

# Work in Progress - The Synergistic Integration of an Entering Students Program with an Engaging Introductory Course in Programming

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**Abstract** - We report on the synergistic integration of a required entering students' program with an introductory course in programming. The course is evenly divided among Python-based algorithmic-centric media programming modules and content specified for ESP students at the University of Texas at El Paso (UTEP). UTEP is an urban university serving a largely Hispanic student population principally drawn from the sister cities of El Paso, TX, USA, and Ciudad Juarez, Chihuahua, MX. ESP course content includes modules such as reading, studying, and note-taking skills.

The unifying theme and approach used for both the ESP and programming modules of the course is provided by the concept of Robert Sternberg's "Successful Intelligence," an accessible refactoring of Bloom's Taxonomy into the general categories of analytical, creative, and practical thinking skills.

## INTRODUCTION

A number of observations lead to our introduction of a course integrating content required by an entering students program (ESP) and an introductory course in programming (CS-0) during the Fall of 2007:

- Declining enrollment in Computer Science and high attrition rates for entering college students intending to study computer science or engineering fields;
- Many incoming students with an intention of studying computer science or engineering had little or no prior exposure to programming or other engineering fields;
- Statistics indicating that incoming students struggle with early math courses required for entry into computer science and other engineering programs, often requiring multiple semesters to complete a single course; and
- Many of the students struggling with early courses tend to grasp at shallow, formulaic approaches to computational problems rather than demonstrating a deep understanding of fundamental principles and strong problem-solving skills.

Our original intent in offering this course was to expose students, especially pre-engineering/science majors, to early programming experiences in order to facilitate informed career choices and to build problem-solving skills. As first presented in Fall 2007, the course included ESP topics and multimedia programming [1] content presented as independent units of study. Bloom's full taxonomy was

included among ESP topics, but it was mainly restricted to the context of improving student examination scores in other courses. Students learned keywords associated with different levels of thinking and practiced matching their answers to the level required by the question. There was little explicit integration of ESP and introductory computer science (CS-0) content.

While our CS-0[2] content has much evolved since this project was introduced, it is not the principal focus of this paper.

During the first semester, we realized that knowledge of the various levels of thinking presented in Bloom's Taxonomy [3] not only contributed to student success in other courses, but also was beneficial for effective study of all ESP and CS-0 topics in this course, contributing to students' meta-cognitive processes as they developed new skills. For example, ESP students are expected to develop skills in areas such as values clarification, goal setting, time management, and career development, in addition to academic performance. Approaching all of these tasks from the perspective of the levels of required thinking illuminates the steps and processes involved in achieving them.

We moved toward integration of Bloom's Taxonomy with course content during the second semester as an essential complement to our focus on building problem-solving skills. Our first efforts involved superimposing the full Bloom model on all topics, designing activities and projects not only to build specific skills, but also to elicit an awareness of the levels of thinking skills required to accomplish the tasks.

Although the practice of identifying thinking skills resulted in markedly improved reflection in students' written responses, for both ESP and CS-0 content, we found that approaching some ESP modules at the level of detail involved in the full six-level Bloom model could be unwieldy and was not always relevant. A significant addition to the course in the third semester was the Keys to Success: Building Analytical, Creative, and Practical Skills ESP textbook [4], which offers a unifying theme that psychologist Robert J. Sternberg defines as "Successful Intelligence," a grouping of analytical, creative, and practical thinking skills to enable better decision-making, problem-solving, and achievement of goals.

Use of the textbook provided a unified framework for the course, as ESP and CS-0 projects could be approached

from the same context of analytical, creative, and practical thinking skills. Refactoring of the original six Bloom levels down to just three categories made them more accessible for students and provided the right level of detail for most projects. This allowed common skill sets to be reinforced synergistically between ESP and CS-0 modules.

Figure 1 illustrates the interaction between two projects in the course. On the left are details of an ESP module in which students apply analytical, creative, and practical thinking skills to develop a systematic problem-solving technique for a personal or academic problem. On the right are details of how these same skills are applied to a CS-0 project in which students define and implement color modifications for a JPEG image.

A spiral development and refinement process emerges, both within ESP and CS-0 modules individually, as well as in the transfer of skills back and forth between the two content areas. For example, skills gained in analyzing cause/effect relationships in an ESP context are reinforced by the immediate visual feedback of code implementation in CS-0 projects. Conversely, the sequential analysis of steps required for development and implementation of a CS-0 algorithm reinforces the awareness of sequence of events in the ESP problem-solving process, and students develop more concrete and reflective solution evaluations as a result of the detail required for CS-0 project evaluation.

**ASSESSMENT**

Our integrated ESP and CS-0 is part of a multi-institution study organized by the Computing Alliance of Hispanic Serving Institutions (CAHSI) that examines changes in student attitudes and success in subsequent academic studies. The reforms described in this paper have only

recently been adopted and therefore longitudinal data is not yet available. However, anecdotal results are encouraging. Our instructor observes that the reformed ESP components have positively impacted student ability to reflect on and describe technical course components.

**FUTURE WORK**

Our research focuses on continued integration of UTEP’s required entering students’ program and CS-0 modules. Our goal is to increase opportunities for reflective thought and communication throughout the problem-solving process by frequent student presentations of project analysis, design, and evaluation.

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**Figure 1. Interaction Between ESP and CS-0 Projects**

