

Multimedia and Hip-Hop for Experiential Education

David Birchfield, Melanie West, Wilhelmina Savenye, Thanassis Rikakis

1. Introduction

In this article we present our recent work on two *Student Centered Learning Environment* projects that take experiential approaches to education through the creative and exploratory use of digital media in structured learning environments. We examine the use of media creation tools, the development of hybrid physical/digital learning environments, innovative curriculum design, and hybrid strategies for assessment. Our research methods focus on the role of digital media in facilitating human-to-human interaction between teachers and groups of students while utilizing a variety of instructional methods.

For K-12 education to keep pace with the rapid technological advances in other sectors of our society, we must develop radical new approaches to education that harness new technologies, enable collaborative learning, bridge across the physical/digital realms, and prepare all students for the dynamic world they are entering. We must devise new strategies that engage the creativity and innate curiosity of our students. We must design educational activities that engage minority and underserved students and those with diverse learning styles. We must develop comprehensive evaluation methodologies that provide a full picture of the impact of these new approaches.

One of the most exciting strategies for engaging learners that has emerged in recent years is the development of technology-based learning systems that are highly inquiry-based. The most effective such learning systems are those that are learner-centered, knowledge-centered, and assessment centered [1]. Student Centered Learning Environments (SCLE) encompass a great variety of such learning systems, including open-ended learning environments, microworlds, goal-based scenarios, cognitive apprenticeships, and constructivist learning environments [2]. SCLEs have been extensively used for math and science education but have not as commonly been developed for media education [1].

2. Why are new approaches necessary?

Over the past century a number of educational philosophers have led a reform movement to reshape the face of structured learning. Constructivism is a philosophy or approach to learning that posits that learners construct much of what they learn [3]. Constructivism emphasizes the necessity of play and exploration in self-guided learning, particularly in mediated environments [4]. Instructional

teaching can play a complementary role in these learning environments where advanced students and teachers provide a “zone of proximal development” that speeds learning [5]. Howard Gardner’s thesis in the *Theory of Multiple Intelligences* [6] posits that there are multiple forms of knowledge, including musical and kinesthetic, that support and reinforce one another. This research supports evidence that students have diverse learning styles that are influenced by their life experiences, cultural background, and genetic predisposition. Active and visual learners are examples of students who thrive in environments beyond conventional book and lecture teaching methods. Such students stand to benefit most from new approaches to mediated education.

Dynamic, interactive multimedia offers a great number of opportunities to embrace these proven learning methods, but they have been underutilized in classrooms to date. The scope of multimedia is often restricted to the presentation of audio/visual materials that students passively watch in the classroom. Although these multimedia materials can serve to vary instructional methods, they do not engage active learners. There has been extensive prior work in the development of distance learning frameworks that can deliver educational content to remote learners [7]. Many distance learning courses do offer opportunities for mediated interaction through email, chat rooms, and posting sites. However, students’ learning does not benefit from the direct human-to-human interaction that can motivate and speed their learning as in classroom settings. Educational video games have been introduced in a number of classrooms as a complement to conventional teaching methods [8]. Games can be a powerful motivational force. However, because of their reliance on mouse/keyboard/controller interfaces, most games offer only limited modes of engagement that limit the naturally expressive and social capabilities of students.

In formulating educational strategies for the future, we must develop new approaches to structured learning that harness the potential of emerging digital media tools - including off-the-shelf production tools (Digital Performer by MOTU, Logic and iMovie from Apple Computer, Inc.) and specialized media programming environments (Max/MSP/Jitter [9]), while engaging the innate creativity and motivational forces that students bring to these frameworks. Complex learning can be supported by new technologies that are developed using sound principles of learning. Schank and Cleary [10] describe key characteristics of interactive learning environments that inform our work. In particular, we strive for diverse environments where students can learn by doing, learn through reflection, and learn through exploration.

3. Methodologies

Here we present two ongoing projects that use multimedia for experiential education in structured K-12 learning environments. The Arts, Media and Engineering Education [AMEED] project [11] is lead by researchers at Arizona State University. Our research spans across the development of custom media education tools, supporting curricula, teacher training, and deployment. We take a holistic approach to addressing these challenges through empirical research and direct interaction with media experts, students, artists, educators, and policy makers. *MindRap* is a project of Tiz Media Foundation [12] that facilitates the design and development of rich media content inspired by hip-hop culture for the purpose of exploring math and science concepts. Lessons fuse the creative process of content conceptualization and the technical process of multimedia development.

3.1 AMEED



Figure 1. Interaction in SMALLab as explained in the text

Central to our work is the development of the Situated Multimedia Arts Learning Lab [SMALLab]. A vision based movement tracking module, an audio microphone array, a top-mounted video projector and a multi-channel surround audio system comprise an open, yet immersive media environment that is dynamic and interactive. The interactive system has custom software for fused multimodal sensing, context modeling, and dynamic visual and sonic feedback. The lab allows teachers and groups of students to interact with one another

and their composed media worlds through free-play, structured movement, and vocalization. The use of a multimodal sensing apparatus engages the naturally expressive capabilities of K-12 students. Multimodal real time feedback provides a platform for curriculum design that addresses the needs of students with diverse learning styles. SMALLab's open architecture facilitates social interaction and collaborative learning. The system is low-cost, re-configurable, and can be transported for easy installation in a classroom or community center.

Two overarching and complementary learning objectives guide our work: students should develop a deeper understanding of movement and sound. These broad objectives are subdivided into demonstrable skills that are taught and evaluated through specialized curricula. We are using a

modular approach to curriculum design wherein sets of specialized learning exercises can be grouped to form complete sessions. Multiple sessions can be strung together to form learning paths spanning across weeks or months in a classroom.

Our teaching embraces constructivism and experiential learning theories and utilizes a number of instructional methods including guided discussion, collaborative exercises, and discovery learning with interactive media. For example, students can first exhibit their knowledge about complex movement patterns by verbally describing the movement they see. We are designing instructional sessions that use video footage of movement captured by students to inform discussions of the underlying physical forces that drive such movement (gravity, inertia, and others). To reinforce this verbal discussion method, we have also developed learning modules that allow students to reveal their understanding of movement through physically moving in the space. Students move a color object in SMALLab to mimic observed behaviors. Real time feedback through sound and visual representations of their movement reinforce the details of their patterns. Over the course of multiple sessions, students exhibit increasing sophistication in their motor skills and spatial awareness that reveals a deeper understanding of complex movement patterns.

We have described our development of a physically situated learning environment that supports students' exploration of sound and movement. We now discuss related work that utilizes digital audio production tools and the Internet for science and math education.

3.2 *MindRap*

MindRap [12] is an intensive interdisciplinary learning process utilizing core components of storytelling, poetry, visual arts, and music. During a cooperative design process facilitated by expert educators, artists, poets, and musicians, high school students create content for animated multimedia modules. These modules teach basic math and science lessons to younger children. Student's imagination and enthusiasm for hip hop culture drive the design process. Digital media hardware and software are merely the tools used to make *MindRap* lessons come alive. The technology allows the content that students create to be converted into hip-hop multimedia modules, which are published on a website portal.

While there is no question that a considerable amount of learning takes place through the design process, the goal is to create lessons that can be utilized by teachers in the classroom. Therefore, special attention is given to the pedagogical structure of the lyrics that the students write. Elements of song structure are exploited. For instance, components of the lesson requiring memorization are

presented in the chorus section, which is repeated several times within a song, while the verses are dedicated to conceptualization of the lesson. In addition, students create supportive images that are synchronized with the lyrics, both reinforcing and augmenting the lesson. Figure 2 is an example of a supportive graphic created by students for a lesson on Venn diagrams. The lyrics accompanying this graphic are:

“You can have numbers on the right and numbers on the left, / Circles can range from events to concept, / They tell you ‘bout the situation, tell you what’s in common, / Not in common (and) its flow will sound bombed, / You see five times two equals numero ten / And five plus five equals the same, my friend. / One circle in the middle combinations of both, / Rock your head to the beat



Figure 2. Screen shot from animation on Venn Diagrams

‘cause here comes the chorus. / Venn diagrams, 2 or more circles that compare and contrast, / They gotta overlap / ‘cause if they don’t then it’s a wrap.”

Please note that the intensity in the lesson comes from the verbal delivery of the lyrics, which does not come across in the written form. In addition, often the lyrical content is a reflection of hip-hop culture, so grammatical deviations from what is considered correct are allowed.

In support of current research around culturally specific pedagogies and assessments, we embrace the hip-hop culture. In hip-hop culture, the elements of rhyme, rhythm, and repetition make rap—hip-hop’s linguistic component—an excellent creative vehicle for presenting concepts that require memorization. Math, in particular, lends itself to rap because the creative use of natural language provides a platform for transferring the conceptualization of math into real life experiences through storytelling. This, coupled with the incorporation of multimedia elements that will be widely disseminated and publicly accessible, will hopefully motivate older students to achieve at a high level and inspire younger children to engage in the learning process.

4. Hybrid Evaluation

Our research in experiential education integrates multidisciplinary approaches to the design of new learning environments. Suitably, we approach evaluation in a hybrid, multidisciplinary manner in the *AMEEd* project. Our first level of assessment is empirical observation that occurs during learning sessions with students. Informed by domain knowledge from dance, engineering, theatre, and the sciences, researchers provide expertise regarding student progress and the effectiveness of

our methodologies. We have also developed the *AMEEd Edulink* resource [11], an online portal for observation and annotation. This site serves as an interactive repository for video documentation and annotations of each learning session. Over the course of our pilot studies we have collected a diverse set of empirical observations that assess the effectiveness of all aspects of our work. We corroborate these observations through surveys and interviews with students that focus on their own evolving conceptions of how they construct knowledge through their activities. We also employ psychological methodologies including the design of a perception/action study to evaluate students' ability to navigate real time interactive multimodal environments in SMALLab.

As a complement to these methods, we are developing innovative paradigms for quantitative evaluation in SMALLab that utilize computational models of context and knowledge representation. We are developing models to evaluate aspects of students' sounds and movements that can examine the artifacts of interaction to reveal the emergence of lexical and syntactical elements in their activities. For example, across multiple sessions we expect that a given student's movement sequences will contain some idiosyncratic, yet consistent features. As a student's learning increases, their movement and sound artifacts should diverge from their peers' in quantifiable ways that will illustrate their learning.

MindRap researchers have conducted qualitative surveys of both teachers and students to assess motivational and attitudinal aspects of the project. To expand the work and make it more marketable and applicable for education, we are working on an evaluation strategy to show that there is retention and transferability of knowledge gained both during the creation and presentation of the raps. We will evaluate that across all relevant subject areas. Currently, *MindRap* modules created for solving algebraic equations are being tested on approximately 50 students at a Chicago Public School. Data will be collected regarding demographics, feelings about the modules, and the transferability of knowledge. Dr. Stafford Hood of Arizona State University and Dr. Juan Gilbert of Auburn University will present results from this testing at the American Educational Research Association annual meeting this year.

5. Preliminary Results

As of spring 2006, *AMEEd* is undertaking pilot studies with middle school students who participate in after school programs on the campus of Arizona State University under the auspices of the Herberger College for Kids. This initial study has focused on a small set of learners, but has yielded encouraging results that have already lead to revision and improvements in our methods.

First, we observe that students are highly motivated to participate in these learning exercises. Often, they are initially reserved in their interactions, but through the introduction of increasingly active exercises, students lose their inhibitions and grow noticeably more engaged and expressive in their use of dynamic sounds and movements. Second, students report that they enjoy the social and collaborative aspects of SMALLab. An important design goal has been to develop a learning environment that supports human-to-human interaction and promotes collaborative learning exercises. While many screen/mouse/keyboard interfaces can isolate students and limit their creative capabilities, we are encouraged that here, students are able to engage with their peers in a meaningful way. Third, we can see that multimodal sensing and feedback is having an impact on students' use of movement and sound. For example, we expect that the interactive sound design utilized in learning activities should bias students to move in particular ways. Specifically, we have designed learning activities where real time sonic feedback reinforces movement patterns with highly varied velocity and spatial attractors in the corners of SMALLab. Indeed, analysis of students' archived movement data reveals that these similarities emerge for individuals and across groups of students.

The overall response to *MindRap* has been very positive. Teachers have expressed enthusiasm regarding their access to a database of multimedia learning modules that inspire students. Similarly, students clearly motivated to participate, report that they enjoy the process of multimedia production. This experimental approach is viewed as a welcome break from traditional learning activities, and this has resulted in a commitment (on their part) to exploring science and math concepts.

6. Conclusions and Future Work

Mediated education poses unique challenges and provides great opportunities to design new learning experiences for students. In the *AMEEd* project we will continue to develop the evaluation and learning assessment methodologies that not only document the impact of the project on young students' learning, but will add new models and methods to the research on Student Centered Learning Environments. We anticipate conducting further research on methods for scaffolding student learning in this highly interactive environment, enhancement of learning transfer, collaborative learning, and support of teacher training for these emerging technologies.

The infrastructure for the *MindRap* multimedia development is in place and many aspects have begun to be tested. We are presently developing guidelines for the pedagogy and assessment of

MindRap multimedia modules. The next step is the development of the website portal. Our future work will focus on introductory lesson design that will deepen students' understanding of particular math or science concepts that are presented in *MindRap* sessions

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8. Authors

David Birchfield is with Arts, Media and Engineering at Arizona State University, Melanie West is with Tiz Media Foundation, Wilhelmina Savenye is at the College of Education at Arizona State University, and Thanassis Rikakis is with Arts, Media and Engineering at Arizona State University.

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