2020Classroom Content Development

1. Research Team

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2. Statement of Project Goals

Interactive visualization puts students and their teacher into the picture of what they are studying, allowing them to share and manipulate objects of study. It promises a rich learning experience that engages learning in a dynamic environment. *Interactive visualization* in conjunction with how students can *play* with ideas or concepts central to the curriculum presents an opportunity to design, develop, and assess novel engaging and compelling content material for the 2020Classroom effort.

3. Project Role in Support of IMSC Strategic Plan

The premise of 2020Classroom is that immersive technology closely coupled with innovative curriculum design and meaningful assessment tools will not only increase efficiency, but will improve the quality of the learning experience. The vision is to pioneer a new learning paradigm with high presence, high fidelity technologies. One component is to develop novel curriculum with content and tools specifically designed for this type of environment. BioSIGHT is strategically positioned to develop and test a new paradigm for the application of immersive technologies to science learning and education. As the 2020Classroom project evolves, the collection and analysis of human factors data on student learning will provide feedback for technology research and development. We view this as two complementary processes: research in integrated media systems gives rise to new educational tools and the lessons learned from using these tools provide new directions for the development of more advanced systems.

4. Discussion of Methodology Used

The design method includes defining specific learning outcomes in parallel with the development of a compelling back-story and engaging game play. Game play is determined by the tasks that must be accomplished and learning goals are tightly linked to tasks at each level. The pace and flow are determined by users interaction. As we design content, ideas are storyboarded through activity scenarios (tasks that the user has to accomplish); information scenarios (background and detailed content to convey and metaphors to use); and interaction scenarios (usability issues such

as user interface, interaction devices, as well as ways that the user will encounter tasks and avenues to resolution and information). Our approach addresses the pedagogy of how learning can be conveyed through games without diminishing content, specifically examining the notion of how students can *play* with ideas and concepts central to the curriculum. Specifically we will address (*i*) how immersive environments can be designed to convey scientific concepts to a novice target audience; (*ii*) what pedagogical issues impact corresponding classroom implementation; and (*iii*) how immersive environments influence the teaching and learning process.

5. Short Description of Achievements in Previous Years

Created a **Web-based stand-alone investigatory module** for exploring kinetics and reaction rates in physiological systems. Students will be exploring concepts in basic chemistry, neurophysiology, zero and first order kinetics, integration by approximation, and physiology to prosecute a defendant driving under the influence of alcohol.
We have **created 3D models, information scenarios, and preliminary interaction scenarios** for content assets in cardiovascular physiology using 3D StudioMax to support content that focuses on the **electrophysiology of the heart**.
Animations using 3D models to depicting concepts for transport, molecules, and fluid mosaic model of membranes.

5a. Detail of Accomplishments During the Past Year

***Metalloman* back-story and three levels of game play on paper.** The setting for *Metalloman* is in the distant future and due to environmental conditions that forewarn the decline of this species, *Metalloman* must go back in time to the year 2020 before the merging of man and machine to learn about human physiological systems – anatomical and molecular components as well as the physical laws that govern these systems. Levels have been designed to be incrementally challenging, where level one is completed when gross anatomical organs are identified and critical components for each organ has been identified. Level two then proceeds to develop an understanding that tissues and organs have distinct roles and the tasks are linked to finding out about these roles, and level three applies functional relationships to assign physical laws that govern functional properties. Specific tasks for levels include (*i*) perform digestion, (*ii*) obtain gradient maker, (*iii*) make glucose available, (*iv*) activate circulatory system, (*v*) store glycogen, (*vi*) mobilize glucose transporters, (*vii*) store muscle glycogen, and (*viii*) store fat.
3D model generation and world development. Using StudioMax, wire frame models and associated textures must be custom created to be exported and implanted into Torque game engine.
2020Classroom Prototype (v1.0). The Torque game engine is used to prototype rapid development, deployment, and technology integration for data mining techniques in support of gesture mediated navigation through immersive environment; offline data analysis for use profile generation and short-cut and help responses for assessment; and immersive audio for representative cues and spatialization for full immersion.

6. Other Relevant Work Being Conducted and How this Project is Different

The use of computer games for facilitating learning has not been very successful and is a scattered field without internal consistency and successful application. Current attempts have primarily focused on adventure genre or simulation genre. Edutainment has largely been responsible for the development of games with learning potential, with most games for this genre for history. The MIT's *Games to Teach* project involving undergraduate students from comparative media as well as seasoned game developers and designers, developed conceptual frameworks (on paper designs) of games for math, science, and engineering education. This Microsoft *i*Campus sponsored initiative has led to the development of The Education Arcade, a consortium to expand development work for and assessment studies of games in education. The Electronic Learning Communities group at Georgia Tech focuses on the design of Internet communities using constuctionism as the pedagogical approach. Several prototypes have been developed (AquaMOOSE 3D, Palaver Tree Online and MOOSE Crossing) with an intended target audience of kids under 13. Closer to home, ISI's *Mission to Arabic*, uses artificial intelligence and computer gaming techniques to make learning languages quicker, more effective, and fun for military personnel. Content development for the 2020Classroom effort, as well as the software prototype we are deploying is targeting undergraduate biomedical engineering students. In addition, the 2020Classroom effort is addressing the challenge at each level, all the way from content development, technology integration, learning and usability issues, as well as assessment.

7. Plan for the Next Year

Usability studies planned for prototype with limited tasks implemented by April/May 2004.
Further development and refinement of content for 2020Classroom prototype.
Develop and implement physiological simulation equations to drive content interaction.

8. Expected Milestones and Deliverables

Content development as well as 3D models and worlds, technology integration and usability studies to be supported in 2020Classroom prototype implemented with the Torque game engine.

9. Member Company Benefits

Not Applicable.

10. References

[1] Education Arcade (www.educationarcade.org)
[2] Electronic Learning Communities (http://www.cc.gatech.edu/elc/research.html)
[3] MIT's *Games to Teach* Project (http://www.educationarcade.org/gtt/)
[4] Tactical Language Training project (http://www.isi.edu/isd/carte/proj_tactlang/index.html)