

Application for Academic Year 2009-2010
Center for Writing Excellence Department Development Grant
Communication Coming Into the Capstone
Computer Science and Systems Analysis (CSA) Department

Overview

The Computer Science and Systems Analysis (CSA) department offers two computing degree programs: Computer Science (CS) and, starting in Fall, 2009, Software Engineering (SE) as well as a minor in CS and several thematic sequences. When representatives from the computing industry are asked what skills they require in new graduates, the importance of communication skills invariably comes up. In the summer of 2008, Miami University hosted the NSF-sponsored Software Communication Chautauqua. This was a joint project between the CSA department at Miami, the Roger and Joyce Howe Center for Writing Excellence, and the CS and Humanities departments at Michigan Technological University. This Chautauqua (workshop) brought together 35 participants from Academia and Industry to discuss the skills required of our graduates, the difficulties in teaching them those skills, and to share some activities and techniques used at various institutions to teach communication.

One of the issues that arose at the Chautauqua is the need to define student learning outcomes for communication and integrate those into the curriculum in such a way that teaching communication can be done in support of, not instead of, teaching the technical skills. We propose to refine industry and professional requirements for communication skills into a realizable set of student outcomes and to design assignments and activities to realize those outcomes within a group of critical courses without compromising the technical requirements of those courses. We are asking The Joyce Howe Center for Writing Excellence to help us in this effort by providing initial training for instructors, reviewing proposals for activities to realize outcomes and guidance in designing effective evaluation procedures and improvement strategies. This is part of a larger effort involving other past and future projects.

Although CS and SE curriculum guidelines and accreditation requirements provide some guidance regarding such outcomes, they are very general. Examples are the following:

- Computer Science curriculum guidelines, CS2008 (<http://www.acm.org/education/curricula-recommendations>), identifies the importance of professional practice and communication skills it provides little guidance on what those skills are beyond mentioning teamwork and presentations.
- Our accreditation agency, ABET, requires that CS students should have “an ability to communicate effectively with a range of audiences” and the that engineering graduates (which include Software Engineering students) should have “an ability to communicate effectively.”
- The Software Engineering (SE) curriculum guidelines, SE2004 (<http://sites.computer.org/ccse>), are slightly more specific, requiring writing (of reports, assignments, evaluations, etc.), team communication (written, oral, etc.), reading (source code and documentation), and presentation skills as topics that should be taught in the SE curriculum.

The SE guidelines explicitly state, and the CSA department’s last ABET evaluation emphasized, that it is not sufficient for students to see these topics only in their general education courses.

The aims of this proposal are to teach the above writing and communication skills by:

- Designing an integrated approach in our CS and SE curricula using a Writing Across the Curriculum Approach
- Over the summer, developing specific student learning outcomes in a set of required courses so that all we address all of our majors, writing-based activities to meet the student learning outcomes, and rubrics to measure student accomplishment
- During Fall 2009, testing the outcomes and activities by the authors of the proposal and then repeating the activities in Spring 2010 by other faculty using the training activities and evaluation rubrics as guidelines.

We will target the following courses which are required for both degree programs: CSA174 (Fundamentals of Programming and Problem Solving), CSA271 (Object Oriented Programming), CSA274 (Data Structures), CSA262 (Technology, Ethics, and Global Society), and CSA201 (Introduction to Software Engineering). The goal is to develop writing and communication outcomes and integrate those outcomes into those courses so that the students can progress in their abilities throughout the program. The activities will include:

- **The learning activity description.** The activity description will include the student learning outcomes addressed by the activity and the instructions given to the student to perform the activity

- **Training materials for the students** on the writing skills required to successfully complete the activity
- **Evaluation rubrics** to measure the success of the students in completing the activity
- **Training materials for instructors** on how to administer the activity, how to tailor it for use in subsequent semesters, and how to provide useful feedback to the students on their writing.

Collaboration with the Howe Center for Writing Excellence

Howe Center support will be needed during the summer for initial training of the instructors (two will attend the May workshop), reviewing the initial learning activity plans, and reviewing the completed activities. In the fall semester, the Howe Center will participate in a project-kickoff at the first faculty meeting, meet with participants to discuss evaluation strategies, and provide advice on how assignments should be adjusted depending on the results of the first semester. During the spring semester the Howe Center will meet with faculty at the start of the semester (the initial project team and faculty teaching the target courses in the Spring who are new to the project) and toward the end of the semester to review the project assessment developed for the final report.

Potential Impact

The five courses involved in this proposal are all required for CS and SE majors with current enrollment of 204 majors. In addition, three of the targeted courses are required for the ECE program (75 majors), and for the CS minor (34 students) and thematic sequences (25 students). The Ethics, Technology, and Global Society course (CSA 262) is a Miami Plan course offered to non-majors as well as required for majors. This could result in impacts on students from programs outside of engineering. This project will only be applied to courses offered at the Oxford campus but we plan to seek partners in CIT to incorporate the outcomes and assignments into courses taught at the regional campuses as well.

Besides providing immediate benefits to our students, this project will serve as an initial study to guide a larger effort that we are proposing to undertake with partners at North Carolina State University (NCSU) to define program-wide student learning outcomes, a set of communication learning activities to achieve those outcomes and model curricula integrating those outcomes into our programs. These model curricula would be implemented and evaluated at Miami and NCSU. The project proposal is being submitted to the NSF's Computer & Information Science & Engineering Pathways to Revitalized Undergraduate Education in Computing (CPATH). PIs on the project are Janet Burge, Paul Anderson, and Gerald Gannod (Miami) and Mladen Vouk and Mike Carter (NCSU).

In addition, there is the possibility of a national (or even international) impact from this project should the CPATH proposal receive NSF funding. The outcomes and assignments developed for this project will serve as examples for the larger project.

Project Objectives

Using the grant, we hope to accomplish the following goals.

1. Identify a set of course-specific learning outcomes that identify the communication skills that students should learn in the target courses.
2. Develop writing-based learning activities and assessment rubrics that address those outcomes for each of the target courses that allow students to progress toward the needed communication skills as they move through the program.
3. Package these learning activities along with training materials for faculty on how to administer and evaluate the activities, training materials for students on the writing skills required, rubrics to use in grading, and instructions on how to give beneficial feedback to the students.
4. Use these activities in Fall 2009 and Spring 2010 offerings of the target classes. The Fall 2009 offerings will be taught by the faculty who develop the activities.

Project Plan

Our plan is oriented around the following core student learning outcomes. These outcomes are based on (and contain the language of) the draft communication outcomes from the Software Communication Chautauqua and a draft paper written by two of the participants¹.

1. **Audience** – Students should be able to communicate effectively with a wide variety of audiences. In particular, the student should be able to select the most appropriate format for communicating with a particular audience and for a particular purpose.
2. **Completeness** – Students should answer questions clearly by going beyond what the question explicitly asks, by anticipating what else the questioner might wish to know, and by focusing on the bigger picture.
3. **Collaboration** – Students should be able to work collaboratively to develop joint solutions or communications. This requires the ability summarize key issues, negotiate solutions, and make the transition from debate to formalizing a decision.
4. **Design** – Students should be able to explain code, methods and design decisions clearly, using consistent and appropriate terminology. The student should be able to explain both the intent of the code and the reasons behind key choices.
5. **Critical Reading** – Students should be able to read many kinds of communications (including code and diagrams as well as prose) with comprehension, and be able to evaluate information to determine its credibility and/or relevance.

The following table summarizes the current uses of writing in each course, the learning outcomes to be addressed by our revisions under this grant, and other pertinent information. Note that each of the outcomes listed above will be addressed in at least two of the courses. We expect to refine the learning outcomes during our planning this summer to create concrete outcomes that can be assessed.

<p>Course: CSA 174 – Fundamentals of Programming and Problem Solving</p> <p>Current writing: Students write journal entries with no specific requirements other than to describe their efforts on labs, including documenting any problems encountered. An online forum is available where students post questions about assignments, and reply to posts from other students. Forum participation is not required. Focus is on <i>knowledge</i> and <i>comprehension</i>.</p> <p>Outcomes: Completeness, Critical Reading</p> <p>Proposed revision: Instructors are unsatisfied with levels of completeness and critical reading. We propose to redevelop the requirements for journaling assignments and online forums, and develop rubrics for evaluating journal entries, to increase student success.</p>
<p>Course: CSA 271 – Object Oriented Programming (Requires CSA174)</p> <p>Current writing: Students write reflections on each homework assignment. Focus is on <i>application</i> of object-oriented design principles</p> <p>Outcomes: Critical Reading, Design</p> <p>Proposed revision: Instructors are unsatisfied with the quality of the reflections produced. Students do not take these assignments seriously. We propose to re-develop the requirements for the assignments so that students will produce project reports that serve as a combination status report and test report. We will also develop rubrics for evaluating project reports, to evaluate student success. We will also develop an assignment where students review code to look for defects and to evaluate the design quality. We plan to use this assignment in improve their code reading skills as well as design abilities (by studying both good and bad designs).</p>
<p>Course: CSA201 – Introduction to Software Engineering (Requires CSA271)</p> <p>Current writing: Each student writes approximately 25 brief (less than one page) summary and reaction essays for course readings (audience is the instructor). Also, when working in teams students write a number of software design artifacts. Artifacts can include a vision document, use case scenarios, requirements document, design diagrams using UML, test plans, and others. The audience for these documents varies by type and can include an external client, the instructor, and peers. Documents are also maintained in a version control environment. As a team, students make two or more presentations to peers, the instructor, and the client. Focus is on <i>communication</i> of design requirements, goals, and team status</p> <p>Outcomes: Audience, Collaboration, Design, Completeness</p> <p>Proposed revision: Increase the level of critical thinking in the individual writing assignments. Develop a revision methodology so that students use successive refinement and peer review to refine and improve their design documents, and maintain version history, throughout the course. Also, provide evaluation rubrics for assignments developed for different audiences to educate students on how the style and content of their writing needs to be tailored to the expected audience.</p>
<p>Course: CSA264 – Technology, Ethics, and Global Society</p> <p>Current writing: Students write 3-5 major papers, and also use free-writes to document their reflections on readings.</p>

¹ Ruff, Susan, Carter Mike, “Communication Learning Outcomes from Software Engineering Professionals: A Basis for Teaching Communication in the Engineering Curriculum,” accepted for publication at the Frontiers in Education Conference, 2009.

Outcomes: Audience, Collaboration, Critical Reading

Proposed revision: Currently all of the papers in the class tend to have the same format: Thesis-driven position papers. We would like to design several assignment frameworks and rubrics that explicitly address issues of audience. Secondly, we routinely use small group exercises in class, but we generally grade them based only whether or not students participate, not on the quality of what they produce. We would like to explore developing assignments and rubrics to making these collaborative writing exercises more rigorous.

Course: CSA 274 – Data Abstraction and Data Structures (Requires CSA271)

Current writing: Students are given a concrete problem. They must select the best data structure for solving the problem, and write a justification for their selection. The focus is on *analysis* of requirements and *synthesis* with received knowledge about the efficiency of various data structure operations.

Outcomes: Collaboration, Design

Proposed revision: Students currently have a group project, but they are not currently required to come to consensus on their design, or to document their design process (as they would have to do in the workplace). We propose to create a new group design assignment that follows from the individual design assignment we already do.

The team members on this proposal are all scheduled to teach offerings of the target courses in the Fall 2009 semester. These faculty members will develop the outcomes, activities, and supporting materials during the Summer of 2009.

Assessment Strategy

We will assess the project in order to make improvements as needed and also to have publishable results (several of the team members have been very successful at publishing project results at conferences such as SIGCSE (Special Interest Group on Computer Science Education), CSEE&T (the International Conference on Software Engineering Education and Training), and FIE (Frontiers in Education). We will be applying for IRB approval of our assessment so we can publish the results.

All members of the team will be using the new learning activities in courses that they have taught previously. When possible, they will use data collected from the prior course offerings as a baseline coming into the project (not all courses involved electronic submission so student data may not be available for all courses).

During the Fall of 2009, the project will be assessed using the following methods:

- Surveys administered at the start and end of the course
- Evaluation of student work using the evaluation rubrics developed for the project
- Comparison of student work for students who enrolled in one course with communication learning activities versus those who took multiple courses simultaneously
- Comparison of student work to previous semesters (when data is available)

During the Spring of 2010, the project assessment will have a more detailed assessment:

- Surveys administered at the start and end of the course
- Evaluation of student work using the evaluation rubrics developed for the project
- Comparison of student work from those who had courses with communication learning activities the previous semester and those who did not
- Evaluation of student progress for those who had communication learning activities the previous semester (how they improved from semester to semester)

Team Members

The principal contacts include N. Krumpe (CSA174), J. Burge (CSA271), W. Brinkman (CSA274), D. Troy (CSA201), and A. Sanders (CSA 262).

Schedule

Summer 2009:

- Participants J. Burge, N. Krumpe, and A. Sanders will participate in the CWE workshop “Improving Student Writing and Learning in Any Course” (D. Troy and W. Brinkman have taken the workshop during previous years)
- Team will meet with Howe Center personnel to discuss plans for outcome and assignment development
- Team will assign learning outcomes to the target courses

- Team will develop communication learning activities for the target courses, training materials for students on the writing skills required, and rubrics to use in grading
- Team will meet with Howe Center personnel to present these activities and receive feedback to incorporate prior to the start of the Fall semester
- Team will prepare an IRB application so that the results of the project can be published

Fall 2009:

- Project will be officially kicked off at a CSA department meeting where the department will be briefed on the goals of the program and the plans for the current semester
- Team will use the communication learning activities in their Fall courses and collect student data for assessment
- Team will develop training materials for the activities for use by faculty teaching the courses in Spring 2010
- Team will made adjustments to the activities as needed
- Team will present results of the Fall 2009 courses to the department

Spring 2010:

- Learning activities tested during Fall 2009 will be used in Spring 2010 offerings of the target courses
- Student data will be collected on the success of the assignments. This data will include information on which students had participated in communication learning activities during the prior semester and which had not
- The project team will write a report on the project
- The project team will present the results of the project to the university community

Budget

In order to start this project during the Fall semester, we will need to refine the learning outcomes and develop the assignments over the Summer of 2009. For that reason, we have requested summer compensation for the time required. The \$5,000 will be distributed evenly to all participants in the form of summer salary.

Presenting the Results

We will disseminate the results of this project in the following ways:

- A report will be prepared describing project results
- The team will present the project at a seminar at Miami University
- The team will write a conference paper describing the project and submit it to an educational conference such as SIGCSE, CSEE&T, or FIE

Additionally, if the CPATH proposal is funded, the results of the Communication Coming Into the Capstone project will be presented as part of a workshop held at CSEE&T and at an NSF-funded workshop.

Summary

This proposal offers many significant outcomes: It will improve the writing and communications skills of our majors, minors, and students in our thematic sequences; It will aid us in meeting professional curricular guidelines and accreditation requirements; It will build on previous research from the Communication Chautauqua; and has potential national impact through our related work with other institutions. Most importantly, we hope that students will view writing and communication skills critical to their professional success as work toward a Writing Across the Curriculum approach. We hope that what these students learn will carry writing and communication skills into their performance in their other courses and that seeing our success at integrating communication into a subset of courses will encourage other faculty to do the same in additional courses.

Thank you for your consideration. If you need any more information, please feel free to contact any one of us.

Douglas Troy, Chair Department of CSA

_____ Date _____