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Leveraging Lighting Color, Temperature and Luminosity for Improving Classroom Learning:

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Leveraging Lighting Color, Temperature and Luminosity for Improving Classroom Learning: A Work-in-Progress Report of Teacher Action Research

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Abstract

This short article addresses a preliminary exploration of a third grade teachers' action research applied to the use of a dynamic lighting system for improving educational performance in the classroom. Dynamic lighting offers teachers' four light settings: focus, energy, calm, and normal. Prior research has revealed a positive relationship between dynamic light use and student cognition, motivation and concentration. What is not known is how a teacher should make use of the four settings throughout the day during all of the activities, content-area learning, and transitions in students' experience. Teacher data (journal entries) was collected for one year. Case study analysis methodology was utilized with the unit of analysis consisting of the teachers' perceptions within the boundaries of light setting selection and classroom context. Pattern recognition analysis shed light on how to make use of all four settings of the dynamic light system.

Formation of a Research Team

Theresa Thomas is the preliminary study leader and a third grade classroom teacher with almost two decades of experience. Her immediate connection, expertise and awareness of her classroom dictated that her viewpoints -- expressed in discussion and via journaling -- guide the study questions. Her fascination with light in the form of color also dictated that she would be the ideal teacher-research leader of this project. Her classroom has been painted many different colors, all based upon research on the impact of color on mood, motivation, and learning. She is a passionate educator with a classroom that is designed to encourage children to explore, question, and engage in problem-solving. In her own words:

> I love the work that I do each day with my third graders. I believe that observation of my students, how they respond to my voice and how they react to their friends during work is the key to learning. I think there are many things that go into how this process can be enhanced -- and this is where the lighting comes in… (Journal entry)

Michael Mott, is a Professor of Education at the University of Mississippi and former New York City public school teacher of first and second grades in the East Harlem section of New York. Jodie Lawman Burnette, a graduate researcher working with Michael Mott, is also from the University of Mississippi. Jodie taught for several years in the Lee County Schools District where she and Teresa Thomas became colleagues and friends.

Mrs. Thomas soon became known as the "Light Lady" in the third grade hallways due to the fact that she often visited to simply check the lighting, conduct numerous tests on reading skills, motivation, and concentration, or relay messages to the teachers from the lighting company and/or university. Upon hearing that Teresa's classroom was one of the focused settings in the lighting study, Jodie and Teresa immediately rekindled their professional friendship. Teresa, Jodie and Michael

would meet after school to discuss the study and resolve any problems that had occurred. This article addresses the preliminary stages of our research together.

Description of the Work in Progress

Dynamic Lighting System

Dynamic lighting (Philips Corporation) Research conducted independently.consists of ceiling mounted lights with an accompanying wall panel control unit with four settings (see Figures 1, 2, and 3). The system is designed to improve light quality in the classroom for improving cognition, motivation and concentration. Light for each setting varies according to color (as measured in Kelvin), temperature ("cool" to "warm" along the radiation spectrum) and luminosity (Lux) to create four distinct settings mounted on the classroom wall with buttons. The four settings consist of *Normal, Focus, Energy*, and *Calm* and are designed to correspond with various classroom activities. They can be selected by the teacher via a control panel.

The *Normal* setting can be used "for regular classroom activities" whereas the *Focus* setting can be employed "when children have to concentrate, such as for tests." *Energy* is a setting designed for use during times of day when students experience a reduction in energy, usually "in the morning and after lunch." The *Calm* setting is designed for group activities requiring cooperation or supporting the students to settle down when students are "overactive." Each lighting fixture (or panel) contains three lamps, with the two outer lamps generating a "cool color temperature" and the single inner lamp producing a "warm color temperature." The lamps within the lighting panel are incrementally "decreased (dimmed)/increased in light output per selected scene [setting] to create the light effect per scene."

Studying Dynamic Lighting with Case Study Research Methodology

Prior quantitative research (Mott, Robinson, Walden, Rutherford & Burnette, 2012) has revealed dynamic light effects on learning with tightly controlled variables that constricted the possible effective use of the lighting system. The *story,* however, of how a teacher might maximize lighting benefits has not been told. Such a story might contribute to light curriculum and strategies for use, leading to further quantitative evaluation to test new hypotheses.

Because of Teresa's avid journaling practice on light use and the context for that use, university researchers felt it would be an appropriate instrument to discern data of the complex classroom environment and the myriad light-setting choices by teacher/student activity.

Mrs. Teresa Thomas: A 3rd Grade Public School Teacher in the Mid-South

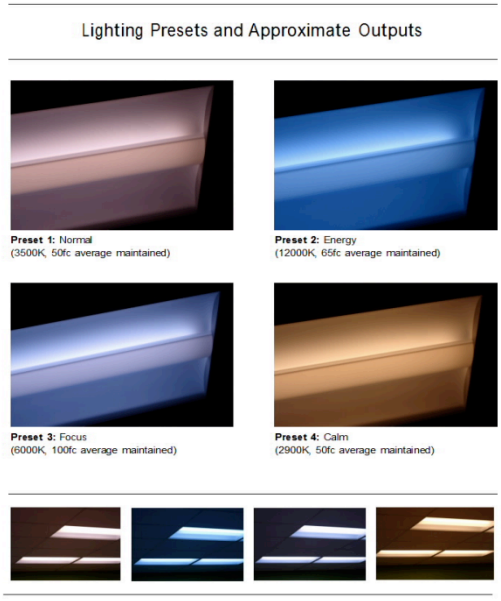
Jodie Burnette and Michael Mott approached Teresa as the perfect candidate for lighting research. Teresa had been fascinated with color and had takenthe initiative and used her own resources to paint her room a light blue color based upon her research on how color impacts learners. The fact that Teresa was so invested in color indicated that she would be very open to considering a research project to do with lighting.

Teresa's classroom is carefully designed to meet her teaching needs. She has been an educator for nearly two decades in many schools throughout the South-eastern United States. She has taught a handful of lower grades, and currently teaches reading to approximately eighty third graders.

A critical portion of her philosophy as a teacher is the importance of the classroom environment, which she and her students refer to as their classroom "home." "Design and organization of the physical classroom should correlate with educational theory and the methodology being applied" (journal entry dated 10/2011). She believes that teachers should use their physical setting as a tool for balanced instruction. Her "sky blue" wall coloring choice was a result of personal research to determine the best color for student academic learning, comfort, and success.

Other aspects of her physical classroom design include sections for specific student activities. For example, there is a quiet corner filled with various colored beanbags, a comfortable rug, and books geared to the variety of reading levels and interests

Figure 1. Mrs. Theresa Thomas and a Composite View of the Lighting Types.



Figures 2 and 3: Dynamic Lighting Wall Panel and Light Fixtures

of the students. A terrarium that houses the pet turtle is on display in the "touch and learn" center, along with animal skulls and artwork showing the topics of the literary selection of the week.

These individualized learning spaces support a sense and expression of identity for students. Reading on the beanbags or carefully touching the

chainsaw art sculptures of reptiles provide the children with a true sense of "I am a reader." This chance for private exploration provides further detail to their texts and makes them more alive in students' minds. Desks are arranged in face-to-face areas to encourage a sense of belonging among the whole group. Not one student is alone or apart from any discussions or other types of learning. This is all crucial for student success in her room.

Results: Pattern Recognition from Teacher Journal Entries

Teresa kept a journal in her classroom for several years and recently, after the light installation, focused on lighting impacting learning. Her entries consist of commentary, observations, and reactions students have to her teaching, as well as remarking on her own thoughts about the teaching and learning that occurs in her midst. She considers the visual environment, especially lighting, aligns directly with her students' ability to identify visual stimuli and that these observations consequently affect overall student performance. She explains by means of excerpts from her journal:

> The impact of our project lighting system is still to be determined. I believe that it is a definite part of the future of the 21st century school system. My students are the recipients of the environmental elements that can be brought together to effectively cause engagement through learning and behavior using the benefits of environmental lighting and the degree of flexibility it affords me as a teacher.

She is actively involved in the lighting system that is now installed in the classroom and along with the researchers, Michael and Jodie, a preliminary analysis of her data has provided information on how the various light settings impacted her students.

> (Student A), a "squirmy" student, seems to thrive in the energy light setting. He is usually restless and talkative, but I have been able to tell a difference in his focus on the days that I've turned on the energy light setting. His behavior has to be corrected less, he has better focus during whole group instruction, and his work is often superior on the energy light days as opposed to the normal light days.
>
> (Student B), seems to have better focus and get her work completed in a more timely fashion when influenced by the focus light setting. Student B is a habitually slow worker. She's easily distracted and her attention span seems to be shorter than that of an average third grader. I noticed a difference in her behavior during a makeup work day. On this particular day, she came into my classroom during the time that my first class (the focus light group) was in session. She completed 5 assignments in one class period-quite a record for this student! I bragged and bragged about her wonderful work, but in retrospect, I believe it may have been that the lighting change played a large role.
>
> (Student C), who is medicated for ADHD, seems to do his best work in the energy light setting. He's more involved in class discussions and interested in the given task when the lights are set on energy. His demeanor, which is often somewhat "sluggish", is "peppier" (for lack of better wording) when the energy setting is on.

Additional entries specific to light settings:

> The focus setting is the most beneficial of all settings I have used it to increase students study time in reading and now in math I find it helps them to settle in and concentrate much easier than any of the other lighting modes.
>
> The children don't seem to even be aware of the focus lighting but they are always aware of the energy or calm setting yet when I change to the focus setting they just appear to settle into whatever they have been assigned.
>
> The best way to use the lights for now is the same as we've been doing for concentration skills and observation has shown me that the lights do play a part in the classroom behavior as well as thought and concentration.

The Larger Study

These initial results, pointing to student and teacher reactions to how various light settings impact teaching and learning will be developed into a larger qualitative study to examine the various scenarios for light settings and student reactions. It is our hope that results yield important findings for shaping and designing curricula where the goal is how to use a dynamic lighting system to maximize learning.