

SIGCSE 2011 Poster Proposal: Universal Design for Learning in CS1

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1. PROPOSER

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2. STATEMENT OF TOPIC

Universal Design for Learning in CS1

3. SIGNIFICANCE AND RELEVANCE OF THE TOPIC

Students with disabilities are enrolling in higher education in increasing numbers, but they are less likely to complete college degrees and less likely to pursue careers in the sciences than students without disabilities [2]. Reaching out to these students requires more than assistive technology and special accommodations, although both of these solutions are important. A majority of disabled college students have “hidden disabilities” such as learning disorders or mental/emotional disorders, rather than the visible physical impairments traditionally associated with disability [5, 6]. Furthermore, students with disabilities do not always seek institutional accommodation, for a variety of reasons [3, 6]. Therefore, it is important to proactively design courses with inclusion in mind rather than wait for students to self-identify as disabled.

Universal Design for Learning (UDL) is an inclusive approach to course design that helps build accessibility into the initial design of a course. This accessibility helps not only disabled students, but also students with different learning styles and other under-represented or at-risk students. The “universal design” part of UDL comes from a movement to

make buildings and environments accessible to as many people as possible without requiring separate accommodation for the disabled. Universal Design for Learning is the delivery of instruction with similar goals [1].

The Ensuring Access Through Collaboration and Technology (EnACT) multi-campus project in the California State University system brings together interdisciplinary communities of faculty members to collaboratively implement and support UDL in their courses [4]. As a result of this project, a set of small, targeted UDL changes were made to the CS1 course at Sonoma State University. This poster will present the UDL approach and its application in this course. In an independent evaluation, students gave the changes to the course a mean score of 2.68 on a scale of 1 (not important) to 3 (very important), with female and disabled students rating the changes slightly higher than male and non-disabled students.

3.1 Universal Design for Learning

Universal design for learning is based on three principles:

1. Multiple means of representation
2. Multiple means of engagement
3. Multiple means of expression

Multiple means of representation means providing a variety of accessible course content and materials using different instructional modes (e.g. visual, auditory, etc.). Introductory programming courses often support multiple means of representation by using a large number of course materials: textbooks, accessible websites, lecture notes, online resources and videos, and reference sheets. It is also common to depict a program’s internal structure in multiple ways – from narrating the step-by-step execution of the code to drawing diagrams – in an effort to help students develop mental models of a program.

Multiple means of engagement means giving students multiple ways to participate in the course and practice with the material. In introductory programming courses, this can mean offering lectures, labs, and independent online activities. It can also mean encouraging natural support systems among students and allowing them to work together in teams.

Multiple means of expression means allowing students multiple ways to demonstrate mastery of the material. This UDL principle can be the most difficult to translate to programming courses, where the content (programming knowledge) is often inseparable from the means of expression (writing programs). However, instructors can still experiment

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with programming projects that are somewhat creative or open-ended in order to allow students to personalize their expressions of knowledge. In general, UDL considerations should not undermine the learning objectives of the course; rather, they should remove unnecessary barriers to students' achieving these objectives.

3.2 UDL Changes

In the CS1 course at Sonoma State University, UDL was used as a framework to identify small, high-impact changes to the course. It is important to note that UDL is not distinct from general good pedagogy; rather, it is a framework to guide pedagogical decisions with broad accessibility in mind.

Some representative changes made to the CS1 course were:

1. *Multiple means of expression*: Explicit support for multiple programming toolsets, from IDEs on various operating systems to the Unix command-line environment. This change drastically reduced the number of drops in the first two weeks of the course, and it was unanimously rated as "very important" by all of the female students responding to the end-of-course evaluation. It also helped the students understand the difference between the process of programming and the process of learning to use a programming toolset, which is typically a major point of confusion in the early part of the course.
2. *Multiple means of representation/engagement*: Students engaged with programming projects in new ways through reflective activities assigned once the project was due. As a group activity, students tested and modified other students' project code, which provided a window into other people's approaches to problem solving and a vivid illustration of the need for good programming style. As part of this process, students also reflected on their own programming habits and time management. This metacognitive reflection explicitly addressed a learning objective that had been implicit in past offerings of the course: creating strategies for developing and testing programs in the presence of uncertainty.
3. *Multiple means of representation*: Written feedback on printouts of students' code critiquing their programs' design and style. Previous semesters' feedback had been broad and abstract, leaving it up to students to connect the feedback with specific elements of their code. Providing written feedback cut down on the number of errors that were repeated from one project to the next.

The changes to the course are described in more detail in a video case study [7].

4. CONTENT

The poster will contain the following subsections:

1. Introductory material on students with disabilities in secondary education and specifically in computer science
2. Introductory material on Universal Design for Learning and inclusive education

3. Examples of the three principles of UDL – *multiple means of representation*, *multiple means of engagement*, and *multiple means of expression* – particularly as they relate to introductory programming
4. A description of the UDL changes made in a CS1 course
5. Quantitative and qualitative results of a formal evaluation of these changes
6. Further UDL resources and related work

5. ABSTRACT (DESCRIPTION)

Universal Design for Learning (UDL) is an inclusive approach to course design that helps build accessibility into the initial design of a course. This accessibility helps not only disabled students, but also students with different learning styles and other under-represented or at-risk students. As part of a multi-campus interdisciplinary initiative, a set of small, targeted UDL changes were made to the CS1 course at Sonoma State University. In an independent evaluation, students gave the changes to the course a mean score of 2.68 on a scale of 1 (not important) to 3 (very important), with female and disabled students rating the changes slightly higher than male and non-disabled students. This poster illustrates the UDL approach and its applications to introductory computer science.

6. REFERENCES

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