009.10. Faculty determined that mid-developing to competent was an appropriate benchmark for the course embedded assessments. The NSSE benchmarks were developed based on selected peer comparisons.

As this is a pilot of all developed rubrics, they will be regularly evaluated by faculty (content experts) to obtain suggestions for modifications. The rubrics are representative and provide good coverage of important general education knowledge and skills. The rubrics are designed to address the knowledge and skills that directly relate to the general education student learning outcomes. Reliability will be developed over time. The rubrics will continue to be assessed to ensure they include clear criteria, and relevance-appropriate knowledge and skills for general education.

1. Communication Outcome: Revise and Improve Written Products

Benchmark: As a first-time assessment of the formally established General Education Student Learning Outcomes, one of the goals for *Revise and Improve Written Products* was to determine the level and type of revision that students use in the writing process. The chart below identifies the overall benchmark for using revision to improve written products and the established benchmarks based on the data collected and analyzed.

Benchmark	**Result**
100% of students will demonstrate some form of revision intended to improve writing products.	Met (99.5%)
Performance Goal	**Benchmark Established as a Result of Year 1 Assessment**
Use revision to use source information to support claims or thesis.	70%
Use revision to address errors in editing and mechanics.	70%
Use revision to improve organizational structure.	55%
Use revision to show increased complexity of thought and audience awareness.	30%

Assessment Method

Portfolio Collection—at the end of the fall and winter terms, over 200 portfolios of student writing were collected from students enrolled in Writing Seminar: 119 portfolios from 40 sections in fall; and 117 portfolios from 39 sections in winter. Given the course enrollments, the random sample of portfolios amounted to 16% of the entire course enrollment during fall and winter. After removing those portfolios that did not offer multiple drafts for analysis, and for which no revision and no improvements were observed, the final collection consisted of 174 portfolios, representing 11.6% of the students enrolled in Writing Seminar. This sample size is adequate in that it gives us a baseline understanding of revision in the writing process. Faculty collected a portfolio of written work consisting of drafts of the "documented research essay" which is often the third of the three formal essays assigned in Writing Seminar.

Scoring Guide— during the initial meeting of the Communication Team, members drafted a preliminary list of criteria for assessing the revisions students made to improve their essay drafts. That list served as the basis for the creation of a scoring guide to assess the revisions students completed in order to improve their written drafts. Because of the relationship between peer and instructor feedback to revisions made, a review of literature was conducted to create a second list of types of feedback students receive which motivate revision. Finally, a third list of revision activities that faculty designed for students in the Writing Seminar course was generated. This last list was not used in the final draft of the scoring guide, but rather was included in a student survey that became the cover letter for those portfolios collected during the winter quarter.

The final draft of the scoring guide, the result of numerous revisions based on faculty use and feedback, focused on the revisions students made in order to improve their written work. Please refer to Appendix D. As indicated above, the list of criteria for assessing revision was also used in the student survey, as was the

list of revision activities used by program faculty. The final drafts of both the scoring guide and the student survey are included in the appendices. Please refer to Appendices D and E.

Summary of Key Findings

Types of Revision

The most frequent types of revision addressed changes in editing and mechanics:

- Source information was added, removed, or modified to support claim/thesis (67%)
- Copyediting that reduced distracting errors in spelling, punctuation grammar, and format (67%)

The least frequent types of revision addressed issues of complexity:

- Implications and/or questions articulated showing increased complexity of thought and audience awareness (26%)
- Multiple or alternative perspectives are considered showing increased complexity of thought and audience awareness (30%)

Other Findings (Refer to Appendix F for Additional Data Tables)

- Although the average revision grades and average essay grades were the same for the entire collection of student work (2.8 on a 4.0 scale), the higher the revision grade received the higher the essay grade. For the data tables please refer to Appendix E.
- 92% of students reported having peer response in their classes, and 100% of faculty reported routinely asking students to participate in peer response; yet, instructor feedback (67%) was seen as leading to more significant review than peer response (9%).
- 60% of revisions only occurred where comments were written locally on the page.

Use of Results (Curriculum, Instruction, Assessment, and Other)

- Develop pedagogical strategies to integrate and incorporate revision processes in writing instruction.
- Develop two workshops to develop specific commenting strategies on what faculty value and that facilitate the improvements in writing.
- During Writing Seminar Program Meetings, these results will be used to focus conversations on what faculty value in feedback and how to benchmark the achievement of the General Education Student Learning Outcome within the Writing Program as well as program-level improvements in terms of curriculum and instruction.

Recommendations/Next Steps

Based upon these findings, the following recommendations are made:

1. Conduct student focus groups – In order to understand better what students think about revisions and making decisions about how to improve their writing, focus groups and individual interviews should be conducted with students.

2. Develop and implement a faculty survey – In order to understand better the pedagogical activities faculty use within their classes and the beliefs and values that generate those activities, a separate

survey should be designed and distributed to all faculty teaching Writing Seminar and writing intensive courses.

3. Design a follow-up assessment – In two years (2013.14), after the discussions among faculty have occurred and revision practices developed, we should repeat this assessment.

4. Continue the assessment of revision. With the approval of the Writing Across the Curriculum program, which includes three required "writing intensive" (WI) courses, a similar assessment of student revision should be conducted in the near future. All WI courses require revision opportunities.

5. Review and discuss the following questions and consider areas of improvement generated from these results:
   - Do faculty in the program value mechanical and grammatical correctness over complexity of thought?
   - How are faculty working and talking with students about developing the complexity of their thinking?
   - How are students thinking about organizational issues in their writing? For example, they seem to complete revisions focused on organization more often than they are being directed to do so.
   - In what ways do the different kinds of revisions improve the essay?
   - What kind of feedback are peers giving? What are authors doing with peer feedback? How are students taught to provide feedback and how are they taught to use feedback?

2. Communication Outcome: Express Themselves Effectively in Common College-Level Written Forms Using Standard American English

During the 2009.10 cycle, indirect assessment was used to measure this particular outcome. The National Survey of Student Engagement (NSSE) provides an opportunity to measure this outcome. NSSE questions focus on the level of student engagement (not student satisfaction) and the survey is administered to freshmen and seniors every other year.

Benchmark: Graduating students will indicate RIT has helped them "quite a bit" in the area of writing clearly and effectively (mean score of 3 on a 4 point scale on NSSE).

Assessment Method

NSSE includes a bank of questions that focus on *Academic and Intellectual Experiences.* One question in particular relates to effective writing and was used to compare RIT students' responses to the responses of students at other colleges and universities. The questions was, *To what extent has your experience at this institution contributed to your knowledge, skills, and personal development in the area of writing clearly and effectively?*

We hope in the future to validate these initial findings by linking NSSE results to other means of direct assessment at RIT through assessment conducted in writing intensive courses which will comprise RIT's new Writing Across the Curriculum Program.

NSSE uses the following scale: 1=Very little, 2= Some, 3 = Quite a bit, 4= Very Much

Survey Year		RIT Mean	Selected Peers Mean	Sig	Effect Size	Carnegie Class Mean	Sig	Effect Size	Selected Peers II Mean	Sig	Effect Size
2007	FY	2.59	2.77	***	-.21	3.00	***	-.49	2.79	***	-.23
	SR	2.76	2.82		-.07	3.09	***	-.38	2.91	***	-.17
2009	FY	2.60	2.78	***	-.19	3.06	***	-.55	2.93	***	-.37
	SR	2.80	2.94	***	-.16	3.14	***	-.40	3.04	***	-.27

Summary of Key Findings

NSSE Question: "To what extent the experience at this institution contributed to knowledge, skills, and personal development in the area of writing clearly and effectively."

- Between 2007 and 2009, RIT mean score for freshmen and senior respondents slightly increased as follows: Freshmen 2.59-2.60 and Seniors 2.76-2.80.
- RIT lags behind its comparison groups for both years at both survey points (freshmen and senior)

Note: Items with mean differences that are larger than would be expected by chance alone are noted with three asterisks (***) to indicate a significance level of $p<.001$. The smaller the significance level the smaller the likelihood that the difference is due to chance. The effect size indicates practical significance of the mean difference. An effect size of .2 is considered small. A negative sign indicates that RIT lags behind the comparison group.

For descriptions of comparison groups, please refer to Appendix K.

Use of Results (Curriculum, Instruction, Assessment, and Other)

- Continue to review and monitor NSSE data to determine trends or patterns.
- Compare data post implementation of writing across the curriculum and intensive writing initiatives (in 2013) to determine if expected levels of RIT contribution to writing clearly and effectively increased to a mean score of 3.0 or higher.

Recommendations/Next Steps

1. Share data campus-wide on an annual basis.

2. Further direct assessment of this goal will be built into RIT's new Writing Across the Curriculum Program.

3. Scientific, Mathematical, and Technical Literacy Outcome: Explain Basic Principles and Concepts of One of the Natural Sciences

Benchmark: The majority (more than 50%) of students will demonstrate a mid-developing to competent rating of 2.5-3.0 on a 4 point scale using holistic rubric.

Assessment Method: Biology and Physics
Faculty determined which course-embedded assignments mapped to this particular outcome and then used a holistic rubric (Refer to Appendix G) developed by a faculty team to determine at what level students were achieving the outcome. Faculty assessed the outcome multiple times within the course. Within the Biology and Physics course, faculty assessed the student learning outcome multiple times using selected assignments such as: homework, exams, quizzes, and online activities. Faculty members piloted the rubric in their classes to assess the achievement level: beginning (1), developing (2), competent (3), and exemplary (4) of the students on various course-embedded assignments as well as to test the process and rubric.

Summary of Key Findings (Refer to Appendix G for additional information)

Biology
- Overall student achievement level on all assignments and exams is 2.6 which indicates a skill that is "developing."

The overall finding is based on a holistic rubric that looked at student performance on a variety of assignments. Department faculty may want to unbundle or view each of the individual assignments as a separate unit of reference in order to determine if the results suggest potential changes in pedagogy, assessment strategies, or course outcomes. Below, findings are broken down by type of assignment:
  - Student achievement on all homework assignments, quizzes, and online activities was an average of 2.9 (developing).
  - Student achievement was highest on the on-line activity #1 at 4.0 (exemplary)
  - Student achievement was lowest on Exam 2 with a 2.44 (developing).
  - Student achievement was within a range of 2.47-2.81 (developing) on all exams.

Physics
- Overall, the majority of students achieved at a level of competent or exemplary (3.0-4.0).

Use of Results (Curriculum, Instruction, Assessment, and Other)
- Use findings to guide the course instructor and the department in the development of courses to address the needs of students. This would best be achieved by the presentation of results to a College Curriculum Committee by the Faculty.
- At year-end, collate and combine reports into a global data set. Results should be combined in the aggregate, but also reported on a course-by-course (not section-by-section) basis, to be reported back to each department.

- Examine trends in the "beginning" level of the scale. Trends should be shared with instructors and curriculum committees. Results should be tracked on an ongoing basis to serve as a baseline for future efforts.

Recommendations/Next Steps

1. Compare results presented herein to similar science classes in the General Education curriculum. Without this "big picture" type of approach, it is difficult to determine if the students truly are struggling in a particular course (i.e. Key Findings: "Overall, students achieved the outcome at a satisfactory level"), or if the students are struggling with all of the General Education science courses.

2. Engage faculty in continuing this assessment on their own to monitor student performance and course progress over several years. This "snap shot" of the course is insightful but not representative of what could truly be taken away from this opportunity/experience in General Education assessment.

3. At year end, collate and combine reports into a global data set. Results should be combined in the aggregate, but also reported on a course-by-course basis, to be reported back to each department.

4. The General Education faculty should meet to review the results of these assessments and workshops to discuss ways in which to improve the learning comprehension of the students in these courses. If they are indeed required General Education courses, there is some level of comprehension that should be achieved to consider the student as having received "General Education."

5. Examine trends in the "beginning" category. Trends will be shared with instructors and curriculum committees. Results will be tracked on an ongoing basis and serve as a baseline for future efforts.

6. With support from the Student Learning Outcomes Assessment Office, a further review and analyses of the findings will be done in summer 2011 with the faculty who piloted the assessment and the original Scientific, Mathematical, and Technological Literacy Faculty Team to determine any refinements or improvements to curriculum, instruction, or assessment.

4. Scientific, Mathematical, and Technical Literacy Outcome: Apply Methods of Scientific Inquiry and Problem Solving to Contemporary Issues

Benchmark: The majority (more than 50%) of students will demonstrate a mid-developing to competent rating of 2.5-3.0 on a 4 point scale using holistic rubric.

Assessment Method

The process included developing and piloting a general, holistic rubric (Refer to Appendix H) in a biology lab course to assess the level of student achievement. Faculty determined which course-embedded assignments mapped to the outcome and then used the rubric to determine at what level students were achieving the outcome: beginning (1), developing (2), competent (3), and exemplary (4). Faculty assessed the outcome multiple times within the course and selected assignments including: exams, lab reports, homework, and quizzes.

Summary of Key Findings (Refer to Appendix H for additional information)

- Overall, students achieved between 2.28-3.57 score which indicates a developing and competent range on the student learning outcome with an average of 2.65.

The overall finding is based on a holistic rubric that looked at student performance on a variety of assignments. Department faculty may want to unbundle or view each of the individual assignments as a separate unit of reference in order to determine if the results suggest potential changes in pedagogy, assessment strategies, or course outcomes. Below, findings are broken down by type of assignment:

  - The student average was the highest (3.57) on the first quiz and the student average was the lowest on homework assignment #2 (2.28).
  - Faculty did not predetermine benchmarks, but overall, the faculty member felt the findings were consistent with a course that includes both science majors and non-science majors.
  - The student average on the Lab Report (2.66), indicates that the students are only "developing" in their writing skills.

Use of Results (Curriculum, Instruction, Assessment and Other)

- Use results of findings to guide the course instructor and the department in the development of courses to address the needs of students. As this course is a co-requisite of the lecture course, it is imperative that the needs of the students are being met in the most consistent ways between the two courses. The students, in general, should not be excelling in lab and not lecture, and vice versa.
- Secondarily assess the students' writing skills (given the 2.66 average on the Lab Report). This course assessment supports the theories of science educators in recent years that students simply cannot convey information in the written form, and it is very probable that their grades and learning comprehension are suffering because of this.
- At year-end, collate and combine reports into a global data set. Results should be combined in the aggregate, but also reported on a course-by-course (not section-by-section) basis, to be reported back to each department.
- Examine trends in the "beginning" category. Trends should be shared with instructors and curriculum committees. Results should be tracked on an ongoing basis to serve as a baseline for future efforts.

Recommendations/Next Steps

1. Compare results presented herein to similar science classes in the General Education curriculum. Without this "big picture" type of approach, it is difficult to determine if the students truly are struggling in a particular course (i.e. Key Findings: "Overall, students achieved the outcome at a satisfactory level"), or if the students are struggling with all of the General Education science courses.

2. Engage faculty in continuing this assessment on their own to monitor student performance and course progress over several years. This "snap shot" of the course is insightful, but not representative of what could truly be taken away from this opportunity/experience in General Education assessment.

3. The General Education faculty will discuss the results of these assessments and workshop ways in which to improve the learning comprehension of the students in these courses. If they are indeed required General Education courses, there is some level of comprehension that should be achieved to consider the student as having received "General Education."

4. With support from the Student Learning Outcomes Assessment Office, a further review and analyses of the findings will be done in summer 2011 with the faculty who piloted the assessment and the original Scientific, Mathematical, and Technological Literacy Faculty Team to determine refinements to curriculum, instruction, or assessment.

5. Scientific, Mathematical, and Technical Literacy Outcome: Comprehend and Evaluate Mathematical and Statistical Information

Benchmark: The majority (more than 50%) of students will demonstrate a mid-developing to competent rating of 2.5-3.0 on a 4 point scale using holistic rubric.

Assessment Method

Faculty determined which course-embedded assignments mapped to the selected student learning outcome and then used a holistic rubric (Refer to Appendix I) to determine at what level students were achieving the outcome. The process included piloting the rubric for use in multiple math courses with different assignments to assess the level of achievements: beginning (1), developing (2), competent (3), and exemplary (4). Faculty assessed the outcome multiple times within the courses.

Summary of Key Findings (Refer to Appendix I for additional information)

Math Course 1

- 2 (developing) was the average rating for the class
- 49.9% of students were assigned rank 1 (beginning)
- 6.0% of students were assigned rank 2 (developing)
- 13.2% of students were assigned rank 3 (competent)
- 30.8% of students were assigned rank 4 (exemplary)

- Two sections of Calculus B were "trailer sections" (the students were not on sequence which means they did not follow the course in the prescribed order); the student success rate is low.

Math Course 2

- 3.3. (competent) was the class average on questions related to achievement of outcome
- Class course average was an 85.8
- Student learning outcome was a good match to course
- Helped focus faculty on outcomes for course

Use of Results (Curriculum, Instruction, Assessment, and Other)

- At year-end, collate and combine reports into a global data set. Results should be combined in the aggregate, but also reported on a course-by-course (not section-by-section) basis, to be reported back to each department.
- Examine trends in the "beginning" category. Trends will be shared with instructors and curriculum committees. Results should be tracked on an ongoing basis to serve as a baseline for future efforts.

Recommendations /Next Steps

1. Review with faculty the expectations to unify the process and methods for assessment for the student learning outcomes using course-embedded assignments.

2. Revisit the scale on the rubric to include an additional level of 0 which would indicate no level of understanding at all.

3. Norm raters across sections if using the same rubric.

4. It may be difficult to determine how each professor may categorize/align their questions to the student learning outcome.

5. Professors may find different methods for ranking students based on their own methods for assessing their students' progress.

6. A specific set of expectations should be decided by each team (departmentally) before beginning the assessment. It will be extremely important to unify the methods for assessment among learning outcomes.

7. With support from the Student Learning Outcomes Assessment Office, a further review and analyses of the findings will be done in summer 2011 with the faculty who piloted the assessment and the original Scientific, Mathematical, and Technological Literacy Faculty Team.

6. Scientific, Mathematical, and Technical Literacy Outcome: Perform College-level Mathematical Operations on Quantitative Data

Benchmark: The majority (more than 50%) of students will demonstrate a mid-developing to competent rating of 2.5-3.0 on a 4 point scale using holistic rubric.

Assessment Method

The process included piloting the general, holistic rubric for use in multiple courses with different assignments to assess the level of achievement. Faculty assessed the outcome multiple times within the course. Faculty reported the raw scores as well as the aggregate scores. **Math and Physics** courses were selected to pilot the assessment of the student learning outcome.

Summary of Key Findings (Refer to Appendix J for additional information)

Math Course

- Students achieved an average rating of 2 (developing).

The overall finding is based on a holistic rubric that looked at student performance on a variety of assignments. Department faculty may want to unbundle or view each of the individual assignments as a separate unit of reference in order to determine if the results suggest potential changes in pedagogy, assessment strategies, or course outcomes. Below, findings are broken down by ranking:

- 40.9% of students were assigned to rank 1 (beginning) and 45.4% was the average rating
- 6.0% of students were assigned to rank 2 (developing) as was the average rating
- 15% of students were assigned to rank 3 (competent) and 14.1% was the average rating
- 38.1% of students were assigned to rank 4 (exemplary) and 34.5% was the average rating
- Two sections were "trailer sections" (the students were not on sequence); the student success rate seemed low

Physics Course

- Overall, the majority of students achieved at a level of exemplary (3.0-4.0).

Use of Results (Curriculum, Instruction, Assessment, and Other)

- At year-end, collate and combine reports into a global data set. Results should be combined in the aggregate but also reported on a course-by-course (but not section-by-section) basis, to be reported back to each department.
- Examine trends in the "beginning" category. Trends should be shared with instructors and curriculum committees. Results will be tracked on an ongoing basis to serve as a baseline for future efforts.

Recommendations/Next Steps

1. Review test questions if more than 5% of students were not able to answer (Physics specific).

2. A specific set of expectations should be decided by each team (departmentally) before beginning the assessment. It will be extremely important to unify the methods for assessment among student learning outcomes.
   - It may be difficult to determine how professors categorize/align their questions to the student learning outcome.
   - Professors may find different methods for ranking students based on their own methods for assessing their students' progress.

3. Norm raters across sections if using the same rubric.

4. With support from the Student Learning Outcomes Assessment Office, a further review and analyses of the findings will be done in summer 2011 with the faculty who piloted the assessment and the original Scientific, Mathematical, and Technological Literacy Faculty Team.

7. Scientific, Mathematical, and Technical Literacy Outcome: Describe the Potential and the Limitations of Technology

Benchmark: Not Established

Method of Assessment
Faculty determined that this outcome was more appropriately assessed and measured at the program level or First Year Seminar. The General Education Committee (GEC) proposed this as a student learning outcome in the First Year Seminar course to be implemented in 2013 in the semester model. The outcome and method of assessment will be developed with the GEC and the First Year Seminar faculty.

Key Findings and Use of Results - Not Applicable

Recommendations/Next Steps
1. Review outcome to determine any refinements and best opportunity for assessment.

8. Scientific, Mathematical, and Technological Literacy Outcome: Use Appropriate Technology to Achieve Desired Outcomes

Benchmark: Graduating students will indicate RIT has helped them "quite a bit" in the area of computing and technology (mean score of 3 on a 4 point scale on NSSE).

Assessment Method

The General Education Faculty Team determined that this student learning outcome was more appropriately assessed and measured at the program level as every discipline uses varying types of computing and information technology. An indirect method of assessing the outcome on a more general scale is the use of the NSSE data. NSSE includes a bank of questions related to *Academic and Intellectual Experiences* with one question, *To what extent has your experience at this institution contributed to your knowledge, skills, and personal development in the following areas?* This question is focused on using computing and information technology and can be used to compare RIT students' responses to students' responses at other colleges and universities.

Summary of Key Findings

NSSE Question: "To what extent the experience at this institution contributed to knowledge, skills, and personal development in the area of using computing and technology."

NSSE Scale: 1=very little, 2=some, 3=quite a bit, 4=very much

Survey Year		RIT Mean	Selected Peers Mean	Sig	Effect Size	Carnegie Class Mean	Sig	Effect Size	Selected Peers II Mean	Sig	Effect Size
2007	FY	3.40	3.11	***	.30	2.99	***	.46	3.17	***	.26
	SR	3.50	3.22	***	.31	3.18	***	.37	3.33	***	.21
2009	FY	3.32	3.26	*	.08	3.03	***	.33	3.17	***	.17
	SR	3.41	3.40		.01	3.23	***	.22	3.26	***	.18

- RIT mean (weighted arithmetic average of student responses) increased between freshmen and senior years in both 2007 to 2009 survey results.
- RIT scores are higher than all comparison groups in 2007. An effect size of .2 is considered small.
- Although RIT's mean decreased from 2007 to 2009, RIT's mean improved in 2009 compared to all peers means.

Use of Results

- Continue to review and monitor NSSE data to determine trends or patterns.
- Compare data post implementation of semester model in 2013.

Recommendations/Next Steps

1. Share data with General Education Committee on an annual basis.

2. Review outcome to determine if use of technology for information literacy is more appropriate to General Education Outcome.

Appendix A: Participating Faculty Members

Peter Cardegna, Associate Department Head and Professor, Physics Department, College of Science
Sandi Connelly, Assistant Professor, Biological Sciences, College of Science
Breandan Connor, Adjunct Professor, English Department, College of Liberal Arts
Linda Coppola, Library Liaison, College of Liberal Arts/Wallace Center
Rebecca Dagger, Senior Lecturer, School of Mathematical Sciences, College of Science
Paul Desormeaux, Adjunct Faculty, English Department, College of Liberal Arts
Babak Elahi, Associate Dean, College of Liberal Arts
Josh Faber, Assistant Professor, School of Mathematical Sciences, College of Science
Suzanne Graney, Associate Professor, Psychology, College of Liberal Arts
Lauren Hall, Assistant Professor, Political Science, College of Liberal Arts
Elizabeth Hane, Associate Professor, Biological Sciences Department College of Science
Lisa Hermsen, Associate Professor, English Department, College of Liberal Arts
Ron Jodoin, Professor, Physics Department, College of Science
Julie Johannes, Instructional Faculty, English Department, College of Liberal
Joel Kastner, Professor**,** Imaging Sciences, College of Science
Carl Lutzer, Associate Professor, Assistant Head, School of Mathematical Sciences, College of Science
David Martins, Assistant Professor and Writing Director, English Department, College of Liberal Arts
Douglas Merrill, Professor, Biological Sciences, College of Science
Chris O'Dea, Associate Professor, Physics**,** College of Science
Bruce L. Oliver, Professor, Accounting**,** Saunders College of Business
Deana Olles, Lecturer, School of Mathematical Sciences, College of Science
Bobby Pelfrey Adjunct Professor, English Department, College of Liberal
Andy Perry, Writing Instructor, Program Coordinator, Student Affairs
Linda Rubel, Instructional/Support Faculty, Liberal Studies, College of Liberal Arts
Richard Santana, Professor and Department Chair, English, College of Liberal Arts
Elena Sommers, Instructional Faculty, English Department, College of Liberal
Sean Sutton, Assistant Professor and Chair, Political Science**,** College of Liberal Arts
Paulette Swartzfager, Adjunct Faculty, English Department, College of Liberal
Helen Timberlake, Senior Lecturer, School of Mathematical Sciences, College of Science
Larry Torcello, Visiting Assistant Professor, Philosophy, College of Liberal Arts
Rose Marie Toscano, Instructional/Support Faculty, English Department, College of Liberal

Appendix B: General Education Student Learning Outcomes Assessment Schedule

Rochester Institute of Technology General Education Student Learning Outcomes Assessment Plan (3 Year)				
General Education Learning Outcome	**Student Learning Outcome**	**2009.2010 Assessment**	**2010.2011 Assessment**	**2011.2012 Assessment**
Communication	Express themselves effectively in common college-level written forms using standard American English	✓		✓
	Revise and improve written and visual products	✓		✓
	Express themselves effectively in presentations, either in spoken standard American English or sign language (American Sign Language or English-based Signing)		✓	
	Comprehend information accessed through reading and discussion		✓	
Intellectual Inquiry	Review, assess, and draw conclusions about hypotheses or theories		✓	
	Analyze arguments, in relation to their premises, assumptions, contexts, and conclusions		✓	
	Construct logical and reasonable arguments that include anticipation of counterarguments			✓
	Use relevant evidence gathered through accepted scholarly methods and properly acknowledge sources of information			✓
Ethical, Social, and Global Awareness	Analyze similarities and differences in human experiences and consequent perspectives		✓	
	Examine connections among the world's populations		✓	
	Identify contemporary ethical questions and relevant positions			✓
Scientific, Mathematical, and Technological Literacy	Explain basic principles and concepts of one of the natural sciences	✓		
	Apply methods of scientific inquiry and problem solving to contemporary issues	✓		
	Comprehend and evaluate mathematical and statistical information	✓		
	Perform college-level mathematical operations on quantitative data	✓		
	Describe the potential and the limitations of technology	✓		
	Use appropriate technology to achieve desired outcomes	✓		
Creativity, Innovation, and Artistic Literacy	Demonstrate creative/innovative approaches to course-based assignments or projects		✓	
	Interpret and evaluate artistic expression considering the cultural context in which it was created			✓

Appendix C: General Education Student Learning Outcomes Assessment Revised Schedule

Rochester Institute of Technology- General Education Student Learning Outcomes Assessment Plan (5 Year)						
Theme	**Student Learning Outcome**	**2009.2010 Assessment**	**2010.2011 Assessment**	**2011.2012 Assessment**	**2012.13 Assessment**	**2013.14 Assessment**
Communication	Express oneself effectively in common college-level written forms using standard American English	✓				
	Revise and improve written products	✓				
	Express oneself effectively in presentations, either in spoken standard American English or sign language (ASL or English-based Signing)					✓
	Comprehend information accessed through reading and discussion					✓
Intellectual Inquiry	Review, assess, and draw conclusions about hypotheses or theories				✓	
	Analyze arguments, in relation to their premises, assumptions, contexts, and conclusions				✓	
	Construct logical and reasonable arguments that include anticipation of counterarguments				✓	
	Use relevant evidence gathered through accepted scholarly methods and properly acknowledge sources of information			✓		
Ethical, Social, and Global Awareness	Analyze similarities and differences in human experiences and consequent perspectives		✓			
	Examine connections among the world's populations		✓			
	Identify contemporary ethical questions and relevant positions			✓		
Scientific, Mathematical, and Technological Literacy	Explain basic principles and concepts of one of the natural sciences	✓				
	Apply methods of scientific inquiry and problem solving to contemporary issues	✓				
	Comprehend and evaluate mathematical or statistical information	✓				
	Perform college-level mathematical operations on quantitative data	✓				
	Describe the potential and the limitations of technology	✓				✓
	Use appropriate technology to achieve desired outcomes	✓				
Creativity, Innovation, and Artistic Literacy	Demonstrate creative/innovative approaches to course-based assignments or projects			✓		
	Interpret and evaluate artistic expression considering the cultural context in which it was created				✓	

Appendix D: Writing Scoring Guide

1. **Please indicate which of the following documents are contained in the portfolio:**
   - ☐ Assignment Sheet
   - ☐ Cover Letter
   - ☐ Draft 1 - with Peer Feedback
   - ☐ Draft 2 - with Instructor Feedback
   - ☐ Final Revision

2. **Comparing the three drafts included in the portfolio, what revisions do you see the student completing or attempting to complete while preparing the final draft:**

   Sources
   - ☐ Source information has been added, removed, or modified to support claims/thesis
   - ☐ Sources are more fully integrated into the essay (e.g., through signal phrases, inter-textual references, etc.)

   Complexity & Audience Awareness
   - ☐ Multiple or alternative perspectives are considered showing increased complexity of thought and audience awareness
   - ☐ Implications and/or questions are articulated showing increased complexity of thought and audience awareness
   - ☐ Focus of essay has been changed, narrowed, or expanded (e.g., through changes in word choice, organization, and/or use of sources)

   Organization
   - ☐ Transitional words of phrases, between and within paragraphs, have been added or modified to improve coherence and flow
   - ☐ Paragraphs have been added, removed, or moved to demonstrate intentional organizational structure

   Editing & Stylistics
   - ☐ Copyediting has reduced distracting errors in spelling, punctuation, grammar, and format
   - ☐ Sentence-level changes in word choice, word order, and redundancy make essay clearer and more concrete
   - ☐ Other (please specify):

3. **Which of these revisions improved the essay the most?**

   Sources
   - ☐ Source information has been added, removed, or modified to support claims/thesis
   - ☐ Sources are more fully integrated into the essay (e.g., through signal phrases, inter-textual references, etc.)

   Complexity & Audience Awareness
   - ☐ Multiple or alternative perspectives are considered showing increased complexity of thought and audience awareness

- ☐ Implications and/or questions are articulated showing increased complexity of thought and audience awareness
- ☐ Focus of essay has been changed, narrowed, or expanded (e.g., through changes in word choice, organization, and/or use of sources)

Organization

- ☐ Transitional words of phrases, between and within paragraphs, have been added or modified to improve coherence and flow
- ☐ Paragraphs have been added, removed, or moved to demonstrate intentional organizational structure

Editing & Stylistics

- ☐ Copyediting has reduced distracting errors in spelling, punctuation, grammar, and format
- ☐ Sentence-level changes in word choice, word order, and redundancy make essay clearer and more concrete
- ☐ Other (please specify):

4. **Where were the completed revisions targeted?**
   - ☐ Revisions occurred only where comments were written locally on the page
   - ☐ Revisions were carried out globally throughout the entire essay
   - ☐ Other (please specify)

5. **Considering the feedback received, what revisions did the peers/instructor believe were necessary to improve the draft?**

Sources

- ☐ Source information has been added, removed, or modified to support claims/thesis
- ☐ Sources are more fully integrated into the essay (e.g., through signal phrases, inter-textual references, etc.)

Complexity & Audience Awareness

- ☐ Multiple or alternative perspectives are considered showing increased complexity of thought and audience awareness
- ☐ Implications and/or questions are articulated showing increased complexity of thought and audience awareness
- ☐ Focus of essay has been changed, narrowed, or expanded (e.g., through changes in word choice, organization, and/or use of sources)

Organization

- ☐ Transitional words of phrases, between and within paragraphs, have been added or modified to improve coherence and flow
- ☐ Paragraphs have been added, removed, or moved to demonstrate intentional organizational structure

Editing & Stylistics

- ☐ Copyediting has reduced distracting errors in spelling, punctuation, grammar, and format
- ☐ Sentence-level changes in word choice, word order, and redundancy make essay clearer and more concrete
- ☐ Other (please specify):

6. **Who seemed to provide comments that lead to the most significant revision?**
   - ☐ Peers
   - ☐ Instructor
   - ☐ Neither peer nor instructor feedback seemed to influence revision changes
   - ☐ Other (please specify)

7. **Considering all of the feedback received, what kinds of comments seemed to lead to the most significant improvements to the essay? (Check no more than three.)**
   - ☐ Directive suggestions for revision
   - ☐ Requests for clarification
   - ☐ Rhetorical questions to encourage rethinking and reconsideration of ideas
   - ☐ Invitations for the writer to reconsider or explain decisions made in writing the essay
   - ☐ Support or affirmation
   - ☐ Evaluation of the quality or effectiveness of writing
   - ☐ Connections or references to classroom context
   - ☐ Frequent use of essay-specific language
   - ☐ Criticism without guidance or suggestions
   - ☐ Other (please specify)

8. **Considering the revisions made and the feedback offered, where was the most generative feedback located?**
   - ☐ In-text or marginal comments
   - ☐ Summative comment located at end of essay
   - ☐ Scoring guide, rubric, or handout with prompts
   - ☐ Other (please specify)

9. **Evaluation of revision and final draft**

   Instructions: Consider the quality of the revision work you observed in the portfolio as well as the quality of the final essay draft.

	A	B	C	D	F	
How would you grade the quality of improvements made to the essay?						
How would you grade the quality of the final draft of the essay?						

Appendix E: Writing Student Survey

The Writing Program is conducting an assessment of student writing from all sections of Basic Writing, Writing Seminar, and Honors Writing Seminar. Our focus is on the work students do to revise and improve their research-based writing. As part of this assessment you are invited to take 10 minutes to complete this survey. Students who complete and return the survey will be eligible for one of three $25 gift cards from Barnes and Noble @ RIT. Your participation is completely voluntary. Thank you.

1. Describe your typical writing situation. For example, where do you write? Are other people around? What technologies do you use? If you compose at your computer what other programs are you using/running in addition to your word processor? How do you integrate source material into your writing? **Write your answer on the back of this sheet.**

2. As you think back on your experiences in Writing Seminar this quarter, what different revision activities did you complete or participate in? Please check all that apply:

   - ☐ In-class Peer Review
   - ☐ Take-home Peer Review
   - ☐ In-class Analysis of Peer Reviews
   - ☐ Instructor feedback
   - ☐ Revision Plan
   - ☐ Teacher-Student Conference
   - ☐ In-class Discussion of Evaluation Criteria/Rubric
   - ☐ In-class Workshop on Student Writing
   - ☐ In-class Modeling of Revision
   - ☐ In-class Revision of Passages (Using Computer Lab/Laptops)
   - ☐ In-class Thesis/Sentence Revision
   - ☐ "Self-Assessment" Questionnaire
   - ☐ Reflective Essay
   - ☐ "Track Changes" Draft
   - ☐ Writing Center visit
   - ☐ Other:

3. Thinking back to the work that you did to complete your writing assignments. Which of the activities listed above were the most helpful for you to improve your drafts, and why?

4. When you look at the revision changes you made or plan to make in your final draft of the researched essay, how would you describe those changes? Please check all that apply:

   Sources
   - ☐ I added/removed source information (quotes, summary, paraphrasing) to support my claims/thesis.
   - ☐ I did more to introduce and evaluate my sources.
   - ☐ I more accurately presented information from my sources in support of my claims/thesis.

Complexity

- ☐ I demonstrated greater complexity of thought by presenting and considering multiple perspectives on my topic.
- ☐ I demonstrated greater complexity of thought by reflecting on the implications of my claims/thesis.
- ☐ I narrowed/expanded the focus of my essay to communicate more clearly with my audience.

Organization

- ☐ I added or changed the transitional words or phrases between and within paragraphs in order to improve flow.
- ☐ I changed the order of my paragraphs.

Editing & Stylistics

- ☐ I edited the essay to reduce errors in spelling, punctuation, grammar, mechanics, format, and syntax.
- ☐ I chose different words, changed word order, or deleted redundant words to improve the essay.
- ☐ Other (please explain):

5. What compelled you to make these changes? For example, if you look at each of the changes listed above, who or what was responsible for helping you see what needed to be changed (e.g., a peer, a professor, a roommate, a writing center instructor, reading a peer's essay, rereading your own essay, etc.)?

6. Thinking back to the feedback you received on your essay, were there suggestions from your peer or instructor that you considered, but then chose not to follow? What were those suggestions and why did you decide not to follow them? Write your answers on the back of this sheet.

Appendix F: Writing Framing Questions and Data Tables

What type of revision is most successful in improving the final written product?

As described earlier, the scoring guide used a list of revision types for three separate questions: one that asked readers to identify which of the revisions were seen (even if only once in the portfolio), a second that asked readers to identify those revisions that seemed to them to improve the essay the most, and finally, a third question asked readers to look at the feedback offered in the margins of the essay text, in summative comments, or on scoring guides that might be used in peer or instructor response. Dividing the results for how often that revision-type was seen to improve the essay the most by the result for how often each revision was observed, we can see how successful each revision was to improve the essay. Each type of revision is listed below in order from least successful to most successful for improving the essay:

9. Transitional words or phrases, between and within paragraphs, have been added or modified to improve coherence and flow (meaning-preserving change)	.51
8. Copyediting has reduced distracting errors in spelling, punctuation, grammar, and format (formal change)	.53
7. Sentence-level changes in word choice, word order, and redundancy make essay clearer and more concrete (meaning-preserving change)	.54
6. Sources are more fully integrated into the essay (e.g., through signal phrases, inter-textual references, etc.) (formal change)	.66
5. Focus of essay has been changed, narrowed, or expanded (e.g., through changes in word choice, organization, and/or use of sources) (meaning-preserving change)	.70
4. Paragraphs have been added, removed, or moved to demonstrate intentional organizational structure (micro- or macro- structural change)	.71
3. Multiple or alternative perspectives are considered showing increased complexity of thought and audience awareness (micro- or macro-structural change)	.73
2. Implications and/or questions are articulated showing increased complexity of thought and audience awareness (micro structural change)	.74
1. Source information has been added, removed, or modified to support claims/thesis (micro structural change)	.80

As stated above, the most frequent revisions observed addressed source information in support of claims (68%). That same revision was observed to be requested the most frequently throughout the collection, and it was the revision seen most frequently to improve the essay the most, for a success rate of .80. The two other most frequently observed and requested revisions, the two addressing editing and stylistics, were ranked as 7 and 8, in terms of improving the essay the most. The revisions that were the most successful in improving the final essay were those revisions that addressed complexity, organization, or use of sources. Except for the addition, modification, or removal of source information, the other three most successful revisions were the least frequently observed and least frequently requested revisions in the collection.

What differences can be seen between more and less successful students, based on improvement grades and essay grades?

Significant differences can be observed in the revision activity between more and less successful writers. Although the average revision grades and average essay grades were the same (2.8 on a 4.0 scale), the table below shows that the higher the revision grade received the higher the essay grade.

Revision Grade	Essay Grade
4.0	3.5
3.0	2.9
2.0	2.4
0.9	1.8

The average number of revision-types seen in each portfolio, aggregated by revision grade, presents a significant trend: those students whose portfolios were evaluated to show greater success at improving their drafts also showed a higher average number of revisions completed or attempted. The table below demonstrates this result based upon improvement, or revision, grade recorded for each portfolio.

Revision Grade	Average Number of Revision-Types Observed (Standard Deviation)
A (n=41)	6.8 (1.9)
B (n=75)	4.3 (1.8)
C (n=39)	3.1 (1.5)
D/F (n=19)	3.7 (1.1)

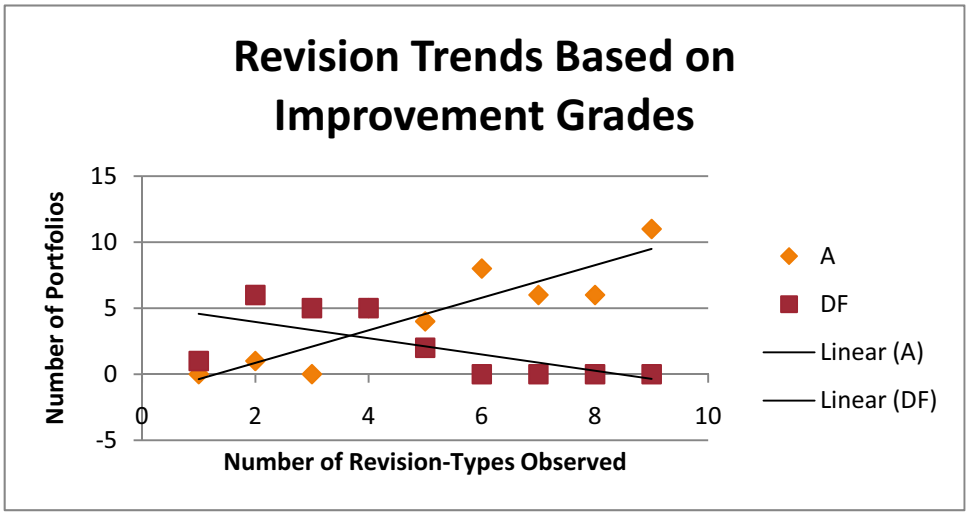
The following table demonstrates a similar result based upon essay grade.

Essay Grade	Average Number of Revision-Types Observed
A (n=33)	5.7 (2.2)
B (n=89)	4.7 (2.1)
C (n=37)	3.4 (1.8)
D/F (n=15)	3.7 (1.6)

Because the standard deviation for each group was around 2.0 for the A and B groups, a "count if" function was performed to determine how many different kinds of revision were observed in what number of portfolios based upon final revision grade. The results are shown in the table below.

# of Revisions	Revision Grade A	Revision Grade B	Revision Grade C	Revision Grade D/F
9	11	0	0	0
8	6	5	0	0
7	6	6	2	0
6	8	8	1	0
5	4	9	3	2
4	5	20	7	5
3	0	17	11	5
2	1	9	11	6
1	0	1	4	1

These results suggest that students, who are most successful in improving their essays, have completed more types of revision than those students who less successful in improving their essays (see Figure A for the trend). The same trend can be seen, though not as pronounced when conducting the same analysis based upon essay grade.



Observing that students more successful at improving their drafts, and therefore improving their grades, completed a greater number of different kinds of revision, the question can turn back to what were the most successful revisions that the most successful students completed. In portfolio presenting A or B level improvements and essays graded A, the two most successful revisions were either the articulation of implications or questions which increased the complexity of thought and audience awareness (.89), or the consideration of multiple or alternative perspectives which increased the complexity of thought and audience awareness (.79). Both changes address complexity, and can be seen in 55% and 53% of "A" portfolios. Those same two revisions were seen in 0% and 13% of the portfolios in which the essay was graded as "D" or "F."

The two most requested revisions in portfolios that evidenced A or B level improvements and A essays, were to add, remove, or modify source material to support claims and to change, narrow, or expand the focus of the essay. Conversely, the two most requested revisions in portfolios that evidenced D/F level improvements and D/F essays, were to reduce with copyediting distracting errors in spelling, punctuation, grammar and format, and making sentence-level changes to make the essay more clear and more concrete.

Appendix G: Explain Basic Principles and Concepts of One of the Natural Sciences – Rubric and Data Tables

Rubric

Outcome	Beginning	Developing	Competent	Exemplary
Explain basic principles and concepts of one of the natural sciences	Student does not exhibit clear understanding of scientific principles and concepts.	Student displays limited understanding of scientific principles and concepts.	Student displays frequent but inconsistent understanding of scientific principles and concepts.	Student manifests a thorough understanding of scientific principles and concepts.
	Displays little comprehension of basic ideas, their scope, and their interrelationships.	Displays comprehension of basic ideas, but fails to understand their scope and interrelationships.	Displays thorough comprehension of basic ideas, but exhibits occasional confusion about their scope and interrelationships.	Displays thorough understanding of basic ideas, how they interrelate, and their domain of validity.
	Often unable to rely on basic principles to solve problems or to identify applicable principles when faced with unfamiliar problems.	Occasionally relies on basic principles to solve problems, and sometimes identifies applicable principles when faced with unfamiliar problems.	Often able to rely on basic principles to solve problems or to identify applicable principles when faced with unfamiliar problems.	Able to call upon correct scientific arguments when faced with unfamiliar problems.

Sample Biology Course Data Table - Biology Average Scores by Assignment (n=253)

Class Assignment	Class Average Score
Exam 1	2.81
Exam 2	2.44
Exam 3	2.47
Final Exam	2.69
Homework 1	3.12
Homework 2	3.68
Homework 3	3.68
Homework 4	3.31
Homework 5	3.98
Homework 6	3.27
Quiz 1	3.91
Quiz 2	3.94
Quiz 3	3.93
Quiz 4	3.96
Quiz 5	3.87
Quiz 6	3.79

On-line Activity 1	4.0
On-line Activity 2	3.77
On-line Activity 3	3.84
On-line Activity 4	3.89
On-line Activity 5	3.55

Sample Physics Data Tables

For short answer questions, a rubric was defined by the instructor specifically for the question. This formula maps to each level of the scale: B=beginning, D=developing, C=competent, and E=exemplary. For short answer questions, an additional level of the scale was developed as na=left blank.

Rubric Results by Test

Holistic Rubric Scale	Test 1 Multiple Choice (n=52)	Test 2 Multiple Choice (n=47)	Test 2 Short Answer (n=47)		Test 3 Multiple Choice (n=44)
			#1	#2	
B= Beginning	2 (3.84%)	0 (0%)	18 (38.29%)	3 (6.38%)	1 (2.27%)
D= Developing	18 (24.61%)	8 (17.02%)	4 (8.51%)	24 (51.06%)	4 (9.09%)
C= Competent	23 (44.23%)	35 (74.46%)	7 (14.89%)	6 (12.76%)	32 (72.72%)
E = Exemplary	9 (17.30%)	4 (8.51%)	16 (34.04%)	13 (27.65%)	7 (15.90%)
na= left blank			2 (4.25%)	1 (2.12)	

Competent/Exemplary Frequency

Holistic Rubric Scale	Test 1 Multiple Choice (n=52)	Test 2 Multiple Choice (n=47)	Test 2 Short Answer (n=47)		Test 3 Multiple Choice (n=44)
Competent and Exemplary	32 (61.53%)	39 (82.97%)	23 (48.93%)	19 (40.41%)	39 88.62%)

Appendix H: Apply Methods of Scientific Inquiry and Problem Solving to Contemporary Issues - Rubric and Data Tables

Rubric

Outcome	Beginning (1)	Developing (2)	Competent (3)	Exemplary (4)
Apply methods of scientific inquiry and problem solving to contemporary issues	Often fails to identify important elements of problems. Has difficulty communicating ideas clearly and concisely.	Inconsistent in identifying important elements of problems. Communication of ideas is often unclear, but generally aimed toward the proper goal.	Often successful in identifying important elements of problems. Communication of ideas is reasonably clear, but with weaknesses in presentation or content.	Identifies important elements of problems. Communicates ideas clearly and concisely.
	Typically uses inappropriate methods/ experiments to collect data, or inappropriate analysis techniques.	Often uses appropriate methods/experiments to collect data, but inadequacies in data collection or analysis hamper drawing inferences.	Typically uses appropriate methods/experiments to collect data, but quality of data collection and analysis are inconsistent.	Uses appropriate methods/ experiments to collect data, and usually analyzes them correctly.
	Conclusions are frequently incorrect or unjustified by the experiment in question.	Conclusions are generally correct, but often not justified by the experiment in question.	Conclusions are generally correct, but their justification is sometimes incomplete.	Conclusions are correct and justified.

Sample Data Table: Biology Class/Lab Average Score by Assessment

Class Assignment	Class Average Score
Exam 1	2.84
Lab Report	2.66
Homework 1	2.64
Homework 2	2.28
Homework 3	3.06
Homework 4	3.33
Quiz 1	3.57
Quiz 2	3.09
Quiz 3	3.13
Quiz 4	3.23
Quiz 5	2.52
Quiz 6	2.52

Appendix I: Comprehend and Evaluate Mathematical or Statistical Information Rubric and Data Tables

Rubric

The Mathematical, Scientific, and Technology Literacy Team developed a holistic scoring guide as there could potentially be large numbers of students in the science courses. They choose to develop a short, narrative description of the characteristics of four levels of achievement of the outcome (see rubric below). Faculty members then used the rubric to assess the achievement level of the students on various course-embedded assignments.

Outcome	Beginning	Developing	Competent	Exemplary
Comprehend and evaluate mathematical or statistical information	Unable to apply appropriate mathematical, statistical, or graphical models.	Limited ability to apply appropriate mathematical, statistical, or graphical models.	Usually applies appropriate mathematical, statistical, or graphical models.	Applies appropriate mathematical, statistical, or graphical models.
	Quantitative reasoning skills are typically too weak to accurately describe, explain, and interpret the results of scientific and mathematical computations.	Sometimes accurate when describing, explaining, and interpreting the results of scientific and mathematical computations using quantitative reasoning, though major logical and computational errors occur.	Frequently accurate when describing, explaining, and interpreting the results of scientific and mathematical computations using quantitative reasoning, though minor logical and computational errors occur.	Accurately describes, explains, and interprets the results of scientific and mathematical computations using quantitative reasoning.

Grading Scheme - Math Course 1

- Problems considered were those of a theoretical or conceptual nature
- To "comprehend" mathematical information indicates a complete understanding of the concepts, theorems, and definitions that build the foundations of the mathematical topics covered

Grading Scheme

- Each problem was graded and recorded for each student.
- Each problem is worth a specific number of points and those points earned were considered first.
- The percentage of "correctness" was determined for each student each problem.
- Averages for each student and each problem were determined.

Conversion to Rating

- Ratings were determined using the following scale which corresponds with rubric (see below).

Percent Correct	Rating
$0 \leq x < 70$	1 (Beginning)
$70 \leq x < 80$	2 (Developing)
$80 \leq x < 90$	3 (Competent)
$90 \leq x \leq 100$	4 (Exemplary)

- Each problem's average rating was determined and then each student's average rating was determined.

Math Course 2

The following assignments were selected as part of the assessment methodology and scored using the holistic rubric for both courses: Exams (4). The assessments that were selected were based on which questions best matched the student learning outcome, *Comprehend and evaluate mathematical or statistical information*. Questions were then assigned points.

Grading Scheme

- Selected questions that best matched the outcome
- Each question was assigned a point value and calculated for each student
- Ratings 1-4 were used to rank the point values which varied by question
- Conversion to Rating
- Math Course 2: Example of conversion to rating using Exam #1

Grading Scheme Summary

Question #	Total Points Assigned	1 Beginning	2 Developing	3 Competent	4 Exemplary
1	12	0-6	7-8	9-10	11-12
2	28	0-14	15-19	20-24	25-28
3	3	0	1	2	3
5	20	0-9	10-15	16-17	18-20
6	15	0-7	8-11	12-13	14-15
7	2	0	0	1	2

Math Sample Questions/Problems

Samples of problems assessed for comprehend and evaluate mathematical or statistical information:

Quiz One

1. Find $\frac{dy}{dx}$ by implicit differentiation.$4\cos x \sin y = 1$
2. Find an equation of the tangent line to the curve at the given point.$y = \ln\left(xe^{x^2}\right),\ (1,1)$
3. Find y'if $y = \ln(x^2 + y^2)$.
4. A spherical balloon is being inflated. Find the rate of increase of the surface area of the balloon with respect to the radius if the radius is 2 feet.

Quiz Two

1. Find all critical values of the function.$f(x) = x^3 + 3x^2 - 24x$
2. Find the absolute maximum and minimum values for the function on the given interval.$f(x) = x^4 - 2x^2 + 3 \qquad [-2,3]$
3. Verify that the function satisfies the three conditions of Rolle's Theorem and then find all c that satisfy the theorem.$f(x) = 5 - 12x + 3x^2 \qquad [1,3]$
4. Verify that the function satisfies the two conditions of the Mean Value Theorem and then find all c that satisfy the theorem.$f(x) = 3x^2 + 2x + 5 \qquad [-1,1]$

Exam One

1. Find the equation of the tangent line to the curve at the given point. (5 points each)
   a. $f(x) = \ln(2x + 1) - 3,\ \ (0,-3)$
   b. $f(x) = \sinh x,\ \ (0,0)$
2. Use the derivative $\frac{d}{dx}[e^u]$ to show that $\frac{d}{dx}[a^x] = a^x ln a$. [Hint: Find a u such that $e^u = a^x$.] (5 points)
3. A spherical balloon is being inflated. Find the rate of increase of the surface area with respect to the radius r when the radius is 3 feet. (5 points)
4. Find the equation of the tangent line to the curve $y = \log_4 x$ that is perpendicular to the line $y = -(\ln 4)x + 1$. (10 points)
5. Prove the following identities, using the definitions of hyperbolic trig functions.
   a. $\cosh x - \sinh x = e^{-x}$ (4 points)
   b. $\cosh 2x - \sinh^2 x = \cosh^2 x$ (6 points)
6. Consider the function $y = a\log_3(x + 2) - bx$. Find values for a and b such that $y = 4$ and $y' = 0$ when $x = -1$. (10 points)
7. Differentiate. Do NOT simplify your answers! (5 points each)
   a. $y = xln(x - \sin x)$
   b. $y = \frac{lnx}{\sqrt{x} - x}$
   c. $y = e^{3x} ln 4x$
8. Find the linearization of the following function. Then, sketch the graph of the function and the linearization of the function at the given value. (10 points)$f(x) = lnx, a = 1$

Math Course Findings Sample

Learning Outcome	Assignment	Question	Class Average	Class Rating	# 1	# 2	# 3	# 4	% 1	% 2	% 3	% 4
#4 Comprehend and evaluate mathematical and statistical information	Quiz One	1	74	2	33	0	0	34	49.3	0.0	0.0	50.7
		2	65	1	31	13	11	12	46.3	19.4	16.4	17.9
		3	53	1	48	0	8	11	71.6	0.0	11.9	16.4
		4	60	1	23	30	0	14	34.3	44.8	0.0	20.9
	Quiz Two	3	61	1	37	3	11	16	55.2	4.5	16.4	23.9
		4	63	1	33	3	5	26	49.3	4.5	7.5	38.8
	Quiz Three	1	93	4	7	0	5	55	10.4	0.0	7.5	82.1
		2	89	3	9	0	11	47	13.4	0.0	16.4	70.1
		3	80	3	12	0	26	29	17.9	0.0	38.8	43.3
		4	93	4	5	0	6	56	7.5	0.0	9.0	83.6
	Quiz Four	3	64	1	34	0	9	24	50.7	0.0	13.4	35.8
		4	72	2	26	0	8	33	38.8	0.0	11.9	49.3
	Quiz Five	3	80	3	20	0	14	33	29.9	0.0	20.9	49.3
		4	82	3	15	0	10	42	22.4	0.0	14.9	62.7
	Quiz Six	4	52	1	48	0	9	10	71.6	0.0	13.4	14.9
	Exam One	1	69	1	27	7	8	25	40.3	10.4	11.9	37.3
		2	23	1	63	0	3	1	94.0	0.0	4.5	1.5
		3	43	1	58	0	9	0	86.6	0.0	13.4	0.0
		4	27	1	60	4	2	1	89.6	6.0	3.0	1.5
		5	64	1	31	8	14	14	46.3	11.9	20.9	20.9
		6	42	1	53	7	3	4	79.1	10.4	4.5	6.0
		8	66	1	24	4	16	23	35.8	6.0	23.9	34.3
		9	38	1	53	5	3	6	79.1	7.5	4.5	9.0
		10	35	1	60	1	3	3	89.6	1.5	4.5	4.5
	Exam Two	1	59	1	33	0	32	2	49.3	0.0	47.8	3.0
		2	60	1	37	5	12	13	55.2	7.5	17.9	19.4
		3	77	2	16	5	17	29	23.9	7.5	25.4	43.3
		4	39	1	56	4	4	3	83.6	6.0	6.0	4.5
		5	74	2	17	11	22	17	25.4	16.4	32.8	25.4
		6	57	1	43	8	3	13	64.2	11.9	4.5	19.4
		7	42	1	57	3	1	6	85.1	4.5	1.5	9.0
		T2	64	1	25	4	5	33	37.3	6.0	7.5	49.3
	Exam Three	2	64	1	29	5	4	29	43.3	7.5	6.0	43.3
		3	57	1	36	8	14	9	53.7	11.9	20.9	13.4
		4	77	2	19	3	13	32	28.4	4.5	19.4	47.8
		6	87	3	7	4	9	47	10.4	6.0	13.4	70.1
		7	53	1	39	6	6	16	58.2	9.0	9.0	23.9
		8	50	1	46	3	1	17	68.7	4.5	1.5	25.4

Appendix J: Perform College-level Mathematical Operations on Quantitative Data – Rubric, Grading Scheme, and Data Tables

Rubric

General Education Outcome	Beginning 1	Developing 2	Competent 3	Exemplary 4
Perform college-level mathematical operations on quantitative data	Often unable to perform mathematical operations or to organize data into graphical, numeric, or functional forms as necessary for the task.	Inconsistent in performing mathematical operations correctly and organizing data into graphical, numeric, or functional forms as necessary. Errors are often major, and of a conceptual nature.	Generally performs mathematical operations correctly and organizes data into graphical, numeric, or functional forms as necessary. Typical errors are minor, of a functional rather than conceptual nature.	Performs mathematical operations and organizes data into graphical, numeric, or functional forms as necessary.

Grading Schema - Math Course (n=67)

Six quizzes and three exams were selected as part of the assessment methodology and scored using the holistic rubric. The assessments that were selected were based on the following guidelines:

- Problems considered were those of a procedural natural.
- To be able to perform mathematical operations, students must be able to repeat a process they have learned to use in order to solve specific types of problems.
- Each problem was graded and recorded for each student.
- Each problem is worth a specific number of points and those points earned were considered first.
- The percentage of "correctness" was determined for each student each problem.
- Averages for each student and each problem were determined.
- Ratings were determined using the following rubric which corresponds with rubric (see below).

Percent Correct	Rating
$0 \leq x < 70$	1 (Beginning)
$70 \leq x < 80$	2 (Developing)
$80 \leq x < 90$	3 (Competent)
$90 \leq x \leq 100$	4 (Exemplary)

- Each problem's average rating was determined and then each student's average rating was determined.

Sample Physics Data Tables

Student Achievement on Outcome

Holistic Rubric Scale	Test 1 Problems 7 and 9 (n=52)		Test 2 Problems 5, 6, 7b,c (n=47)			Test 3 Problems 2a, 4b, 5 (n=44)		
	7	9	5	6	7b,c	2a	4b	5
B= Beginning	0 (0%)	1 (1.92%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
D= Developing	3 (5.77%)	0 (0%)	0 (0%)	1 (2.13%)	0 (0%)	1 (2.27%)	1 (2.27%)	4 (9.10%)
C= Competent	1 (1.92%)	1 (1.92%)	5 (10.64%)	3 (6.38%)	10 (21.28%)	0 (0%)	0 (0%)	0 (0%)
E = Exemplary	47 (90.39%)	46 (88.46%)	41 (87.23%)	34 (72.34%)	35 (74.47%)	42 (95.45%)	38 (86.36%)	34 (77.27%)
na= left blank	1 (1.92%)	4 (7.70%)	1 (2.13%)	9 (19.15%)	2 (4.25%)	1 (2.27%)	5 (11.36%)	6 (13.63%)

Appendix K: NSSE Comparison Groups

2005	2007		2009	
Selected Peers	**Selected Peers I (Region and Sector)**	**Selected Peers II (Similar Program Portfolio)**	**2009 (AITU &Northeastern)**	**Selected Peers II (AITU& Similar Program Portfolio)**
Adelphi University	Carnegie Mellon University	Butler University	Case Western Reserve University	Butler University
Bucknell University	Case Western Reserve University	Carnegie Mellon University	Clarkson University	Case Western Reserve University
Butler University	Clarkson University	Clarkson University	Drexel University	Clarkson University
DePaul University	George Washington University	Clemson University	Franklin W. Olin College of Engineering	DePaul University
Florida Institute of Technology	Pace University	DePaul University	Kettering University	Drexel University
Georgia Institute of Technology	Polytechnic University	George Washington University	Northeastern University	Franklin W. Olin College of Engineering
Illinois Institute of Technology	Stevens Institute of Technology	Georgia Institute of Technology	Polytechnic Institute of NYU	Kettering University
Northeastern University		Kettering University	Rose-Hulman Institute of Technology	Michigan Technological University
Polytechnic University		Northeastern University	Stevens Institute of Technology	Northeastern University
Seton Hall University		Polytechnic University	Worcester Polytechnic Institute	Polytechnic Institute of New York University
University of Bridgeport		Purdue University		Rose-Hulman Institute of Technology
University of Cincinnati		Rose-Hulman Institute of Technology		Stevens Institute of Technology
University of Dayton		Stevens Institute of Technology		Syracuse University
University of San Diego		University of Cincinnati		University of Cincinnati
University of San Francisco				Villanova University
University of St. Thomas (MN)				Wayne State University
Wayne State University				Worcester Polytechnic Institute
Widener University				