AC 2012-3409: USING A VIRTUAL GAMING ENVIRONMENT IN STRENGTH OF MATERIALS LABORATORY

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Jon Preston is the Coordinator for the Center of Applied Gaming and Media Arts (CAGMA) and Coordinator of the computer game design and development degree and Associate Professor, School of Computing and Software Engineering at Southern Polytechnic State University. He has authored more than 40 papers in conferences and journals regarding computer science, information technology, and game-related learning. He is particularly interested in game simulation, social space development, and the use of these technologies to improve learning. Preston has been teaching computing for 13 years and has taught game development courses over the past six years, including a mobile and casual game development class in which students develop games for Android and the iPhone/iPad platforms. He led the development of the bachelor’s of science in computer game design and development degree at SPSU and was also the Founder of the Center for Applied Gaming and Media Arts at SPSU. In the past two years, Preston has hosted four game jam weekends (two of which were part of the Global Game Jam) totaling more than 20 games developed by more than 120 participants. Preston also serves on the Academic Committee of the Georgia Game Developers Association and is currently the College Fair Coordinator for the 2010 Southeastern Interactive Entertainment and Games Expo. He also participates on the Entertainment Engineering Subcommittee of the American Society of Mechanical Engineers. Preston’s industry experience includes system development for a mobile platform and media company. He has participated in games-for-learning and community building grants to enhance STEM education and was recently awarded an NSF grant entitled "Using a Virtual Gaming Environment in Strength of Materials: Increasing Access and Improving Learning Effectiveness" that develops 3D simulations/games to improve learning among engineering students. Additionally, he has spoken at two recent NSF-sponsored workshops on gaming in engineering and computer science education and how to vertically integrate student teams in games for learning projects.
Using a Virtual Gaming Environment in Strength of Materials Laboratory

Imagine a student in a materials testing lab pressing a switch to begin a tension test on a slender specimen of steel. For a few moments nothing appears to happen. Then suddenly, with a loud bang, the specimen breaks and the test is over. Now imagine the student pressing the backup button and watching as the two halves of the specimen are magically reconnected. The student chooses to repeat the test, but this time, knowing when things get interesting, the student chooses to view the test in slow motion so he may observe the transition from elastic deformation to inelastic deformation and the necking down of the specimen right before it fails. Clearly, this is not your father’s Tinius-Olsen machine. This student is using a simulated testing environment that offers safe inexpensive learning opportunities, some of which can only be realized in a virtual environment.

This paper demonstrates the effectiveness of using 3D game-based virtual lab simulations in the Strength of Materials lab for civil engineering students. Some of the Virtual lab characteristics such as easy access to the information, visualization, and simulation capabilities allow auditory, visual, and kinesthetic learning environments to emerge. These environments allow students to discover strengths and weaknesses of their learning practices and facilitate self-improvement. By using 3D simulations of lab experiments depicting the equipment in action, and the corresponding data results, students achieve a visual representation of actual events that would normally be witnessed only in a lab. By using the simulation, a number of scenarios can be virtually shown to students that would normally not be tested in a lab due to cost and safety concerns.

Our design of this simulation utilizes formative iterative evaluation to ensure the highest quality interaction. The interface design engages students by using familiar graphics and information design. The use of familiar aesthetics aids in increased learning comprehension and peaks interest in the course material. The effectiveness of this approach is measured using quantitative and qualitative analysis and compared to student performance in the traditional physical laboratory. Two methods of summative evaluations are employed: learning evaluation and...
usability evaluation. The direct outcomes of this project will be the delivery of three virtual 3D simulated laboratory exercises for use in Strength of Materials courses. Based upon the creation of the 3D immersive simulated laboratories, learning will improve, access will be broadened, and costs will be reduced.

By using a game-based learner centered interface for the materials strength test lab, student failure rate is expected to decrease and overall performance on tests is expected to increase due to the interactive and visual nature of the learning environment. The strength of materials laboratory simulation is available freely through a web browser interface to increase access for all Engineering faculty to use in their courses.

As you can see from the following figures, the simulation allows the user to explore tension and torsion experiments in a highly-interactive, 3D environment and accurately models the lab setting.

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