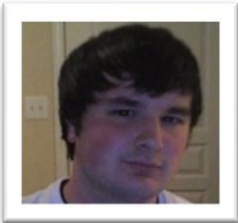


Teaching Computer Science Through Culturally Situated Design Tools

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Introduction

While demand for Computer Science (CS) majors continues to rise in the public and private sectors, enrollment in Computer Science and related degree programs has suffered steady declines from year to year. In addition, enrollment of females and minorities has also remained low with some degree programs even seeing a decline.

To remedy this, researchers are focusing their efforts on broadening participation in CS and STEM (Science, Technology, Engineering and Math) fields via outreach programs, recruitment, and interest building in the K-12 community. Our research targets the K-12 group and utilizes Culturally Situated Design Tools, or CSDT's.

Background

Culturally Situated Design Tools are instructive applications which are based around cultural elements in order to foster a connection with students, particularly minority students. These tools facilitate the instruction of specific math and science concepts to K-12 students. Due to the players familiarity with the cultural aspect, the tool will feel familiar and the player can easily relate to the learning content. Prior research in the field of CSDTs has proven that they are effective in teaching mathematical and CS related concepts. Further research has also proven that, when it comes to educational tools and games, the learning gains are measurably more than those of a traditional classroom setting when users can collaborate on a project

and share knowledge and creations freely. Using this knowledge, our group has created Bead Loom Game, Dance Tool and a CSDT centered social website for sharing custom creations and enabling competitive game play.

Research

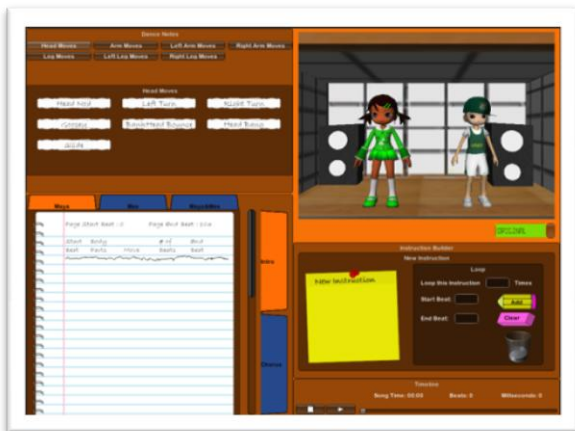
The first aspect of our CSDT Community Project was to develop the actual tools and/or games that would be incorporated into the site. An existing CSDT called Virtual Bead Loom was one of the more successful and effective CSDTs. Virtual Bead Loom helps students learn graphing concepts and Cartesian coordinates, as well as the computational concept of Linear and Triangular Iteration, through the cultural aspect of Native American Bead looming. A second CSDT called BreakDancer, which teaches rotation and sine functions, hit on an urban youth cultural aspect that also was proven to be quite effective.

Using Virtual Bead Loom and BreakDancer as foundations for our work, we created a new CSDT based game, Bead Loom Game, and a new CSDT, Dance Tool.

- Bead Loom Game
 - Incorporates Player Achievements, Rankings, and Medals to motivate players to solve Puzzles in the ideal number of "moves" and in a short amount of time. Correct knowledge of Cartesian coordinates and Iterative Tools helps players solve Puzzles in a minimal amount of "moves" and time.
 - Allowed creation of Custom Puzzles so that players can express their creativity and create new challenges for others.
 - Implemented Hint Systems, Code Samples and a Timer that can all be toggled for experimenting with various aspects of the game.

•Dance Tool

- Enables players to “program” or choreograph dancers to execute dance moves for a song of their choice using a Drag-and-Drop interface.
- Players have motivation to loop Instructions together to minimize the number of times they have to program a dancer to execute a list of moves.
- Players also must time the dance moves properly so they do not overlap. If overlaps occur, the offending will be highlighted and marked as errors.



Dance Tool User Interface

•CSDT Community Website

- Users create profiles that stores information about themselves and their game play within the site.
- High scores, custom puzzles, and custom dances are saved under the users profile and can be shared on the site.
- Users can comment, rate, and discuss other users puzzles or dances, as well as work together to solve puzzles or improve dances.

Impact

Through the creation of Bead Loom Game and Dance Tool, as well as play-testing with groups of K-12 students, our team has gained insight and interesting data for improvement of all three components.

•Impact of Bead Loom Game

- Players showed improvements in the knowledge of layering and Iteration.

- Most players created custom puzzles or gained multiple Achievements to further their game play.
- Some players accessed the game outside of play-testing, either at home or during their free time, showing that providing social motivation and open-ended game play increases intrinsic motivation.

•Impact of Dance Tool

- The Drag-and-Drop interface allows players to quickly begin creating dances, allowing them to focus on their creativity instead of fighting a learning curve resulting from the interface.
- Visualizing the timing for each dance Instruction, as well as highlighting instructions with errors, enables the players to successfully recognize timing problems and understand proper ordering for their Instructions.
- Use of easily recognizable Pop and Hip-Hop songs helps the players relate to the tool easily and become more engaged.

Conclusions

- Using cultural aspects helps players relate to the material better due to increased familiarity with the cultural elements.
- Learning gains can be realized in a social setting where the players creativity is unlimited and knowledge can be freely exchanged.
- The design of the interface should present only minimal challenge to the user. The learning curve for players to achieve basic functionality of the tool should be as low as possible in order for the focus to be on learning the educational content.

Future Work

- Plans for future work include expansion of the CSDT Community Site to include more CSDT's and games, as well as a collaborative problem solving system to enhance group problem solving and creation of custom designs. In addition, more CS elements will be incorporated into Dance Tool, as well as the addition of more songs.