

Work in Progress - Improved Approach for Delivering an Introductory Computer Science Course

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Abstract - In this work, we present a new teaching approach that we have implemented in our introductory computer science programming course. The methodology consists of team teaching, a hybrid delivery system, recorded lecture retrieval capability, readiness assessment activities, objective assessment of student progress, and cooperative learning through team work. The two new aspects of this approach are team teaching and objective assessment to provide additional feedback to students. Details of this work, including its advantages, disadvantages, and student feedback, are included in the paper.

Index Terms – Assessment, Computer Programming, Hybrid Delivery, Team Teaching.

INTRODUCTION

The usual approach to teaching a computer programming course is to have a classroom lecture component and a supervised laboratory module, where students write simple programs reflective of the subjects that they have learned during the lectures. For smaller class sizes, an alternative approach, which consists of conducting the entire course in a laboratory setting, has also been implemented. An improvement to this approach involves making the lectures more interactive, transforming them using a multimedia package, and conducting class sessions in a "technology-ready classroom"[1]. The subject material is reinforced with the inclusion of hands-on programming exercises shortly after the presentation of new concepts, which promotes active learning [2-3]. Another enhancement, which has been employed, is the use of the problem-based learning approach [4-5]. In this work, we describe our new approach to teaching an introductory programming course that consists of team teaching, the incorporation of a hybrid delivery system, the utilization of a variety of assessment tools, and the employment of cooperative learning through team work. Although some of these approaches have been implemented individually by other researchers and the authors, the combination of the aforementioned tools has not been tried as a single methodology. The use of objective assessment, which is mainly a program assessment tool, has not been employed in the evaluation of student progress. To the best of our knowledge, the utilization of readiness assessments, to help students gain a better understanding of

the topics that will be covered in class, has not been implemented in the delivery of introductory programming courses.

PROPOSED APPROACH

Team Teaching

The benefits of the team teaching approach include improved course delivery, increased student participation, enhanced learning environment for students with diverse programming experience, and more individual attention and assistance than before, while maintaining the pace of the course. The implementation of this approach entailed having one instructor focus on lecture delivery and the other on assisting and monitoring students. The instructors' roles changed depending on the class activity. For example, during hands-on coding demonstrations, one instructor guided the students through the process, while the other instructor assisted those having difficulties. Both instructors assisted and guided students, while they worked on team programming activities.

The course related tasks were divided between the instructors based on individual preferences. Lecture materials, quizzes and exams were prepared jointly and grading was divided evenly. At the end of each class, additional help was provided by one instructor. If graduate teaching assistants are available, this approach could be accomplished by having one instructor and 1 or 2 assistants.

Hybrid Delivery System

Our hybrid approach consisted of several components: (i) lecture delivery in a computer laboratory setting using an online synchronous delivery system, which allowed classroom and/or Internet attendance; (ii) asynchronous delivery of classroom lectures via downloadable recordings; and (iii) use of a course management system.

Centra [6], a real-time communication, collaboration and learning software environment, was employed for lecture delivery, recording, and facilitating active student participation. ANGEL [7] (A New Global Environment for Learning) is the University's CMS (Course Management System) tool that is used for posting courseware modules, the course syllabus, the daily schedule, quizzes, exams, readiness assessments, homework folders, attendance, and grading.

Readiness Assessment

The primary objective of each readiness assessment is to make sure the students gain a general understanding of the subjects that will be covered in class, attain more information from the presentation, and become more engaged in classroom activities. ANGEL's quiz feature is used to randomly generate a 15-20 question quiz from a bank of preloaded problems. Students are allowed multiple attempts.

Objective Assessment

In the majority of cases, students are unable to identify the intended relationships between the class assignments and the intended learning objectives of the course. The goal of the objective assessment is to provide individual feedback to each student regarding mastery of ongoing course objectives through collective evaluations of quizzes, readiness assessments, exams, and homework submissions. The use of objective assessment, which is mainly a program assessment tool, has not been employed in the evaluation of student progress.

Our objective assessment feedback was designed by breaking down each chapter's goals into more specific measurable outcomes. Each outcome was rated using a scale of 1 to 5, where 1 indicated that the goal was not met and 5 indicated that the objective was satisfied. This process was used to help students identify areas that they needed to improve based on their performance in various class assignments, to summarize their activities, and to provide them with specific feedback by topic. For example, we evaluated the topic "Working with Functions," which had several outcomes, such as:

- Be able to write functions without arguments.
- Be able to write functions with arguments.
- Be able to write functions with reference parameters.

These outcomes corresponded to the assignments and quizzes, which covered those topics. This process was repeated on a monthly basis during the semester.

Based on the aforementioned approach, objective assessment can be used to indicate mastery of subject matter as well as identify areas of weakness. They also provide qualitative translations of a student's performance based on his/her graded assignments. Moreover, they help the instructor evaluate achievement of his/her teaching objectives and his/her methodology. If a certain area indicates weakness by a majority of students, the instructor needs to readdress that area and adjust his/her approach for that topic.

Cooperative Learning through Team Work

Cooperative learning is accomplished by forming student teams who work together on homework assignments and classroom activities. After the first objective assessment, teams were restructured, by the faculty, so that each would include at least one strong student, identified by prior graded work.

During the in-class programming activities, students were asked to work with their teammates and come up with a solution to the assigned problem. As others have observed, there are always dysfunctional teams that need some special attention and, possibly, change of membership.

REMARKS

The following items represent a few of our observations and recommendations

- Student reactions, based on an online survey, have been positive and encouraging.
- The ability to see the slides and presentation on their own screens and to interact with the instructor through the Centra system was referred to as the most positive aspects of the new delivery system.
- Readiness assessment quizzes play an important role in student preparation and participation in class discussions.
- In the future, include post-assessment components to evaluate if the learning objectives have been met and to identify any areas of weakness. We recommend using the same question banks as the readiness assessments for this process. We are also planning to include a comparison against other computer programming assessment systems in the project.
- Cooperative learning portion could be further emphasized and encouraged by incorporating it in the course grading scheme.

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