Associated Colleges of the South
***REPORT ON* Teaching with Technology Fellowship**
"Using LED technology to teach Additive Color-mixing Theory"
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PLEASE NOTE THAT REPORT IS IN BOLD ITALICS

1. Background: Rationale for Overall Project

In a growing world where energy consumption will steadily be rising, a "new" illuminant is peeking over the horizon: Light Emitting Diodes. For years, they were mostly indicator lights on electronic equipment, but within the past decade, advances in their lumens per watt ratio have thrust this energy saving light source into our daily lives (traffic lights, auto tail lights, flashlights, etc.) and into the world of entertainment lighting. The LED fixtures consume less than a tenth of the energy of incandescent lamps and last for hundreds of thousands of hours- hundreds of times longer than incandescent lamps. A stage lighting fixture powered by LEDs consists of a concentrated cluster of one-watt Light Emitting Diodes, of which an equal amount are blue, red and green, the three primaries used in Additive color theory.

When teaching the additive color mixing system, students invariably confuse the subtractive and the additive theories, because they often are first exposed to pigments of color in art classes. I have time and again demonstrated, with three separate fixtures housing blue, green and red polyester filters, that all three pointed from the same object will create a white light. But the result is a timid yellow- because of incandescent lamps and because the primary gel colors are really not accurate. Today's LEDs are super white and bright. Demonstrating the additive color system and LEDs to our students will afford them perhaps a close up familiarity with tomorrow's light bulb and should make the theory of mixing colored light a fun and creative exercise.

After I received word that my proposal had been accepted, a soon-to-be senior Theatre major expressed interest in this project. She and I decided her participation could serve as her capstone (mandatory culminating project in one's major) experience. Mindy felt that it might be instructive to try to recreate commonly used gel filters by creating recipes of red, blue and green light.

2. Description: Part of the Project to be done under ACS funding

I intend build a series of assignments that challenge students to use the additive color theory to re-create standard, commercially manufactured 'gel' colors and to create new ones. I can see adding a component to three of my courses (Stagecraft, Lighting Design, and Advanced Lighting Design).

Using the funds from this fellowship, we acquired a bare bones digital dmx controller and three different LED fixtures that were in our price range. Mindy Griffin and I set up a laboratory in a room with a wall-to-wall white dry/erase board- which was perfect for our need to observe the mixing of red, blue and green light and gave us a writing surface for our gel recipes.

3. Timeline: Deliverables/Milestones for ACS Funded part of project

I do not have any theatrical designs contracted for summer, 2006; thus I will have ample time to test and research the capabilities of an LED fixture. I should be able to incorporate this technology into my courses beginning in the fall of 2006. I intend to offer a demonstration of the color mixing pedagogy to the 2007 ACS Drama Workshop. I have attended three Workshops and demonstrated automated lighting technology at the 2004 ACS Drama Workshop at Trinity University. I am also considering a Powerpoint Teaching Assignments with LEDs, which would be made available to any ACS faculty or students.

I was asked by Doug Cummins from Furman University to present our research at the 2006 ACS Drama Workshop. Mindy indicated that she could attend as well, and we decided that she would be presenting our research via a powerpoint presentation at the Workshop.

4. Technology: Technical Requirements for the Project

I have been researching the available LED fixtures, many of which require a separate controller. There are now a number of LED lighting fixtures with in the budget on the market, the automated Coemar fixture (I-wash LED) would be a good fit because we own a compatible controller that runs off of a Windows XP system.

We began researching independently for information on LEDs- their history, their illuminating properties, their technical makeup, their impact on today's lighting market, etc. I began a series of conversations with a local LED distributor for fixtures within our budget.

5. Other Support: Institutional and/or Outside Support for Project

Once the process of selecting the most appropriate LED fixture has been completed, I may need to augment our Control system (Whole Hog PC) with the programming wing, in order to make it as accessible to non-technical-savvy

learners. These issues can be accomplished by the end of Spring semester, 2006. I have several students who have expressed interest in continuing research into LED technology; we are thinking of applying for further Southwestern University resources in order to thoroughly study and analyze this emerging technology. We might apply for a Mundy or Jones Fellowship to compensate for the time and energy spent exploring LED technology.

I began by pursuing the above-mentioned Coemar I-wash fixture (which would have eaten our entire budget), but we ultimately decided on several stationary fixtures and a dmx controller. Part the reason we went this direction was because I could see multiple student applications for a portable LED lighting system. Lighting students could use it to augment our twelve-dimmer system in the Rehearsal Hall, where most of the student showcase work occurs. Then, they could also truck it over to any smallish "found" spaces where they might be in need of production lighting.

6. Learning Outcomes: How the Project will enhance Teaching/Learning

I am excited about the possibility of incorporating today's technology into my courses. Color theory (especially additive- light) is one of the most difficult subjects to understand, without concrete demonstrations. Our students deserve to experience and to be enriched by the fantastic learning tools that are now within our reach. I hope to teach and inspire other teachers about the huge learning opportunities LED technology will offer lighting designers. I, too, will personally benefit from the freedom of creativity that this technology offers to the experienced and inexperienced designer.

Adding color to one's compositions is a partly intuitive process that I feel is best learned by hands-on experimentation. By acquiring a stand-alone LED lighting system, I believe that we will be serving students' learning outcomes to the fullest.

7. Curriculum: How the Project will be integrated into the Curriculum

As stated above, the abstract nature of Additive color theory will be somewhat demystified when the beginner can actually see the three primary colors of light and can actually manipulate the primaries in a nearly infinite manner. I imagine that I will create a series of assignments that gradually increase their knowledge of color mixing. The student will be able to reproduce certain standard gel colors and will then be challenged to create their own.

Of course I intend to develop an assignment in which lighting design students will be using the LED system, mixing the three additive primaries to achieve their results. At this time that project is in need of more time and thought. I teach Lighting Design in the rehearsal hall, which should allow us to hang the LED fixtures from the pipe grid and play!

8. Assessment: How the Project will be evaluated

I think that I will try to involve one or two interested lighting students in the initial phases of this Summer 2006 process. From them, I can more accurately gauge what sorts of learning possibilities the LED technology can provide. If I do employ a student as a teaching assistant during my initial incorporation of this visualization software, I will expect to get the student's point of view during the period of the course itself and I will ask the students enrolled in the course to evaluate the use of the technology at the end of the semester. I will also ask for feedback from ACS faculty, either at the ACS Drama Workshops or through individual contact.

We found one of the three LED fixtures to create the brightest and the whitest "white light." This fixture, the WallWasher II, was made for architectural (not theatre or discoteque) application; it is boxy and rather unattractive, compared to today's sleek ellipsoidals. Still, we found the WallWasher II to be effective only in very small rooms, where the distance from the fixture to the performer is no greater than six feet. This distance is just right for our rehearsal hall, where the majority of the student lighting designers cut their teeth.

9. Dissemination: How the Project will be shared with ACS Colleagues

After I have taught *Lighting Design* in Spring 2006, I would like to offer a session at the ACS Drama Workshop for interested faculty. The Workshop could be two-fold: informational (demonstrating the LED color mixing technology) and educational (sharing strengths and weaknesses of my early pedagogical choices). I also will make my pedagogy available to other interested faculty by adding a powerpoint file of the assignments and perhaps also add superior student accomplishments as these opportunities arise.

Mindy Griffin presented our research to the ACS Drama Workshop at Furman University in an entertaining and informative powerpoint presentation. I intend to use an expanded version of her ACS Drama Workshop presentation at the Association for Theatre in Higher Education conference in Chicago August 4, 2006.
Further, I have attached the ppt file reflecting our presentations and to provide easy access, I suggest that it be linked to the ACS Drama home page- AD LIB.