Provost’s Learning Innovations Grant for Faculty
Request for Full Proposal
2004-2005

Adaptation & Implementation Program

Project Title: Implementing Active Learning and Students Cohorts in the First Course of the IT Introductory Programming Sequence

Applicant(s):

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<th>Name</th>
<th>Dept.</th>
<th>Telephone</th>
<th>College</th>
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<tbody>
<tr>
<td>Keith Whittington</td>
<td>Information Technology</td>
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Implementing Active Learning and Students Cohorts
In the First Course of the IT Introductory Programming Sequence

1. Summary of Proposed Project

1.1 Background

This project will expand upon the lessons learned from the successful curricular change to the Information Technology (IT) Department’s introductory programming sequence that President Simone cited in his white paper entitled “Becoming a Category-of-One University”, dated February 3, 2004, and described as a C1U example.

The original IT freshman programming sequence consisted of three (3) courses, IT-1, IT-2, and IT-3. The second course, IT-2, had proven to be a “gatekeeper” for students. The change cited by President Simone was the creation of a two-course decelerated sequence, IT-2A and IT-2B, as an alternative to IT-2. The goal of this change was to help students who initially struggle with programming concepts to succeed. In its first year of implementation, AY 2002-3, the alternative course option significantly increased student retention through the introductory programming sequence, improved overall student performance, and enhanced student satisfaction. These results were described in a paper presented at the 2003 CITC4 conference entitled “Implementation of Alternative Pacing in an Introductory Programming Sequence” and published by ACM Press (Whittington, Bills, and Hill, 2003).

1.2 Goals

The goal of this project is to extend the benefits achieved from the pedagogical and curricular techniques used in the alternative sequence, IT-2A and 2B, to students in the first IT programming course, IT1, for Fall 2004.

In addition to allowing students more time on task, the alternative sequence had two other apparent benefits: the separation of students into more homogeneous populations than the standard classroom, and enhanced student communication due to the incorporation of active learning techniques. The addition of the alternative sequence option in AY 2002-3 separated students into two groups – those who felt ready for IT-2 and those who felt that they would benefit by a slower pace of instruction. Students in the alternative sequence reported increased levels of self-confidence and diminished the feelings of peer intimidation. Active learning techniques were used to encourage classroom communication and engage students in the learning process. As a result, students felt better about themselves, and the overall rate of student success increased.

These benefits should be advantageous to our incoming freshmen students in IT-1 as well. The question is how to “cohort” incoming freshmen? Our experience has been that performance in high school course work, even in Advanced Placement Computer Science courses, is an inadequate predictor of success in computer-related curricula (Tymann, Bills, Biles, Howles and Niemi, GCCIS Under-Prepared Committee Report, April, 2002). However, performance in the first college-level programming course is a good predictor of performance in subsequent programming courses. Thus, we use performance in IT-1 to advise students for their next course.

We intend to survey our incoming freshmen to develop an algorithm for separating them into homogeneous cohorts for IT-1; and we intend to incorporate active-learning techniques in this course as well. Ultimately, we would like to extend the benefits of active learning by developing a set of techniques for use by all instructors in the introductory programming sequence. Our goal is to identify strategies that all faculty members can conveniently implement whether or not they are proponents of active learning. Courses in the IT introductory programming sequence are taught in studio format, which is a natural fit for active learning; so faculty acceptance should not be a major problem and all students will have the opportunity to benefit from this teaching approach.

The members of the proposal committee base this approach on previous and ongoing research efforts discussed in the next sections.

1.3 Previous Results

The retention literature shows that students in their first year are at the greatest risk for dropping out of college. The IT introductory programming sequence is required for all freshmen IT students. If students successfully make it through this programming requirement, they tend to stay in the IT program.

The IT faculty has been engaged in a series of curricular changes designed to improve our introductory programming sequence. The first phase was the successful conversion of the courses to the studio model in AY 2001-2 (Hill, Bills and Biles, 2002). The next step was adding the alternatively paced option to allow more time on task for concepts that had proven to be the biggest hurdles for students and incorporating active learning AY 2002-3.
Based on student surveys from IT-2A and 2B in AY 2002-3, separating students based on performance in IT-1 dramatically reduced students’ feelings of peer intimidation. The obvious reason for this was that the students who excelled at programming were no longer in the classroom to cause intimidation. However, another key factor reported by students was enthusiasm for the active learning techniques developed for and implemented in these courses. Many students commented that they felt more comfortable discussing their problems in class than they had in the first course (IT-1).

Our experience has shown that active learning techniques work best with homogeneous student populations. This is substantiated by student and faculty reactions to the classroom environment in IT-2A this academic year. This is the second year for the alternative sequence, and the classroom atmosphere is very different. While student reactions are still positive, the active-learning exercises that worked so well last year did not generate the same level of student involvement and excitement as in the previous year. We believe one of the reasons for last year’s overwhelming success was the homogeneous nature of the student populations. This year, because more students took the alternative sequence, the sections were less homogeneous; so issues of peer intimidation returned. Thus, we intend to be more careful in advising students in future.

1.4 Additional Studies
The members of this grant proposal have been involved in other educational research that relates to this endeavor. All of the members were involved in a survey that given to every incoming freshman student who entered other computer-related fields at RIT: Information Technology, Computer Science, Software Engineering, and Computer Engineering. The survey was administered over the summer of 2003 with the goal of better understanding our incoming student characteristics so that we can advising students towards a field of study suited to their goals and abilities (Reek, Weeden, Bills, Whittington, Holden, and Howles, Research into Student Success Factors in Introductory Programming, GCCIS/RIT, 2003).

In the Fall of 2003, Prof’s. Holden and Weeden analyzed the performance of several sections of IT-1 students. Students were given a background survey to see if any performance results could be predicted based solely on previous computing experience. The results of the study indicated that previous programming experience had a positive impact on success in the first programming course but diminished thereafter. (Holden and Weeden, 2003)

1.5 Implementation Plan
We intend to use the data and results above, and additional data gathered on freshmen programming performance in AY 2003-4, to help us predict how to cohort AY 2004-5 freshmen IT students for IT-1 in the Fall of 2004. Details are shown in Section 8.

2. Targeted Learners or Population
All freshman IT students taking the first programming course, IT-1, in the Fall of 2004.

3. Number of Students Affected
Approximately 300 students.

4. Anticipated impact on teaching and/or learning
Research indicates that creating a student-centered classroom environment - where students are actively engaged - enhances student understanding and helps guide them to deeper levels of learning. This is particularly important for students who need additional time on task to succeed.

Additionally, we plan to identify active-learning techniques that all professors can conveniently use even if they are not themselves proponents of active learning. Not all the faculty who teach IT introductory programming courses are familiar with active learning methodologies, and this will give them a first hand chance to experience it.

5. How the Project Will Impact Student Success
Hopefully, placing IT-1 freshmen students into cohorts based on their background in computer programming and implementing active-learning techniques will enhance the learning environment in all sections. One goal is to reduce peer intimidation so that students will be more open to asking questions focused on their own particular needs. Another common problem experienced by faculty who teach introductory programming courses is the diversity of student backgrounds and abilities. Two antagonistic populations often emerge, the students who “get-it” and become bored versus the students who don’t “get-it” and are intimidated. Faculty members typically end up teaching to the mythical “middle-level” learner, which is unsatisfactory to both groups of students.
We also plan to use various active learning techniques to enhance learning by creating an interactive, cooperative, and student-centered environment. This enhancement is grounded in theory and research that believes that students learn best when they are actively involved in the learning process (Millis and Cottel, 1997).

6. How We Will Measure the Impact, Report the Findings, and Share the Project in a Faculty Forum
We will compare the student feedback, satisfaction, and performance in IT-1 for AY 2004-5 with previous years to see if there are any improvements. We will also look at the overall flow of the students and see if there is an increase in the number of students continuing in the programming sequence. Classroom surveys will also be given to get a more detailed analysis of student feelings and opinions of the course.

7. Rationale for Project
a. Why It Is Not Part of Regular College Business
Our goals require in-depth analysis of student backgrounds before they enter their first year of college to try to place them in homogeneous sections. They also require substantial analysis of our existing data in preparation for this work. We need a database to house multi-year data more efficiently for ongoing analysis. We also need to create, distribute, and analyze questionnaires and feedback surveys.

b. Relevance to Required Cluster, College, and/or Department Competencies
This grant is relevant to the IT Department since all IT students are required to take the introductory IT programming sequence.

c. Relevancy to Other Faculty and How to Transfer the Success to Other Faculty
This study and its results are relevant to the other two GCCIS faculty, CS and SE, and any department that teaches computer programming. We intend to share our results with colleagues informally and formally through conference(s) and publication(s) – possibly through revues such as RIT/FITL, CITC and ACM, and/or the Lilly Conference.

d. Relevant Credentials, Experience of Involved Faculty/Staff
Keith Whittington developed the IT-2A and IT-2B courses and helped develop IT-1. He is also the primary author of the paper that reported the results of IT-2A and IT-2B. Dianne Bills has been involved in student flow and retention efforts at RIT since her MS thesis, “NTID Student Enrollment Projection System” (1988), when she developed the original student flow model for NTID. She is a co-author of the papers that reported the results of the IT Department’s studio model conversion for the introductory programming sequence, and alternative-paced programming curriculum; and she did most of the statistical analyses for the studio model and alternative-paced research studies. Ed Holden and Elissa Weeden co-authored the paper that analyzed the background experience and performance of 20021 freshman students. Elissa is currently the interim IT undergraduate coordinator for quarters 20033-20034. All members have extensive experience teaching introductory programming courses and are members of the research team that gathered data on AY-2003 freshman student characteristics.

References for the papers cited are included at the end of this document.

e. How This Innovation Is In Our Discipline or Program
It directly affects the comfort, satisfaction, and hopefully the retention, of incoming IT (VKSF) students.

8. Timetable of the development of the project
We project that three (3) adjunct salaries (or summer course pay) will be required for Summer 20034. One to develop and enter the data into a database, a second to collect and analyze the data on student performance in the IT-2A and IT-2B for 2003-4, and a third to correlate, analyze and make recommendations for handling of incoming students in the Fall of 2004.

Two (2) course releases will also be required in during AY 2004-5 to gather and analyze data on student performance in the IT introductory programming sequence, and to disseminate the results of the grant. We also plan to disseminate the results of our project at the Lilly conference in 2004. The Lily conference is the major educational conference that promotes active learning; some of the most notable educational researchers in the country attend it.
**Summer 2003:**
- Develop a database and load the AY 2003-4 freshman background data.
- Analyze the IT-2A and IT-2B questionnaires and survey data.
- Analyze the AY 2003-4 freshman student survey and IT-x performance data to develop norms for cohorting.
- Determine the active learning techniques to implement for AY 2004-5.
- Develop and distribute background surveys for AY 2004-5 students.
- Analyze the background data from incoming AY 2004-5 freshmen students.
- Determine criteria for cohorting students into specific IT-1 sections.
- Assign the students into specific IT-1 sections.
- Develop questionnaires to be distributed during and after IT-1 course sections are delivered in the Fall of 2004.

**Fall 2004:**
- Deliver the IT-1 courses.
- Distribute and gather questionnaires in the IT-1 sections.
- Get qualitative feedback from IT-1 faculty on teaching experiences and feelings.
- Winter 2004/2005:
  - Analyze the Fall 2004 IT-1 student performance and questionnaire data.
  - Write reports and papers based on the results of this research project.

**Winter 2004 and Spring 2005:**
- Analyze the Fall 2004 IT-1 student performance and questionnaire data.
- Write reports and papers based on the results of this research project.
- Disseminate the results (possibly at the 2005 FITL and Lily conferences).

**References**


The principal investigator's department or college or unit must provide matching funds to demonstrate broad faculty and administrative support for the project. Funds can be used to cover release time, pay student workers, and/or purchase supplies and services (such as CD pressing, video production, digitizing, photography). Funds will generally not be available for activities consistent with normal college business, overload pay, scholarly research, capital equipment purchase or travel - though the latter will be considered if a clear connection to the project can be demonstrated.

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Student Compensation
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Other Compensation - Consultants $______ _____________________
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SALARIES TOTAL $ 9500 _____________________

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General (envelopes/letters/postage) $______ _____________________

SUPPLIES TOTAL $ ______ _____________________

MATCHING FUNDS FROM DEPARTMENT/COLLEGE $ 9500 _____________________
Department Head and Dean’s signatures required.

(Dean)