Assessment in Academic Affairs

CSUCI values using assessment as a critical tool for creating a learning-centered organization. We began taking steps to implement assessment programs shortly after the first students arrived on campus. We recognize that assessment deals not only with student learning and development, but also with organizational effectiveness. Assessment requires incorporating the results back into decision-making for improvements in curriculum, organizational processes, and institutional climate. In this way we can ensure continuous quality improvement. The quality of excellence we aspire to should reflect our deliberate efforts to measure educational effectiveness, demonstrate and confirm accountability for external stakeholders, and thus support the educational mission of the institution.

Assessment during 2003-04 has taken place through the personal commitment of faculty, staff, and administrative leadership. The campus has spent the past year identifying objectives and outcomes, inventorying the campus for currently available data, and beginning to measure our educational effectiveness. Assessment in Academic Affairs has been exemplified through:

1. Pilot Assessment Studies
2. Mini-grants
3. Making plans for 5 yr. program reviews
4. Semi-formal changes in curriculum
5. Informal changes in individual classrooms

In addition, faculty have furthered a culture of assessment by sharing assessment stories at orientation and at other on-campus venues, engaging one another in on-going conversations about the nature of assessment, and through publishing articles and giving conference presentations about their assessment efforts at CSUCI.

2003-04 Pilot Assessment Studies

This work highlights the efforts of faculty who participated in the Pilot Assessment Studies project. The combination of limited resources and the need to jump start the assessment program in preparation for implementation of a systematic assessment program provided the impetus for the Pilot Assessment Studies project. Created a year and a half ago, the Director of Faculty Development made funds available for departments that wanted to do assessment projects. Specifically, funding was through re-assigned faculty time. Some of the volunteering faculty had no prior assessment experience, thus Assistant Professor Harley Baker acted in the role of technical assistant for those who requested assistance.

Assessment topics were chosen by the individual faculty participants. The assessment projects varied from the examination of specific knowledge and ability, to congruence with external program competencies, to student advising, to classroom instructional methods. The complete faculty reports are provided following the Executive Summary.
2004-05 Assessment Plans

For 2004-05, CSUCI plans on utilizing two approaches for its Academic Affairs assessment efforts. First, we will continue to support individual faculty assessment efforts. The Provost and Dean of Faculty have allotted re-assigned time for program areas. Program area chairs have specifically requested re-assigned time to be used in support of assessment in each of the programmatic areas. Additionally, funds for assessment are available through the Director of Faculty Development. The Faculty Development Advisory group is identifying a number of assessment projects to bring forward for funding. Also, the Director has suggested presenting a series of assessment workshops to assist faculty with their individual efforts.

Second, CSUCI has appointed Dennis Muraoka the Special Assistant for Assessment and has plans to implement a formal assessment structure through the Assessment Council. The Assessment Council will be comprised of Assessment Officers representing each of the main divisions of campus. The Assistant Provost, the Director of Institutional Research, and the Special Assistant to the President will serve as advisors. This formal structure will allow us to take several important steps:

- Create a unified and systematic assessment and evaluation design that reflects the institution’s mission and values
- Build on the data and assessment programs that are currently in place
- Begin development of global data bases that allow cross-sectional and longitudinal assessment
- Coordinate and leverage institutional efforts to maximize and support fully integrated institutional assessment
- Support the use of assessment data in decision-making to ensure gaps between promise and performance are examined and that changes are made to narrow those gaps

These steps will help CSUCI move toward increased congruence between our stated mission, purposes, and objectives and the actual outcomes of our programs and activities.
Executive Summary of Pilot Assessment Projects

Multiple Subjects Credential Program Assessment

Background. Led by Jeanne Grier, Assistant Professor of Education, faculty used portfolios to assess and measure student learning in the Multiple Subjects Credential Program. The Teacher Performance Expectations (TPEs) outlined by the California Commission on Teaching Credentialing (CCTC) were used as a basis for the program portfolio but were not driven by them. Faculty identified four “Core Competency” pieces of which one was assessed. An assessment team was convened and developed the Portfolio Rubric and in May 2004 education faculty and supervisors reviewed 39 multiple subjects candidate portfolios.

Findings. Positive scores of students in the two categories of “Background, Family Behavior, Culture, Language” & “Approaches to Learning, Prior Knowledge, Abilities, Interest, Individual Differences” indicate students are receiving these program experiences and able to show their understanding of them. Three additional programs, Advanced Student Teacher in the Multiple Subjects Program, Initial Student Teachers in the Single Subject Program, and Student Teachers in the Education Specialist Program, were also assessed using a portfolio program based on the work of the Pilot Project.

Next Steps. The three remaining Core Competencies need to be analyzed into subordinate elements. The timing of the assessment work in terms of data collection and measurement impact the reliability of the results and will be considered in the future. Additional re-assigned time and administrative support are needed to sustain and grow further assessment efforts.

Directed Self Placement Assessment

Background. Harley Baker, Assistant Professor of Psychology, examined whether test-driven and self-placement models for introductory English classes agreed in their placement recommendations and if there were differences in these students based on how the classes differed. Students could choose English 102 Stretch Composition, part of a two course sequence, or Standard English 105 Composition and Rhetoric. After attending an orientation and given guidelines students chose the course they felt best suited their ability and needs. The assessment used CSUCI records, the CIRP Freshman Survey, and created a questionnaire based on several standardized self-rated tests dealing with writing and personality.

Findings. Self-based and test-based placement methods yield different placement results, with self-based placements consistent with their self-ratings of personality and ability. Students who self-placed in the standard English course had higher self-reported academic ability, creativity, public speaking ability and writing ability than students who self-placed in the stretch English course. There were also differences in their approaches to writing, with students in the standard English course more likely to employ a “deep writing” approach, and students in the stretch English course more likely to employ a “surface writing” approach. A brochure to help students determine which class is more appropriate for them has been created based on the data and students characteristics found in the first survey.
Next Steps. Data collection is continuing. For the current year the survey scales will be re-evaluated to provide a more accurate model and teaching evaluations may be used as a covariate. A longitudinal data base is planned that will provide the opportunity to compare student outcomes in writing courses and other courses based up their initial English course selection.

Peer Review Assessment

Background. William Wolfe, Professor of Computer Science, created web-based peer-review processes for Mathematics and Computer Science students. Students’ reviewed each of their classmate’s work and posted it to the web. The postings were anonymous, but each student reviewer knew the student they were reviewing. Additional reviewer comments were required when a student rated an assignment lower than 8 (on a 1-10 scale). Student reviews were compared to instructor reviews. Students were surveyed about how helpful they felt the peer review process was.

Findings. From the Mathematics class, the average peer reviews agreed with the instructor review and provided a method for more in-depth feedback to the student than offered by the instructor alone. While students felt the reviews were not easy to do for other students, they felt the feedback they received was fair and accurate, helped them learn multiple ways to solve a problem, and motivated them to do better work. This approach allowed students to learn from one another, compare their work with their classmates’, encourage class participation and foster an atmosphere of collaboration.

Next steps. To reduce student workload, specific problems will be selected for peer review, as opposed to assigning all problems. Both those being reviewed and the reviewers will remain anonymous. A more formal experimental design will be employed, with randomization of the assignments and more sophisticated statistical analysis.

Business Writing Assessment

Background. Ashish Vaidya, Professor of Economics, assessed the writing competency of students in two sections of BUS 499, the Capstone course. Students were assessed based on the Quality of Writing and on Analysis and Integration of writing. Two individual cases and one group case comprised the data for analysis. The analysis is based on a rubric developed by faculty.

Findings. The average Quality of Writing score was greater than 3 on a 4 point scale. The average Analysis and Integration score was lower, averaging between 2.3 and 2.7 for individual and group case analyses.

Next Steps. The Business Assessment Test (BAT), a CSU-wide assessment will be given in the Capstone course, but a comprehensive assessment plan for this area needs to be created and specific indicators for assessment identified. Additional performance standards need to be determined as well as the budgetary resources needed to support further assessment efforts.

Biology Laboratory Skills Assessment

Background. Nancy Mozingo, Assistant Professor of Biology, examined four courses: Principles of Organismal and Population Biology (BIOL 200); Principles of Cell and Molecular Biology
(BIOL 201); Cell Physiology (BIOL 300); and Molecular Biology (BIOL 400), to assess whether students were given the opportunity to successful master basic pipetting skills and microscopy procedures. One class, BIOL 300, was further analyzed to determine students’ level of skill in pipetting and microscopy. A check-sheet was developed and the instructor observed basic laboratory procedures during a lab practical.

**Findings.** A content analysis revealed that these courses as a group expose students to a wide variety of laboratory techniques. Students scored an average of 92.8 (out of 100) on pipetting skills. Scores for microscopy were lower, averaging 76.6.

**Next steps:** Assessment earlier in the semester will take place to allow increased time to structure activities to improve student skill level. Additionally, pre and post-test measures will be incorporated into further assessments to better ascertain student learning. Peer-assistance will be considered as a tool to help lower rated students gain proficiency.
MULTIPLE SUBJECTS CREDENTIAL PROGRAM ASSESSMENT

Pilot Project for Assessment in the Education Program Final Report
Submitted by: Jeanne Grier
June 2004

Education faculty—consisting of five full-time tenure track and two full-time lecturers met four times during fall 2003 and five times in spring 2004 with the goal of creating the framework of a Program Portfolio as a tool for program assessment and a measure of student learning in the Multiple Subjects Credential Program (minutes of meetings are available upon request). The task, as was simply outlined in the Pilot Project Proposal, was a much more complex process the further we explored our options and developed our communal philosophies.

Initially, we envisioned designing the program portfolio around the existing Teacher Performance Expectations (TPEs) outlined by the California Commission on Teacher Credentialing (CCTC). It was evident early on in our discussions that the faculty desired a structure for the portfolio that encompassed the TPEs but was not driven by them. Our first several meetings focused on identifying the major “Core Competency” pieces that our teacher candidates should possess and be able to demonstrate upon completion of the multiple subjects program. Four core competencies were identified and the 13 TPEs were backward-engineered and aligned with one of the four competencies. In keeping with the mission of our pilot project we fully developed one of the core competencies for the portfolio that was to be assigned to ALL multiple subject candidates (both initial and advanced) in Spring 2004. Additionally, we designed the initial organizational structure of the portfolio including reflective narratives and explicit connective elements to the TPEs. Please refer to the attachment “Education Program Portfolio Description and Guidelines—Spring 2004.”

As an initial “pilot” for our pilot project thirty-nine initial student teachers in the Multiple Subjects Program were asked to collect “evidence” based on the 13 TPEs in fall 2003. This initial test was to see what kinds of evidence students would collect as well as identify the elements of the portfolio that were lacking or needing implementation. But, because the request to produce a portfolio occurred late in the semester the task was simplified and each student was asked to collect evidence on only three of the thirteen TPEs—the university supervisor determined which three TPEs but a considerable number of students were asked to focus on TPE 8 and TPE 9.

After reviewing the December “pilot” portfolios, the assessment team worked for most of the Spring semester to develop the Portfolio Rubric for Multiple Subject Portfolios. (Please see attachment). This portfolio rubric follows the basic structure of the portfolio organizational outline with the exception that multiple subjects candidates were not required to collect artifacts for all of the core competencies, again, due to the lateness of the distribution of the assignment.

On May 24, 2004 education faculty and supervisors met to review 39 multiple subjects candidate portfolios. At the beginning of each meeting inter-rater reliability was established. This very long
and time-intensive review process elucidated several salient issues as results of our pilot assessment process.

RESULTS

<table>
<thead>
<tr>
<th>Category</th>
<th>Distinguished</th>
<th>Proficient 31.6%</th>
<th>Emergent 52.6%</th>
<th>Unsatisfactory 10.6%</th>
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</thead>
<tbody>
<tr>
<td>I. Resume</td>
<td>N=2, 5.3%</td>
<td>N=12</td>
<td>N=20</td>
<td>N=4</td>
</tr>
<tr>
<td>II. Philosophy of Teaching</td>
<td>N=3, 7.9%</td>
<td>N=14</td>
<td>N=16</td>
<td>N=4</td>
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<tr>
<td>III. Learning About Students—Developmental Characteristics</td>
<td>N=7, 17.9%</td>
<td>N=8</td>
<td>N=19</td>
<td>N=5</td>
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<tr>
<td>IV. Learning About Students—Background, Family, Behavior, Culture, Language</td>
<td>N=5, 12.8%</td>
<td>N=10</td>
<td>N=18</td>
<td>N=6</td>
</tr>
<tr>
<td>V. Learning About Students—Approaches to Learning, Prior Knowledge, Abilities, Interests, Individual Differences</td>
<td>N=10, 25.6%</td>
<td>N=8</td>
<td>N=14</td>
<td>N=6</td>
</tr>
<tr>
<td>VI. Reflective Narrative</td>
<td>N=4, 11.1%</td>
<td>N=6</td>
<td>N=17</td>
<td>N=9</td>
</tr>
</tbody>
</table>

a: Total N=38; b: Total N=36

DISCUSSION

The distribution of scores across the range of “Distinguished” to “Unsatisfactory” in all categories was expected for initial level (first semester) student teaching candidates in the Multiple Subjects Program. In any given category it would be expected that the majority of the first semester students would score in the “Emergent” level after completing the first semester of student teaching and the first semester of the credential program. In fact, portfolios were collected from the students prior to the end of the semester before their entire full-time takeover as a teacher had ended. Being the case, it is not surprising that a number of students scored “Unsatisfactory” on several sections of the portfolio. At the time the portfolio was due, several students had just started their full-day student teaching and may not have put the time into the development of one or more sections of the portfolio assignment. Additionally, students teaching candidates were never taught explicitly how to develop their resume or a teaching philosophy. These are areas that need to be addressed in the program.

One very exciting trend in the data was the number of students scoring either “Proficient” or “Distinguished” in categories IV (Background, Family, Behavior, Culture, Language) & V (Approaches to Learning, Prior Knowledge, Abilities, Interests, Individual Differences). These areas represent two major goals of all Education Programs. These data suggest the initial student teachers in the multiple subjects program are receiving program experiences and collecting evidence that articulates their understanding and represents these areas well.
SUMMARY

The process of developing a program portfolio as a program evaluation tool is far from over. The three remaining Core Competencies need to be broken down further into subordinate elements; the process of administering the portfolio information needs to be clarified further; the process of portfolio review needs to be refined and streamlined and supported financially; and maintaining records and evaluation results needs to be supported not only by release time but also with administrative support personnel. The task of evaluating the 39 portfolios—with two raters per portfolio—took over a total of 40 work hours.

It should be noted in this report that Advanced Student Teachers in the Multiple Subjects Program (N=33), Initial Student Teachers in the Single Subject Program (N=5), and Student Teachers in the Education Specialist Program (N=5) also developed portfolios based upon the work completed in this Pilot Project. All of these programs will also need continued support for programmatic assessment.

We are fortunate at this stage in our program assessment to be relatively small in size with regards to numbers of students. However, as each credential program continues to grow, each of the obstacles identified in this pilot study will magnify and grow almost exponentially.

FOLLOW-UP ACTIVITIES

In mid-July education faculty will be invited to a “portfolio results meeting” where the results of this pilot assessment will be shared, the process of the project will be discussed and evaluated, and implications for program-revision-for-improvement will be discussed.
Education Program Portfolio Description and Guidelines-Spring 2004

Portfolio Description
In order to assist and support you in your professional development as a reflective educator, you will be required to develop a portfolio of your work that demonstrates the qualities and competencies identified by the Education Program Faculty and aligned to the Teacher Performance Expectations (TPEs). During Fall 2003, the Education Program Faculty identified four Core Competencies for beginning teachers. They are: Learning Environment; Instructional Process; Learning About Students; and Professionalism. Your developmental portfolio is a collection of evidence of your work and progress in the Credential Program toward meeting these competencies. Your portfolio is a formal document and is a reflection of you as a professional.

The Education Program Faculty will guide and advise you in the construction of your portfolio both individually and in the student teaching seminars. You will be required to present your completed portfolio to a panel of the Education Program Faculty and area teachers and administrators before completing your Credential Program at CSUCI.

When you seek employment as a credentialed teacher, you will be able to share portions of your portfolio with perspective employers in addition to your resume and letters of recommendation.

Instructions for Portfolio Development
Include a current copy of your resume and philosophy of teaching. Gather evidence from your coursework and fieldwork for each Core Competency. A listing of TPEs has been loosely associated with each Core Competency to assist you in focusing on the competency and choosing appropriate evidence. First semester student teachers and second semester student teachers will be asked to collect differing numbers of artifacts to include in the portfolio. Because the portfolio is seen as a cumulative and summative process students are encouraged to collect artifacts throughout their credential program for inclusion.

Reflective Narratives: For each Core Competency you will write a Reflective Narrative. After gathering your artifact(s), write a 1-2 page reflective narrative for each Core Competency that answers the guiding questions and describes how the artifacts you have chosen clearly demonstrate your core knowledge, skills, and abilities related to the Core Competency.

Connection to TPE’s: For each artifact or set of artifacts per element you will write a one to two paragraph summary of how and why are the artifacts you have chosen to include in your portfolio are representative of the TPE’s associated with that Core Competency.

Core Competency: Learning About Students: The current focus of this semester’s portfolio is “Core Competency: Learning About Students.” This area has been organized into three elements: Developmental Characteristics, Background, and Approaches to Learning. These elements are described in the Education Program Portfolio Component Description and Organization Outline. Students will be expected to provide a summative explanation for each element and how the evidence presented relates to the TPEs.

Please follow the outline when organizing your portfolio.
Education Program Portfolio Component Description and Organization Outline

I. Resume

II. Philosophy of Teaching

III. Core Competency: **Learning Environment** (TPE’s 10, 11)
- **Reflective Narrative:** Why are the artifacts in this Core Competency important to you and how are they representative of your knowledge, skills, and dispositions related to the learning environment?
- **Connection to TPE’s:** How and why are these artifacts representative of the TPE’s?
- **Artifact/s:** One artifact for 1\textsuperscript{st} semester ST; Two artifacts for 2\textsuperscript{nd} semester ST

IV. Core Competency: **Instructional Process** (TPE’s 1, 2, 3, 4, 5, 7, 9)
- **Reflective Narrative:** Why are the artifacts in this Core Competency important to you and how are they representative of your knowledge, skills, and dispositions related to the instructional process?
- **Connection to TPE’s:** How and why are these artifacts representative of the TPE’s?
- **Artifact/s:** One artifact for 1\textsuperscript{st} semester ST; Two artifacts for 2\textsuperscript{nd} semester ST

V. Core Competency: **Learning About Students** (TPE’s 6, 8)
- **Reflective Narrative:** Why are the artifacts in this Core Competency important to you and how are they representative of your knowledge, skills, and dispositions related to learning about students?
  - **Element 1:** Developmental Characteristics (Social, Intellectual, Emotional, Physical)
    - **Connection to TPE’s:** How and why are these artifacts representative of the TPE’s?
    - **Artifact/s:** One artifact for 1\textsuperscript{st} semester ST; Two artifacts for 2\textsuperscript{nd} semester ST
  - **Element 2:** Background (Family, Behavior, Cultural/Linguistic)
    - **Connection to TPE’s:** How and why are these artifacts representative of the TPE’s?
    - **Artifact/s:** One artifact for 1\textsuperscript{st} semester ST; Two artifacts for 2\textsuperscript{nd} semester ST
  - **Element 3:** Approaches to Learning (Prior knowledge, abilities, interests, Learning styles, Individual differences)
    - **Connection to TPE’s:** How and why are these artifacts representative of the TPE’s?
    - **Artifact/s:** One artifact for 1\textsuperscript{st} semester ST; Two artifacts for 2\textsuperscript{nd} semester ST

VI. Core Competency: **Professionalism** (TPE’s 12, 13)
- **Reflective Narrative:** Why are the artifacts in this Core Competency important to you and how are they representative of your knowledge, skills, and dispositions related to professionalism?
- **Connection to TPE’s:** How and why are these artifacts representative of the TPE’s?
- **Artifact/s:** One artifact for 1\textsuperscript{st} semester ST; Two artifacts for 2\textsuperscript{nd} semester ST

VII. Portfolio Summary
1. What are the special qualities that you bring as an individual and you have developed as a professional?
2. How does this portfolio represent you as a developing professional who can address the diverse needs of all students?
3. How does this portfolio represent your evolving philosophy of teaching and practice?

VIII. Professional Documents
Include in this section any certificates, permits, credentials, or documents that show your professional accomplishments or academic distinctions.
### Resume

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<tr>
<th></th>
<th>Distinguished (3)</th>
<th>Proficient (2)</th>
<th>Emergent (1)</th>
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<tbody>
<tr>
<td>1</td>
<td>Correct mechanics; Includes all pertinent information clearly; Professional format using advanced word processing features</td>
<td>Correct mechanics; Includes all pertinent information; professional format</td>
<td>Correct mechanics with minimal errors; Includes all pertinent information; Format needs improvement</td>
<td>Many mechanical errors present; Information is incomplete; Format and professional appearance is lacking</td>
</tr>
</tbody>
</table>

**Comments:**

### Philosophy of Teaching

|                    | Mechanical errors absent; Professional style and presentation; At least three areas fully addressed; Several specific examples for each element | Mechanical errors absent; Professional style and good presentation; At least three areas addressed; At least two specific examples for each element | Few mechanical errors; Style is somewhat professional with a good presentation; At least two areas fully addressed; Only one specific example per element | Many mechanical errors; Style is not professional or presentation is not acceptable; Only two areas addressed but developed; Specific examples not present |

**Comments:**

### Core Competency: Learning About Students

|                    | Appropriate artifact; Connection to the TPEs described; Connection fully explained; Accurate knowledge of typical developmental group characteristics as well as individual variation | Appropriate artifact; connection to the TPEs described; Connection fully explained; Accurate knowledge of typical developmental group characteristics | Appropriate artifact; Connection to the TPEs described; Connection partially explained; Accurate knowledge of development in age group and developmental areas | Inappropriate artifact; Connection to the TPEs not described; connection not explained; Little evidence of knowledge of children’s development |

**Comments:**
<table>
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<tr>
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<th>Distinguished (3)</th>
<th>Proficient (2)</th>
<th>Emergent (1)</th>
<th>Unsatisfactory (0)</th>
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<td>4</td>
<td><strong>Element 2</strong>&lt;br&gt;Connection to TPE&lt;br&gt;Background Family, Behavior, Culture, Language,</td>
<td>Appropriate artifact; Connection to the TPEs described; Connection fully explained; Displays knowledge of individual variation cultural/linguistic and familial background</td>
<td>Appropriate artifact; Connection to the TPEs described; Connection fully explained; Displays knowledge of group characteristics in culture and linguistic heritage</td>
<td>Inappropriate artifact; Connection to the TPEs not described; Connection not explained; Little evidence of knowledge of children's cultural or linguistic heritage and its value</td>
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<tr>
<td>5</td>
<td><strong>Element 3</strong>&lt;br&gt;Connection to TPE&lt;br&gt;Approaches to Learning, Prior knowledge, abilities interests, styles Individual differences</td>
<td>Appropriate artifact; Connection to the TPEs described; Connection fully explained; Displays knowledge of individual variation and how to gain such information</td>
<td>Appropriate artifact; Connection to the TPEs described; Connection fully explained; Displays knowledge of learning styles as applied to group of students</td>
<td>Inappropriate artifact; connection to the TPEs not described; Connection not explained; Little evidence of knowledge of children's learning styles and how to gain information about them</td>
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<td>Comments:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td><strong>Reflective Narrative</strong></td>
<td>Reflected on knowledge, skills and dispositions and connections to core competencies and TPEs; Thoroughly addresses guiding questions</td>
<td>Reflected on at least two (knowledge, skills and/or dispositions) and connections to core competencies and TPEs; Partially addresses guiding questions</td>
<td>Little reflection on knowledge, skills and dispositions related to core competencies, TPEs or guiding questions</td>
</tr>
<tr>
<td></td>
<td>Comments:</td>
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DIRECTED SELF PLACEMENT ASSESSMENT

Power Point Presentation
PEER REVIEW ASSESSMENT

Article on peer reviews in CSU Exchanges, The Online Journal of Teaching and Learning in the CSU, September, 2003:
http://www.exchangesjournal.org/classroom/1156_Wolfe.html

Exchanges: The Online Journal of Teaching and Learning in the CSU
http://www.exchangesjournal.org

Student Peer Reviews in an Upper-Division Mathematics Class
William J. Wolfe
Computer Science
CSU Channel Islands

Introduction
This paper reports on a web-based peer-review process that I used in an upper-division face-to-face mathematics course for the first time. There were 20 students: 17 mathematics majors and 3 computer science majors. I have been a professor of Computer Science for 15 years, but my Ph.D. is in mathematics. I have taught such math-intensive courses as Discrete Mathematics, Analysis of Algorithms, and Automata Theory, but the students were always computer science majors. This was my first time teaching a course that was for mathematics majors. Prior to this class I had implemented peer reviews in several computer science classes, so some of the comments in this paper are based on a comparison with that experience. I will first describe how the peer reviews were implemented and then present the results, including statistics such as the number of reviews submitted and the average scores received (and given) by the students over 12 assignments. In addition, the students were asked to respond anonymously to an online survey about how they felt about the peer-review process. These results will also be presented.

There are several reasons for implementing peer reviews. The primary reason is that they give students direct and timely access to the creative contributions of their classmates. This is a twofold issue: (a) the students learn from each other, and (b) they get to compare themselves with their classmates. The peer-review process puts a student in the role of "critical reviewer," which reinforces his or her understanding of the grading criteria. Peer reviews also encourage class participation, foster an atmosphere of collaboration, and give students a wide audience for their work.

Weekly Assignments
This course and the peer reviews were structured around weekly assignments. While the students were working on the current week's assignment they were expected to do a peer review of the prior week's assignment. Students were asked to review all of their classmates. Therefore, in this class of 20 students, each student was asked to review 19 other students each week. Although this was the goal, many reviews were not done because (a) I told them the reviews were optional (but could be used to satisfy "class participation" requirements), and (b) the reviews turned out to be extremely difficult to do (my choice of assignments got better as the semester progressed but the first three assignments required multiple mathematical proofs, which turned out to be too much for most of the class).

Posting Assignments
Students were required to post their assignments (solutions) on their own web pages. This may seem a little unusual for a mathematics class, but as a Computer Science professor I thought this a skill every student should have and that there was no better time to learn it than now! The school provided a web server, and usernames and passwords were distributed. Many of the students had very little understanding of web pages or web servers. After a few tutoring sessions most of them got the hang of
elementary HTML and FTP. Some students posted their first web pages ever. However, two students never got it completely figured out, so I had them submit their assignments to me (in electronic format) and I did the posting for them.

Electronic Format
The first step in posting an assignment is to get it into electronic format. A few students resisted this and pushed for submitting handwritten solutions, thereby opting out of having any peer reviews done of their work. It is not uncommon for mathematics majors to work exclusively with paper and pencil, but I held the line and insisted that all assignments be in electronic format. The students conformed. However, there were still major issues about how to get sophisticated mathematical symbols or drawings into electronic format. To lessen this concern I steered away from problems that required sketches, and I told them it was fine to write out mathematical symbols such as "summation of k squared from k = 1 to n" since reviewers would know the context (i.e., the problems from the textbook). Some students used MS Word with Equation Editor or MathType. This was a labor-intensive process but produced professional-looking documents. LaTeX files and PDF files were also used to create very professional documents. Using HTML was fairly effective, but not as professional looking. Simple text files with the symbols written out were considered acceptable, and in my opinion preferable, but I could not halt the march toward professional-looking documents. Subsequently, students complained about the amount of effort they were putting into electronic formats. Feeling their pain, I gave them a week off from assignments after the third assignment and reduced the required postings to only one problem per week.

A nice side effect is that many students now have examples of original professional documents to add to portfolios, attach to resumes, or post on home pages.

Course Web Site
After getting their homework in electronic format and posting it on their web pages, they were told to submit their URLs to the course web site, which featured a course-management system that I developed. The course web site then created a page with a list of links, one for each student. After completing and posting their assignments, students logged on to the course web site and clicked on the links to evaluate the solutions submitted by their peers. Each student completed a peer review by submitting a score (1 to 10) and a comment. The course web site kept track of all these entries and provided a way for students to submit reviews and to see the reviews they received from their peers.

Anonymous Reviews
Students knew whom they were reviewing, since that was obvious when they visited another student's web page, but they did not know who reviewed their own solutions. Students were told they could appeal to me if they felt they got unfair or inaccurate reviews. Although this had happened a few times in prior computer science classes, it did not happen at all in this class. I think this was the case because the mathematical content of the assignments left very little room for opinions or subjective judgments. In prior classes there was an occasional comment that could have been viewed as rude or inflammatory. In each of these cases it was clear to me that the comment was the result of poor judgment as opposed to malice. Although rude comments were extremely rare, I found that I had to spend a lot of time reviewing the comments to make sure they were appropriate.

Peer Review Scores
Completing a "peer review" in this context entailed reviewing another student's homework and then submitting a score from 1 to 10 with a supporting comment. The score of "1" was reserved for assignments that were "missing." I felt that the threat of getting a "1" was a strong incentive for students to post their homework on time. Several scores of "1" could bring down a student's peer-review average significantly. I doubt that this is the best way to handle missing and late assignments but it is a simple, clear, and direct way to discourage late work.
Rubric
The students were told to review their classmates' work and try to make helpful evaluations, such as pointing out errors or better solutions. They were also given a rubric that was intended to help them distinguish between three categories of potential problems: accuracy, completeness, and presentation. Students were provided with the following table:

<table>
<thead>
<tr>
<th>Score</th>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Missing</td>
<td>Could not find project.</td>
</tr>
<tr>
<td>2</td>
<td>Unacceptable</td>
<td>Grossly incomplete and/or grossly inaccurate.</td>
</tr>
<tr>
<td>3-5</td>
<td>Poor</td>
<td>Inaccurate and/or incomplete.</td>
</tr>
<tr>
<td>6-7</td>
<td>Satisfactory</td>
<td>Complete, but poor presentation or somewhat inaccurate/incomplete.</td>
</tr>
<tr>
<td>8</td>
<td>Good</td>
<td>Complete, with good presentation (explanations, graphs, charts, etc.).</td>
</tr>
<tr>
<td>9</td>
<td>Excellent</td>
<td>Complete, accurate, excellent presentation.</td>
</tr>
<tr>
<td>10</td>
<td>Best</td>
<td>The best of all the projects you reviewed. (Give this score to only one project.)</td>
</tr>
</tbody>
</table>

There was also an information page that expanded on each table element, giving some examples of each case. Students were also told that for each assignment they should only give one classmate a score of "10." This was intended to discourage them from submitting all 10s. The system did not prevent them, however, from entering more than one 10, but by observing the scores I could see that the majority of the students abided by this rule. It appeared that the students accepted the idea that there was one "best" homework in the bunch.

Participation
Although doing peer reviews was not required, the students were told it would be considered part of their "participation" grade, which was set at 30% of the final grade. They could participate in the class in many other ways, they were told, such as classroom discussions, helping other students, taking part in the online forum, etc. Although participation in the peer reviews was sufficient to ensure a good participation grade, it was not necessary.
All the students were open to receiving reviews, but two students chose not to give any reviews. Three other students gave fewer than five reviews each over 12 assignments, so their participation was negligible. On the other hand, five students gave more than 50% of all the reviews. Fortunately, these five students were among the top students (as measured by the review scores they received from their peers, which was consistent with my own assessment). It appears that the students with a better command of the subject embraced the peer-review process (more about this below).

Review Difficulty
It became clear after the first assignment that reviewing mathematical proofs, the major emphasis of this course, was very difficult. As the teacher I found myself struggling to follow the various rabbit trails that popped up here and there in the jungle of mathematical proofs submitted by the students. Although mathematics is purported to be a very precise science, it was often the case that there were 20 distinct
proofs submitted for a given assignment, many of which were correct. As expected, the students also had trouble following the proofs of their peers. One thing became clear to all of us: At this level of mathematical sophistication, analyzing another person's mathematical proof was a very difficult and time-consuming process. A few times during the semester students expressed appreciation for those students whose postings included extensive explanations of each mathematical step. Because the reviews were so difficult, I reduced the peer-review process to a single problem per week after the third week. Despite the difficulties, I believe doing peer reviews is a great exercise for the students. This was a new experience for these students, even though most undergraduate mathematics is learned from reading a textbook, which is also the evaluation of someone else's mathematical reasoning. The key difference is that a textbook proof is assumed to be correct.

Potential for Cheating
With homework assignments posted on publicly accessible web pages there was an obvious potential for cheating. However, there was a natural force working against copying homework: During the peer-review process the students could see each other's work. If there were any discrepancies the students were very likely to catch and report them. There were a lot of "eyes" on these assignments. That is, a similar detail that might get past the teacher was unlikely to get past all the peers. I did not find any evidence of copying. All the submitted work looked painfully original, and the students were encouraged to read and learn from the solutions submitted by their peers. They were told they could modify their own work if they gave credit to the source. This worked fine, as a few students pointed out things they had learned from other students. A final note in this regard: It seemed to me that the mathematics students were much more resistant to the idea of "shared" work than computer science students. That is, they seemed to consider the mere act of looking at someone else's work as tantamount to cheating, whereas typical computer science students are more likely to look at someone else's code and say "Thanks! I can use that!" It is a badge of honor in computer science to have others copying and using your code.

Late or Missing Assignments
One of the most difficult assessment tasks is that of a student who appears to know the subject fairly well as evidenced by in-class exams but who does not submit the assignments on time or at all. I do not believe that in-class exams provide the most accurate assessment of student "knowledge." I do not think that an exam can capture the subtle and multifaceted forms of learning that go on when a student does assignments on time, participates in related classroom discussions, and meets with the professor from time to time. When a student gets credit for a course I think it should indicate that he or she had a rich experience with the subject matter, having done more than pass an exam or two, but mathematics is one of those subjects where exam performance is often the only important outcome. One way to motivate a student to participate is to apply the threat of a reduced grade, but this puts the teacher in the role of "enforcer" which can lead to a very negative student-teacher relationship, especially if the student knows the subject matter fairly well and feels that participation is a waste of time. The peer reviews address this issue by putting students on notice that not only does the teacher expect timely work but so does the rest of the class. A late assignment will get several scores of "1" submitted, as opposed to just the teacher's feedback, thereby distributing some to the burden of enforcement. In fact, in this peer-review environment the teacher can take on the role of "coach."

Statistical Results
There were 715 reviews in the system after 12 assignments. There could have been as many as 4,560 if every student reviewed the work of every other student on all 12 assignments (20 x 19 x 12). There were only 715 reviews because the process was optional and the students found them difficult to do. Also, some of the students complained about having to do all the reviews in the computer lab because they did not have fast Internet connections at home. The computer labs were abundantly available, but they required a special trip for some students.
Average Review Score
The average review score received by each student over 12 assignments is shown in Figure 1. The students are ranked from 1 to 20 based on this score, and all the charts that follow refer to the students by this ranking. I found the ranking to be accurate. That is, I was hard pressed to disagree with the rankings based on my overall assessment of their performance, which included a semester's worth of assignments, exams, quizzes, emails, office visits, and several problem-solving sessions. I knew each student very well at the end of the semester. After looking closely at each ranking I was surprised by how accurate they appeared to me. For example, the top student (rank=1) was clearly ahead of the rest of the class. This was clear not only from the content of the submitted work but also from the careful explanations provided with each proof. The rankings made fine distinctions. For example, students with high rank submitted excellent work that was always on time. The salient feature of the higher-ranking students was that not only were they excellent students in their own right but there was also strong evidence that they worked in study groups outside the class. Their high average review scores reflected the fact that their peers recognized the quality and consistency of their work. Students whose ranking fell near the middle of the pack were characterized by good but occasionally wrong work and/or some late or incomplete assignments. In my estimation the errors in their work were the kinds of things that would probably have been caught if they had worked together in a study group. As I scrolled down the rankings I could not find any contradictions to my own comparative evaluation of their work. The rather simple and crude reviews done by amateurs produced an assessment tool that appeared to be valid.

Figure 1. The average peer review score received by each student.

Number of Reviews Received
Figure 2 shows the number of reviews received by each student. The distribution is very flat, indicating that each student received about the same number of reviews. However, there is a slight downward trend indicating that the students with higher ranking received slightly more reviews than students with lower
ranking. This might be explained by the fact that the higher-ranking students were rarely late with assignments, and it is also possible that the higher-quality work "attracted" more reviews. Although students were originally asked to review all their classmates, the process was optional and hence students could pick and choose from the list of classmates. Although they were instructed to submit reviews first for the students with the fewest reviews (the web page provided this information), the system did not enforce this constraint. It appears that as the semester progressed the students showed a preference for reviewing those classmates who had better submissions and an avoidance of those classmates whose submissions were often inaccurate, late, or incomplete.

Figure 2. Total number of reviews received by each student.

Figure 2. Total number of reviews received by each student.

Student Comments
Student comments ranged from a perfunctory "good job" to detailed feedback, such as the following:

Your answers for 14 and 19 indicate that your proof works if you choose a specific constant as your epsilon, what if for number (14) you chose the value of epsilon to be 3? We could then find an N to satisfy your requirement making this a Cauchy sequence. What is so special about the value 1/2? If your proof is based on assigning a value to epsilon, you need to tell us why you picked 1/2 as your value. Also you should be able to use two non-consecutive terms such as m = n+2 instead of just m = n+1 as the definition of a Cauchy sequence does not restrict m,n to be two consecutive terms but rather it states for ALL m,n > N, not just n and n+1.

Some of the reviews were much more elaborate than this sample, so it was clear to me that some students were putting it monumental amounts of effort. The other thing that stood out from a review of the comments was that the students were very free with praise and appreciation. For example it was not unusual to see a review such as this:
Excellent. Like where you showed sequences were periodic by using n2\pi.

The variety and level of detail clearly provided more feedback for each student than I could have given.
**Average Score Given**

It appeared that students with lower ranking were giving out slightly higher scores, on average, than students with higher ranking. Perhaps students with weaker knowledge of the subject were unable to evaluate the work of their peers effectively. As was already mentioned, it was difficult to follow all the different proofs, so it may be that some of the weaker students "punted" at times and gave out 9s and 10s.

**Number of Reviews Given**

Five of the top six ranking students gave over 50% of the reviews, while five students, primarily from the lower rankings, submitted very few reviews. This is consistent with the fact that evaluating the proofs was very difficult. It seems that only the best students could embrace the task of reviewing their peers on a regular basis.

**Survey on Peer Reviews**

To get a better picture of how the students felt about the peer-review process, I asked them to fill out an anonymous online survey (see Figure 3). The survey was in the form of ten statements, and the respondents were asked to disagree or agree on a scale of 1 to 5. Fourteen out of 20 students responded. From Figure 3 we see a few interesting things. The chart includes the average numerical result as well as the distribution of responses for each statement.

**Figure 3. Results of a survey about the peer reviews.**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Avg</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>I learned a lot from the peer reviews.</td>
<td>3.36</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>The peer reviews helped me see how my work compared to others in the class.</td>
<td>4.07</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>The peer reviews helped me understand that there are many ways to solve the same problem.</td>
<td>4.36</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>The peer reviews helped me learn a lot about web technology.</td>
<td>3.21</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>The peer reviews were relatively easy to do.</td>
<td>2.43</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>The peer reviews helped me get to know my classmates better.</td>
<td>2.93</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>The peer reviews that I received were very useful to me.</td>
<td>3.07</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>The peer reviews that I received were reasonably fair and</td>
<td>3.71</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>
The peer reviews motivated me to do better work.  

3.57  2  0  2  8  2

The peer reviews motivated me to get my assignments done on time.  

3.15  1  2  6  4  1

Students were asked to rate the ten statements in the above chart from 1 to 5, with 1 = strongly disagree; 2 = disagree; 3 = neutral; 4 = agree; 5 = strongly agree.

Statement 1: I learned a lot from the peer reviews.
It was gratifying that 8 of 14 students felt they learned a lot from the process.

Statement 2: The peer reviews helped me see how my work compared to others in the class.
Thirteen of 14 students agreed (checked either "agree" or "strongly agree"). This is to be expected, but I think the consistent agreement with this statement also implies that students highly valued the chance to see the other students' work.

Statement 3: The peer reviews helped me understand that there are many ways to solve the same problem.
Thirteen of 14 students agreed. This is an important lesson. It is clear that the peer reviews drove home the fact that a correct proof can be presented in many ways. Statements 2 and 3 are things that the teacher gets a large dose of in any class. The peer reviews give the student access to the global views of the class that are often reserved exclusively for the teacher.

Statement 4: The peer reviews helped me learn a lot about web technology.
Half of the respondents felt they learned a lot about web technology. This is fairly close to what I expected but I thought there would be more agreement since most of the students needed help posting web pages, but in some cases I may have underestimated their prior web knowledge and overestimated the degree to which they valued such knowledge.

Statement 5: The peer reviews were relatively easy to do.
Nine of 14 disagreed (checked "disagree" or "strongly disagree") with this statement. This is no surprise given the difficulty of the subject matter, but it is a little surprising that 4 students felt that the reviews were easy to do. These may have been the better students or they may be students who did not put much effort into the reviews.

Statement 6: The peer reviews helped me get to know my classmates better.
This statement did not evoke a clear response, but six students disagreed with it. That surprised me. It is hard to understand how students could not get to know their peers better after evaluating several of their homeworks. I have long been struck by how impersonal computer science and math classes have seemed, and as a teacher I have consciously avoided anything non-technical. When I saw the results of my first peer review class, however, I saw a lot of semi-personal comments, that is, comments addressed to other students that were friendly, encouraging, and leaning a little bit on the personal side. It appeared to me that the peer-review process was helping the students develop relationships. In most mathematics and computer science classes the students come and go with very little classroom interaction or group activity, so there is a tendency in the technical subject areas for students to be isolated. The peer-review
process gets them all communicating, even if it is mostly on a technical level. Given my experience with my previous classes, I expected more students to agree with Statement 6. That they didn't might be explained by the fact that a few of the students knew each other quite well before the class started, so seeing many samples of their friends' work did not help them get to know them any better. It could also be a direct consequence of the fact that five students gave very few reviews (there is no way to know which of these students were among the respondents).

Statement 7: The peer reviews that I received were very useful to me.
I was not surprised by the lukewarm agreement with Statement 7. Although the review process is very effective in getting everyone to evaluate each other's work, it was only the best students in the class who could make very useful comments.

Statement 8: The peer reviews that I received were reasonably fair and accurate.
It is significant that 12 of 14 students agreed that the reviews were reasonably fair and accurate, despite the fact that the reviewers were amateurs and some of the reviewers got the same problems wrong on their own assignment. This is a little surprising.

Statement 9: The peer reviews motivated me to do better work.
Ten of 14 felt motivated to do better work. This is consistent with the "audience" effect: people are motivated to produce higher quality work when they know it will be viewed by a larger audience. Exposing their work to the rest of the class was a significant motivation to do better work.

Statement 10: The peer reviews motivated me to get my assignments done on time.
This statement got a lukewarm agreement. This surprised me a little because I thought most of the students were making an extra effort to be on time to avoid the peer scores of "1." But it appears that this peer pressure did not affect them as strongly as I thought it would.

Conclusions
I believe the peer reviews in this mathematics class were very effective. That is, they facilitated the learning process by demonstrating many ways to solve the same problem, providing hints and tips on how to solve the problems, and providing a lot of personalized feedback. It is clear that the peer reviews were difficult to do but this is partly the result of poorly chosen assignments (it was my first time teaching this course). The peer reviews motivated students to do better work, and, to a lesser extent, motivated them to be on time with their assignments. They gained lots of experience in evaluating mathematical reasoning in a realistic setting (i.e., not the text book). It also appears that students appreciated the chance to see how they were doing with respect to their peers. The results of the peer reviews gave me valuable information, which added an extra dimension to my own assessment of their work. Despite the fact that the reviewers were amateurs, the net effect of all the reviews, as represented by the average review scores received, appeared to be an accurate assessment tool.

If I were again to teach this class using peer reviews, I would spend much more time on selecting the specific problems for peer review. That is, there still would be a set of problems due each week but not all problems—and most likely only a single problem—would be subjected to peer review. This makes the peer reviews easier and avoids overwhelming the average student. However, I am not sure that I would completely suppress a student's willingness to post all the solutions. Some students are willing to contribute significant amounts of work for the benefit of the whole class, and I would not want to lose this energy. Finally, I would spend more time facilitating responses to the reviews. When a student receives a review I would like him or her to act on it. For example, it would not be hard to extend the system to allow the student to respond to a review with "agreed, updated my homework accordingly" or "disagree and here's why." This pushes the dialogue one step further. On the other hand I would not want to encourage "flame wars," so I do not think it necessary to communicate these responses to the original reviewers.
For those teachers who are considering online peer reviews in their classes I would suggest that the first issue is web access (students need high-speed Internet at home or in a lab) and the second issue is web skills (for the teacher and students). Many students have extensive web skills and have no problem posting simple things such as writing exercises on a web site, but there are many who may require a lot of coaching (and this is true for many teachers as well). I would contact the school's IT department and/or faculty development office to see what support they can provide. The IT department should be able to field student questions about web browsers and how to post web pages. After these practical issues are resolved I would focus on the assignments and make sure they are straightforward, but not so simple that the student reviewers end up reading the same answer over and over. This happened on one of my assignments in a prior computer science class and I was a little surprised at the high level of dissatisfaction. The students did not like the idea of wasting their time on a peer-review process that had no meat to it.

Among the things that I learned from applying peer reviews are

1. Students greatly appreciate the opportunity to see what everyone else is doing and thereby compare their work.
2. Some students will apply themselves to the role of "critical reviewer" with a passion.
3. Most students see the wide audience provided by the peer-review process as a golden opportunity to demonstrate, or show off, their skills and abilities. (Be prepared to see some outstanding work!)

The instructor must be online every day for a process as aggressive as the one described in this paper (weekly peer reviews). Although I found the students to be very professional in their approach to peer reviews, I also found that I had to watch the reviews very closely for such things as insulting comments and inaccurate information. I have managed to avoid these pitfalls in the past by responding immediately when I saw anything inappropriate. Oftentimes a student would alert me and then I would act quickly to rectify the situation, so this is not a process that can be put on automatic. But, what I like about the process is that it uses my knowledge and experience in a very effective way. That is, most of the mundane issues, such as missing assignments, incomplete work, etc., were being handled very nicely by the peer-review process, whereas I took on a supervisory role and chimed in with instructions, guidance, and information when and where I deemed it appropriate.

To manage a peer-review process like this I had to develop my own web site, but web platforms such as Blackboard, eCollege, and ConnectWeb are developing the flexibility to handle such activities. A more comprehensive approach to systematic online peer reviews, called Calibrated Peer Review, was developed at UCLA over the past few years (see http://cpr.molsci.ucla.edu). Currently this is a free service so you can sign up on their web site and follow the instructions. Finally, I would be happy to help (time permitting) any teacher who wants to pursue setting up a system similar to mine.

Acknowledgments

I would like to thank the editors of Exchanges for all their helpful comments and suggestions for improving the paper's content. I would also like to thank Professor Carol Holder, CSUCI, for her technical comments, reference material, and overall support for the development of the peer-review method described in this paper. Thanks also to Professor Harley Baker (CSUCI—Psychology), for his comments concerning the statistical results discussed here, and to Professor Paul Rivera (CSUCI — Economics) and Professor Robert Bleicher (CSUCI — Education) for their helpful comments about the applicability of this peer-review method to writing exercises in the Humanities. Finally I would like to thank Cheryl Dwyer Wolfe for her insightful comments.

Posted September 3, 2003

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2. Article on peer reviews in ACM SIGITE, October, 2004:

3. Power Point Presentation at the "Teaching with Technology" Conference at University of Colorado, August 10, 2004, Boulder, Colorado:
http://compsci.csuci.edu/wwolfe/csuci/TWT_Conference/TWT_Presentation.ppt

4. Computer Science Learning Goals website:
(Includes links to "learning goals vs. course" grid, and to an instructor survey).

5. The "Clickers" demo:
http://compsci.csuci.edu/wwolfe/ucd/online/
click on the last course on the list (COMP 424 Computer Security)
Then use the password: GUEST
Then click on Syllabus (at the top of the page)
Then look for the "Clickers" column and click on number 2 (number 1 is blank).
Then pick a question and click on it.
Then enter any answer you want and click on Submit (I'll be able to clean up the data, since any
"GUEST" information will be deleted, so you can pick any answer).
Then click on Show Results link.

6. Peer Review demo:
http://compsci.csuci.edu/wwolfe/ucd/online/
Click on: CSC 4508 Intro SW Engin. Fall 2002 (sixth on the list).
Then use the password: GUEST
Then click on Syllabus (at the top of the page)
Then click on Peer Reviews (at the bottom of the Syllabus page)
Then you can click on "Do Reviews" or "See Scores"
Clicking on Do Reviews sends you to a list of student web pages for that assignment.
The student would then view a student's web page and then come back to this page and then click on
"Do" and enter a score and a comment.
Clicking on See Scores shows you the scores and comments that have been received by GUEST for that
assignment (but GUEST will have no reviews, so this is where the demo needs me to log on and use my
administrator access authority to see sample student scores and comments etc.

7. "Quiz Results" -- another demo that can be done from the course website (log on as GUEST), and:
Syllabus --> QData.
BUSINESS WRITING ASSESSMENT

Assessment Pilot Project Report Spring 2004

Title of Project: Assessing One Of The Three ‘Cs’ in BUS 499
Program: Business and Economics

Project Coordinator: Ashish Vaidya

Description of the Project:

The Business and Economics program for its pilot project directly assessed the writing competency of students in the Capstone course. Students in BUS 499, the Capstone course, individually and in teams, analyze research, discuss and report on, complex written business cases. In Spring 2004, two sections of BUS 499 were offered. Written cases for both sections were assessed.

Two elements of writing competency were assessed: The Quality of Writing, and Analysis and Integration. A scoring rubric (see attached) was used to record the scores on two individual and one group case analysis.

Results:

The results of the scores for the two sections of BUS 499 offered during Spring 2004 are displayed below:

Table 1 and 4 summarizes the Descriptive Statistics for Individual Case 1 for each section.
Table 2 and 5 summarizes the Descriptive Statistics for Individual Case 2 for each section.
Table 3 and 6 summarizes the Descriptive Statistics for Group Case 1 for each section.
Figure 1 – 6 illustrate the scores received on each of the assignments.

The scoring rubric provides a numerical scale for assessing both the quality of writing and the quality of analysis and integration. In each case two individual case reports and one group case report was assessed.

The data suggests the following:

- The average score on the quality of writing is above 3 for three of the four individual cases and both the group cases analyses.
- The average score on the analysis and integration is in the range of 2.3 and 2.7 for both individual and group case analyses.
The variation in the numerical scores is lower for the quality of writing than it is for the analysis and integration.

Individual numerical scores in one section improved between the first and second case, while they declined in the second section.

Next Steps:

The Business program needs to undertake a comprehensive assessment of its major and identify a complete set of direct and indirect indicators of assessment. As part of this process, the program will need to develop a schedule of assessment, budgetary requirements, and performance standards for benchmarking. The program has already committed to administer the Business Assessment Test (BAT), a CSU-wide assessment tool in the Capstone class.

Writing Assessment Scoring Rubric

Quality of Writing
1. Numerous grammatical errors throughout, poorly structured
2. Quality inconsistent: some sections well-written, others poor
3. A few grammatical errors scattered throughout; generally acceptable
4. Excellently written from beginning to end; ideas well-organized; smooth transitions; a pleasure to read.

Analysis and Integration
1. No analysis; sections inconsistent with each other
2. Some analysis; few inconsistencies
3. Good analysis and integration
4. Excellent analysis and integration

Two Additional Excel files give specific analysis data.
BIOLOGY LABORATORY SKILLS ASSESSMENT

Details in PDF File
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III. Lab Skill Acquisition
IV. Syllabi
V. Sample lab exercises for BIOL 200
VI. Sample lab exercises for BIOL 201
VII. Sample lab exercises for BIOL 300
VIII. Sample lab exercises for BIOL 400
I. Final Report
Introduction

One of the specific goals of the Biology Program is to provide students with technical proficiency in modern laboratory skills. Many Biology students plan to pursue careers in the biotechnology industry or go on to graduate school and laboratory skills are essential for these pursuits. To assess whether we are achieving this goal, we devised an assessment project to analyze exposure to laboratory techniques in four courses and mastery of selected laboratory techniques. The four courses examined were Principles of Organismal and Population Biology (BIOL 200), Principles of Cell and Molecular Biology (BIOL 201), Cell Physiology (BIOL 300) and Molecular Biology (BIOL 400). Each of these courses has an associated laboratory component and each class has 12-15 different labs. For each course, we identified specific lab techniques and determined whether students were exposed to introductory or advanced levels of a given skill. To assess student learning, we incorporated some hands-on practice of laboratory techniques in the Cell Physiology course. Students were asked to perform some basic pipetting and microscopy procedures during the laboratory practical.

Data collection

Laboratory syllabi, manuals and handouts were collected for each of the courses and used to develop matrices indicating specific laboratory skills and the course/lab in which the skill is taught. To assess student learning, students were asked to perform some basic laboratory technique during the lab practical. The instructor carefully observed this procedure and used a check-sheet (see attached) to evaluate the procedure. Each item on the check-sheet was given a point value and points were added up to determine proficiency for each technique.

Analysis

Content Analysis

Microscopy. Three of the four laboratories (BIOL 200, 201 and 300) examined provide students with an introductory exercise in microscopy and then follow this activity with numerous labs that allow students to practice their skills in microscopy.

Pipetting. Two of the four laboratories (BIOL 300 and 400) provide students with extensive opportunities for using pipettes.

Electrophoresis. Students are introduced to electrophoresis in BIOL 201 and BIOL 300 and then in the more advanced laboratory setting in BIOL 400 are provided with numerous opportunities to practice this technique.

Standard curve/unknown determination. In three of the four courses (BIOL 200, 300 and 400), students are required to construct a standard curve and then determine the concentration of an unknown using this curve. These exercises allow students to practice quantitative and analytical skills.

Advanced molecular biology techniques. Advanced recombinant DNA techniques are introduced and practiced in BIOL 400.
Field/identification techniques. Students are introduced to field techniques and exposed to a broad spectrum of organisms in BIOL 200.

Lab skill Acquisition

Microscopy. Students were asked to first locate an object using a low power objective and were then asked to focus on a chromosome spread using a high power objective. A scoring sheet was used to assess student performance of these tasks and a proficiency score for each student was determined. The class average for this exercise was 77% with a range of 30-100%. One of the specific areas that lowered student performance on this exercise dealt with the use of the 100X oil objective lens. Seven of the fifteen students were not able to either properly apply oil to the slide or clean the oil off of the lens.

Pipetting. Students were asked to pipette a particular volume of water and note the weight of the pipetted water. A scoring sheet was used to assess student performance of these tasks and a proficiency score for each student was determined. The class average for this exercise was 93% with a range of 70-100%.

Conclusions

This content analysis revealed that students who successfully complete all four of these courses will be exposed to a wide variety of laboratory techniques. Although many of the laboratory exercises involved microscopy and pipetting, use of these techniques was not deemed to be excessive since students gained proficiency in these techniques in the lower division laboratories and then used these techniques to engage in experimentation in higher division laboratories. The lab skill acquisition study revealed that, although most students master techniques in microscopy and pipetting with a high level of proficiency, a small number of students in this sample still struggled with these techniques. The following strategy is suggested to improve student performance in these areas.

1) Assess proficiency in microscopy and pipetting early in the semester.
2) Provide students with written feedback indicating their level of proficiency.
3) Work individually with students that did not perform well on the early assessment
4) Peer-assistance: Pair-up students with high proficiency in the techniques with students that need assistance.
5) Perform a follow-up assessment later in the semester to determine if student performance has improved repeat steps 3 and 4 as needed.
II. Content Analysis of BIOL 200, 201, 300 and 400
<table>
<thead>
<tr>
<th>Name of Lab Activity</th>
<th>Microscope use</th>
<th>pH meter</th>
<th>Data collection</th>
<th>Data interpretation</th>
<th>Ecosystem Interpretation</th>
<th>Evolution</th>
<th>Spectrophotometry</th>
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I = skill is introduced  
P = skill is practiced
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P = skill is practiced
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I = skill is introduced  
P = skill is practiced
III. Lab Skill Acquisition
PRACTICAL (4 @ 2 points each = 8 points)
1. Pipette 3150 µl of distilled water into the weigh boat and calculate the % accuracy. Note: 1 ml of dH₂O weighs 1 gm; 1 µl of dH₂O weighs 1 mg.

2. Pipette 10 µl of solution A into each of the three tubes.

3. Prepare a wet mount of the specimen provided and focus on an interesting object.

4. Locate and focus on a chromosome spread using the 100X objective.
## SCORING SHEET FOR PRACTICAL

### Pipetting techniques

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<tr>
<td>1) Set volume correctly</td>
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<td>2) Used proper pipette for volume</td>
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<td>3) Used proper tip for pipette</td>
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<td>4) Held pipette properly</td>
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<td>5) had plunger at correct stop to draw up fluid</td>
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<tr>
<td>6) drew fluid into tip in slow, even manner</td>
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1, 2, 3 and 5 = 20% each  
4 and 6 =10% each

### Microscope techniques

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<td>1) started at low mag, then progressed to high mag objectives</td>
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<td>2) returned to low power or lowered stage height objective before removing slide</td>
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<td>3) properly applied oil to slide</td>
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<td>4) properly cleaned oil off lens</td>
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<td>5) used only fine focus with high power objective</td>
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<td>6) properly focused on chromosome spread with 100X objective</td>
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<td>7) Focused with lower power lens and then kept stage height constant when switching to 100 X</td>
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<td>8) did not put oil on slide with 4, 10 or 40 X objectives in place</td>
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1 and 6 = 20% each  
2, 3, 4, 5, 7 and 8 = 10% each
LAB SKILL ACQUISITION SUMMARY

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Average 92.8  76.6