Statement of Purpose

I am focused on developing educational technology that will create a shift in pedagogical media. While there have been a number of advancements in the 20th century with regard to pedagogical theory, the media through which subjects are taught have remained relatively constant. Whether through chalkboards, projectors, or Power Point slides, pedagogical media have been mostly static, despite characteristically dynamic subjects. The result of a medium that exists in a separate dimension from its subject is likely to create a paradox in the students' interpretation of the content he or she is learning. The antinomy that springs from this is resolvable, I believe, only by applying media that correspond to the dimensionality of the subject. That is to say, if a subject is dynamic, the medium through which it is conveyed is most effective if it is itself dynamic.

Let me illustrate what I mean with the example that first really inspired me. A couple of years ago, I attended a lecture on string theory that was presented by the renowned theorist, Brian Greene. During the lecture, he reached a point where what he was describing was very difficult to describe with words alone. He then said, “let me now *show* you what I’m saying”, at which point he proceeded to display an animation that he could now speak over and describe. People in the audience were mesmerized, and I was intrigued by the possibility of all teachers having the same luxury that he had. This luxury was the ability for him, the teacher so to speak, to have a technology that could extend the spatial thoughts of his mind, *in addition to* mathematical and word oriented thoughts, to the audience. No writing on a static medium like a chalkboard, or pictures on a Power Point slide, could have conveyed what he was trying to illustrate.

This is not to suggest that a teacher cannot convey dynamic imagery to a student without dynamic media. Words can naturally evoke images in the mind. Static images can even instigate imaginative dynamic interplays within the mind. And, for the best science students, mathematical formulas will trigger images of the world the formulas are meant to describe. But something is missing here. One can imagine a teaching world where all educational media is destroyed besides the speech of the teacher. An articulate orator, who is organized and evocative with speech, may describe events and tie in their mathematics with great precision. But think of the effort it would take to describe a graphical result with no graph, or an unknown shape or complex mathematical formula without a chalkboard. Not only is precision here messy, but a hook for the mind to hold the content is even more difficult. This constriction the teacher faces is best solved not with more creative speech, but with new media; media which the teacher can naturally extend and hold the message of their mind in, and hence give students a robust reference for efficient transmission of the message and it's ultimate construction within a student's mind. After all, the role of the teacher, who is the expert on the subject, is to exemplify the effective mental models he has constructed for understanding the content of his discipline. When the teacher's mental models involve dynamic thought, what better way to transmit this content than through dynamic (animated) media.

Animated media grants many new freedoms to a teacher that previously they did not have. The Phet project (Physics Education Technology) at CU has already documented many of these benefits. Their results show that most of these animations were "as productive, or more productive, for developing student conceptual understanding as real equipment, reading resources, or chalk-talk lectures" (Finkelstein). In addition, they have shown results that surprise some traditional teachers. For example, one virtual lab made students "more capable at understanding, constructing, and writing about real circuits than their counterparts who had been working with real circuit elements all along". (Finkelstein).

There are several constrictions with the only current form of dynamic media, which involves demonstrations and labs. Consider a simple example of a professor launching an object in the air and describing the object while it is in motion. Because the object moves in real time, the professor does not have time to do this with any accuracy. It is difficult to show various tools the professor automatically applies to the falling object, such as "seeing" vectors associated with the movement, on an actual falling object. Animation would solve these problems. An animation could be paused, run at various speeds, and display all the visual and graphical tools standard to understanding the problem. The animations would provide productive constraints, allowing the demonstration or lab to run as it should without error (Finklestein). Interactive animations could employ Piaget's zone of proximal development, creating a playful and puzzling atmosphere for students to make sense of incrementally challenging aspects of the physical event.

My goal is to build off the early success of Phet simulations and take them to the next level. At some point I would like to see more lecture-based, 3d, awe-inspiring animations that professors could revert to in lecture. But first I would like to focus on interactive animations. More specifically, I would like to work on the creation of new packages of interactive animations. For example, I believe entire homework sets could be packaged as virtual games that students play. Instead of answering questions and waiting for the grader to tell the student whether or not they are right, the student could submit their quantitative result and instantly watch its effect in a simulated gaming environment. For example, when doing a kinematics problem of an object launched from the ground, students could first play around with different variables and vector sizes to see where the object could land. They would then work out the problem mathematically and enter their result to see if the object actually hits some virtual target. Essentially, homework would become a fun game, the principle involving a build and then test strategy: students will build their understanding and the mathematical formulas to solve the problem, and then they will get to actually test them out in a simulated environment. I believe that this would not only make homework far more enjoyable and fun, but it would create a better reward system for students based less on just getting the grade and more on seeing the power of their newly acquired mental tools in action.

I believe that the next big step in the evolution of education is the large scale use of dynamic media similar to the Phet simulations and some of the 3D animations that currently exist. I want to be on the frontier of the growth of dynamic media with those who are just now developing various forms of it. A masters degree in computer science will give me the tools to do just this, allowing me to help develop new educational games as my imagination sees fit. My intent is to create some of these games, and to apply my thesis work to studying the effects they have on students. CU offers a perfect environment for my goals, given its position on already leading this front with Phet simulations. This will allow me to collaborate with those already creating these simulations to learn from what they have already discovered.

Programming is something I was only recently introduced to, but almost instantly developed an intense addiction to. Educational gaming perfectly synthesizes this new found interest with my previous interests in both physics and education. I am excited to think about the possibilities I can create with the education I will receive in getting a Master of Science degree, and believe that I will greatly enjoy my time learning new aspects of computer science and exploring their use in the new educational frontier of interactive animation and educational gaming.

Bibliography

N.D. Finkelstein, W. Adams, C Keller, K Perkins, C Wieman and the PhET Team, "High-Tech Tools for Teaching Physics: the Physics Education Technology Project," Journal of Online Teaching and Learning, (2006)