

THEATRE DESIGN & TECHNOLOGY

VOL. 60, ISSUE 1

SHOP CLASS

Employing lean manufacturing and Kaizen concepts to keep spaces effective and efficient

USITT.

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An example of the challenges facing many theatres: how to organize and prioritize which stock scenery items to save. | Photo by John J. Rawlings.



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Eileen Curley, Marist College
Editor in Chief
290 Elwood Davis Road, Suite 100,
Liverpool, NY 13088
315.463.6463, fax 315.463.6525,
tdteditor@usitt.org

Angela Hickman
Managing Editor
404.918.6775
angela@hickmanbrady.com

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TD&T (ISSN 1052-6765) is published five times a year—Winter, Spring, Summer, Fall, and a Portfolio issue published in March—by United States Institute for Theatre Technology, Inc., 290 Elwood Davis Road, Suite 100, Liverpool, NY, 13088. Subscription to *TD&T*, also known as *Theatre Design & Technology*, is a benefit of USITT membership. Fourteen dollars is deducted from membership dues to cover cost of publication. Periodicals postage paid at Liverpool, NY and additional mailing offices. POSTMASTER: Send address changes to *TD&T*, c/o USITT, 290 Elwood Davis Road, Suite 100, Liverpool, NY 13088. COPYRIGHT © 2024 by United States Institute for Theatre Technology, Inc. All rights reserved. Material in this publication may not be reproduced in any form without permission.

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EDITORIAL OFFICES

United States Institute for Theatre Technology, Inc. 290 Elwood Davis Road, Suite 100, Liverpool, NY 13088
800.938.7488 • 315.463.6463
fax 866.398.7488 • 315.463.6525
info@usitt.org
www.usitt.org
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Welcome to the first 2024 issue of *TD&T*! In this issue, our features authors ask us to revisit our understanding of practice, practitioners, and pedagogy. We also remember longtime USITT supporter Dick Wolpert and Union Connector, which he founded. This is also the start of the 60th volume of *TD&T*, and we begin our anniversary coverage in this issue.

John J. Rawlings Jr. takes us through a shop organization methodology based on Toyota's approach to lean manufacturing. As a technical director who has worked in numerous types of shops, Rawlings has experience with stepping into chaotic spaces and turning them into usable workspaces. His observations are particularly pertinent for those working in high schools and colleges with limited staff

and space. A former high school teacher, Rawlings is familiar with those specific challenges and hopes that this piece will assist others in similar situations.

Clifton Taylor asks faculty members and anyone training new staff to reconsider how and why we devise problem-based learning challenges. By combining historical studio learning methods developed by the Bauhaus with contemporary spins on those techniques, Taylor proposes an approach to lighting design programs that offers intriguing ideas for all types of programs and training workshops.

Rich Wolpert shares some remembrances of his father, longtime USITT supporter and member, and the founder of Union Connector, Dick Wolpert. Rich Wolpert shares details about the creation of the company and some of its ubiquitous innovations, taking us on a personal journey through the same time period we visit in Taylor and our archival piece.

TD&T 60 YEARS

Finally, we are kicking off this 60th year of *Theatre Design & Technology* with a slice of our history—revisiting our charge from the founders of USITT and exploring how history viewed the future of design and technology with a reprint of David Thayer's 1965 "Planning for Lighting Control Systems" from our first issue. As we progress throughout the year, we will be looking back at *TD&T* from the future Thayer and early members imagined, and we invite readers to share their memories as well.

Part of our 60th anniversary volume coverage will include a discussion of often re-read *TD&T* articles. If you have a piece you often share with new colleagues, incorporate in academic classes, or find yourself thinking about over the course of the year, then please let us know at tdteditor@usitt.org.

—Eileen Curley, Editor

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Illuminating

Lighting Education

Problem-based learning (PBL) builds on American philosopher John Dewey's belief that a learner constructs knowledge in response to real-life events (Schmidt 1993). PBL increases learners' sense of community and attitudes toward content (Ferreira & Trudel 2012) while also accomplishing two main goals: for the learner to both construct domain-centric knowledge and to apply that knowledge to increase their general problem-solving skills (Barrows & Tamblyn 1980). Here, domain-centric knowledge refers to knowledge acquired in a learner's field; for instance, an understanding of the possible meanings of lighting color or angle. Through the appropriate implementation of PBL, learners across many disciplines have been shown to improve problem-solving and critical-thinking skills (Ulger 2018) and display enhanced creative flexibility (Cheung 2011). This process of acquiring domain-centric knowledge and applying it to problems is a transferable skill that learners can take into their field or any future discipline or career path.



Studio- and problem-based learning approaches to theatrical lighting design provide students with real-world experiences

BY CLIFTON TAYLOR

Clifton Taylor demonstrates a problem for working on angle in light at the Studio School of Design Summer High School Intensive Program. | Photo by Mark Stanley.

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Problem-based learning and studio-based learning trace their historical geneses to the Bauhaus School in Weimar, Germany, and Black Mountain College in North Carolina. These design courses inspired the creation of problem-based learning in other divergent fields such as law and medicine. Theatrical lighting design (TLD) education and other theatrical fields often use these techniques, with faculty updating practices as their fields and students change. Theatrical lighting design could benefit from applying recent research in problem construction and analysis using Woei Hung's 3C3R problem-design model to design problems for students to solve in theatrical lighting design studios and classrooms. Two theatrical lighting design teaching institutions—the University of North Carolina School of the Arts in Winston-Salem, N.C., and the Studio School of Design in New York City, which provides training and workshops for high school teachers and learners in theatrical lighting design—are using problem- and studio-based learning, incorporating Hung's 3C3R model.

Black Mountain College and The Bauhaus

The fundamentals of problem-based learning derive in part from educational processes that Dewey proposed and later observed at Black Mountain College in the first half of the 20th century (Reynolds 1997). Before Black Mountain, the Bauhaus School revolutionized design training through a new conception of studio-based learning (Bayer et al., 1938). Walter Gropius, the founder of the Bauhaus, built the school on a novel concept of education that sought to democratize the relationships between artists and craftspeople, teachers, and learners (Gropius & Dearstyne 1963), eschewing the Beaux Arts-style academy system that was teacher-centered and trained students to gain skills by copying masterworks (Bayer et al., 1938).

The Bauhaus consciously re-cast the instructor as a facilitator in a learner-centered environment (Hmelo-Silver & Barrows 2006). The Bauhaus facilitator set initial prompts, demonstrated essential techniques, led group critiques, and ran the lab (Boling 2016). The success of the Bauhaus model of studio-based learning (SBL) has been widely disseminated

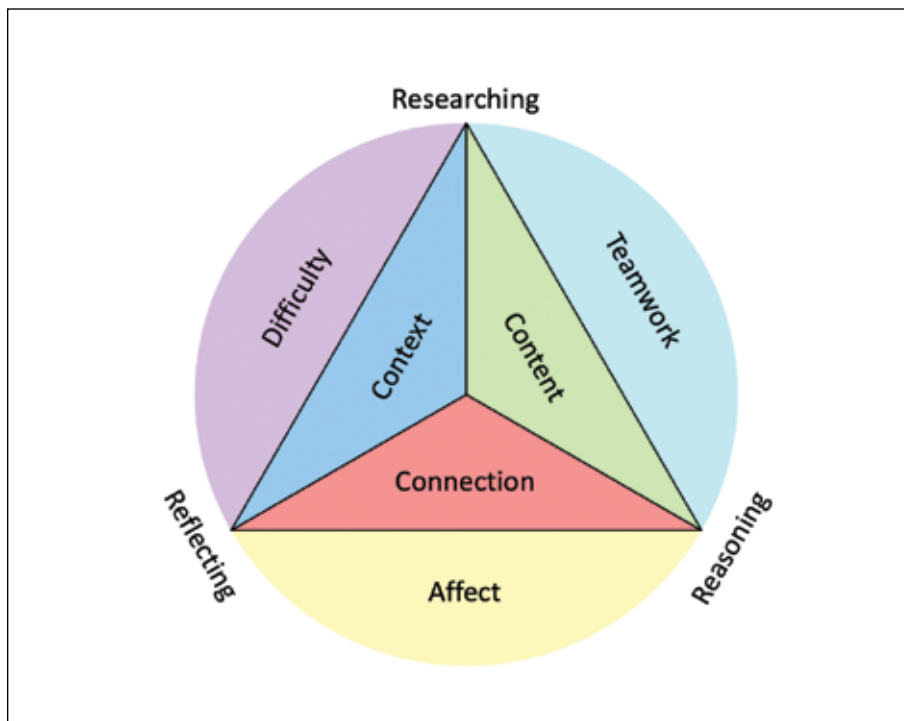


Figure 1: The second generation 3C3R PBL problem design model (Hung 2006, 251).

throughout the world across many design disciplines (Cennamo 2016). SBL emphasizes “knowing-by-doing” and ‘reflection-in-action’ as essential components (Schön 1985, 22 & 24) and has become an essential platform in moving learners from school to related professional communities (Brandt et al., 2013).

These approaches, studio-based and problem-based learning, found a U.S. home at Black Mountain College where Dewey was on the Board of Visitors and Josef and Anni Albers had joined the faculty following their departure from the Bauhaus. Black Mountain's curriculum focused on the arts, crucially in a course led by Josef Albers (Miller 2018), where learners constructed knowledge about art-making through problem-solving actions (Reynolds 1997). Albers presented prompts for learners to work through in novel ways: gathering materials, defining parameters, constructing solutions, and reflecting on results (Ellert 1972). For instance, Albers' teaching at Black Mountain College was bound to the practicalities of solving artistic and design problems with specific materials (Füssl, 2006). This constructivist approach was deeply learner-centered (Reynolds 1997). Black Mountain fostered a studio-based and problem-based model of education, which continues to resonate.

Theatrical lighting design educational

programs share goals with many other design disciplines, including teaching the processes and preparing for professional practice. Studio-based learning, in combination with problem-based learning, is a relevant model for effective theatrical education across many disciplines.

Studio-Based Learning Processes

The studio encompasses three concepts simultaneously: a course, a space, and a learning method (Cennamo & Brandt 2012). In studio-based courses, design problems are rooted in professional practice, and the content learners need to solve a prompt that is discussed in context or discovered through independent research (Boling 2016). While basic instruction in materials and techniques may begin a learning unit, learners are encouraged to take responsibility for acquiring information and constructing knowledge. Understanding how materials or tools can be deployed and manipulated is constructed by doing the action (Boling 2016). In addition, studio-based learning inculcates in learners a way of knowing (Boling 2016).

In studio-based learning (SBL), classes meet several times weekly for three- to four-hour sessions (Cennamo et al. 2011). This ample, in-studio time encourages learners to work together. Outside of these sessions, the studio is always

available, and the program provides learners with dedicated, personal desk space to work all term. Each prompt ends with a group critique.

While it may share attributes with other design disciplines, the workspace of the theatrical lighting design learner is potentially noisier and more resource dependent. In most theatrical lighting design (TLD) programs, the studio is a light lab, a room that shares many elements commonly found on a stage (Taylor 2019). One difference with other design disciplines is that in a scenic design or costume design studio, it is more common to be able to assign a permanent workspace for each learner as they are working on projects that are realized in scaled drawings and models. In an effective theatrical lighting studio, learners must work at full scale to actually utilize theatrical lighting instruments; therefore allocating permanent workstation space within a light lab is rare. In addition to the lab where practical work and critiques occur, TLD studio courses require a second space with dedicated workstations to produce drawings and related materials. This second space is also critical to establish a studio-based environment, and students should be encouraged to work on their design projects in this common space as much as possible.

Problem Design for TLD

Once established in a studio-based environment, theatrical lighting design facilitators must design problems for learners to acquire the skills and acculturation to practice professionally. Design problems are among the most complex problem types (Jonassen 2000). Woei Hung's experience with creating and analyzing problems in other disciplines has led to the 3C3R PBL Problem Design Model and an analysis process to help facilitators conceptualize, design, and order problems within a course (Hung 2006; Hung 2008; Jonassen & Hung 2008; Hung 2019). The rigor of this model can be useful to TLD facilitators to develop functional problems.

The three Cs in the title refer to core components of content, context, and connection. The three Rs refer to processing components of researching, reasoning, and reflecting. In addition, there are three enhancing components: affect (referring to learner motivation, engagement, and



Studio School of Design student Christopher Dias focuses a light at the Studio School of Design Summer High School Intensive Program. | Photo by Rosalie O'Connor.

sense of connection), difficulty, and teamwork (Hung 2019).

An example of the PBL Process:

Key and fill light are fundamental concepts in theatrical lighting design. Key light refers to a motivated light source, like sunlight or the light from a lamp. Fill light is a secondary light source that fills the shadows caused by the key light (Gillette & McNamara 2020). Using these concepts to design lighting that conveys the essence of a recognizable space with poetic meaning and emotional resonance requires effort within a situated practice. For this example, assume there have been earlier problems in creating key light sources. This example tasks the learners with moving beyond key light to create usable fill light. The learner profile for this example is an undergraduate in a beginning-level lighting design course.

A problem-based learning facilitator begins to design a problem in the 3C3R model by identifying goals and tasks (Hung 2008), which for this example include the following:

1. Arrange scenic elements for an end-stage configuration. Design the placement of these elements to make a prompted area the primary

focus of the scene.

2. Design and implement key lighting sources that are visually responsive to the text prompts.
3. Extend the key light ideas into a viable theatrical lighting design by enhancing the key light to accommodate the audience's need to see the actors' expressions while supporting the prompted key lighting design ideas.

Context, or authenticity, considers a problem within the professional cultural practice (Hung 2006). The learners' actions in the studio should authentically relate to their future careers. The problem of key and fill light can be more authentic by contextualizing the problem through a playscript. This example uses the beginning of scene three, *The Poker Night*, from Tennessee Williams' *A Streetcar Named Desire* (Williams 1953) for its context specification (see sidebar on page 22). This is only one example of many possible playscripts that could be used. A facilitator should find a text that is appropriately relevant for the level of the student, the lighting challenges presented, and the experiences students bring to the classroom. Bringing together goals, tasks,

and context can now lead to a problem statement.

Preliminary Problem Statement:

Break into groups of three or four learners. Work together to identify and research the needs of the scene. Plan the design of the space and the lighting. Implement the group's design using furniture, props, and lights.

1. Arrange scenery in response to Williams' text, prioritizing the poker table.
2. Create a lighting design to realize the prompted light from the text by considering lighting angles, color, and distribution in the placement of the lighting sources, as in earlier prompts. Consider both the need to communicate the concepts of the prompted light and the need for the audience to see the faces of the actors.
3. Present the scene to the entire class. The presentation must include human characters (in this case, classmates standing in). Darken all other lights (e.g., classroom lights or daylight) in the space for setting and presenting the scene.

Table 1. Aligning Goals and Problem Statements

Goal	Preliminary Problem Statement
Arrange scenic elements for an end-stage configuration. Design the placement of these elements to make a prompted area the primary focus of the scene.	Arrange scenery in response to Williams' text, prioritizing the poker table.
Design and implement key lighting sources that are visually responsive to the text prompts.	Create a lighting design to realize the prompted light from the text by considering lighting angles, color, and distribution in the placement of the lighting sources, as in earlier prompts.
Extend the key light ideas into a viable theatrical lighting design by enhancing the key light to accommodate the audience's need to see the actors' expressions while still supporting the prompted key lighting design ideas.	Consider both the need to communicate the concepts of the prompted light and the need for the audience to see the faces of the actors.

Table 2. Determining Core and Peripheral Domain Knowledge

Definition of a key light and a fill light	These concepts are core domain knowledge.
The order of first designing key and then fill lights.	This is core domain knowledge.
Assembling denotative and connotative visual research materials.	This is both core and peripheral domain knowledge. For instance, the Van Gogh painting is core knowledge the learners must obtain to understand the problem. Finding the visual definition of an unfamiliar term like "portieres" is peripheral knowledge .
Understanding of an end-stage configuration.	This peripheral domain knowledge increases learners' understanding of core issues.
Arranging the scenery.	This peripheral domain knowledge contributes to the learners' overall understanding of theatrical design.

Problem Affordance Analysis

With this set of goals, tasks, a context specification, and a preliminary problem statement, review the problem against the 3C3R model, a multi-step process for increasing the effectiveness of problem design (Hung 2019). To begin, align problem statements to goals (see Table 1).

The initial part of the problem statement outlines the tasks that learners must accomplish. While it gives an ordered, broad outline, more specificity would make it more straightforward.

Break into groups of three or four learners. Read through the given scene together. Identify and list the needs of the given scene. Research the needs of the given scene. Work together to design a layout for the entire space that prioritizes the poker table but also considers all the elements described in Williams' text for an audience in an end-stage configuration. Make a schematic (not to scale) design plan (overhead view) showing the arrangement of furniture, walls, and lighting instruments for an end-stage configuration. With the plan, set up scenic elements and the lighting using available furniture and lighting tools.

To assist non-expert facilitators, the problem designer could also create a facilitator's guide to research terms (see page 23). Repetition and reinforcement of critical concepts through multiple

problems, called scaffolding, is also vital for effective PBL (Hung 2006).

Analyzing Reasoning Paths (see Table 2): Consider all the reasoning path(s) a learner could use to solve the problem and determine if one is preferred (Hung 2008). The example problem directs the learner to "[c]onsider both the need to communicate the concepts of the prompted light and the need for the audience to see the faces of the actors." This statement is ambiguous because it does not lead the learner through a preferred reasoning path. Fill light is a dependent variable of the key light. The fill light's intensity, angle, or color is indeterminable without a pre-established key light. This reasoning path can be made more explicit by altering the problem statement:

In this problem, design the prompted light by placing key lights. Follow that by placing fill lights to address a need to see the faces of the actors without overwhelming the key light.

While this improves the statement by leading the learner through a preferred reasoning path, it does not expose the dependent relationship of fill light to key light. An additional clarifying statement is necessary:

Look at the scene with the key lighting set up. Take turns standing in as performers in the scene at each acting position around the poker table and in the kitchen

around the poker table. Now, place fill lights in areas in front of the stage space. Consider how the angle and color of the fill light can support the ideas of the key light while also filling in shadows. Place the fill light to help the audience see the performer's faces while also supporting key light ideas.

Analyzing Core and Peripheral Domain Knowledge: List the domain knowledge necessary to solve the problem. Consider both the core domain concepts and peripheral information necessary to work with this problem:

The core domain knowledge is the heart of the assignment. The peripheral domain knowledge provides additional information and can easily be adjusted to meet learners' capacities. For example, a facilitator could provide a scenic design to simplify the problem. This analysis of what is core and peripheral helps guide a facilitator in supporting learning.

Analyze the Necessary Problem-Solving Skills: Consider the research and reasoning skills necessary to solve the problem. Learners must identify areas of knowledge that require research. The goal statement is critical to directing this research (Hung 2006). The learners must then use the available materials to realize their design. Here are additions to the list of goals and problem statements that could help to guide the learner

Revised Problem Statement

Goals or learning outcomes gained through this unit:

1. Work in small groups to read a text and discuss its scenic and lighting design needs.
2. Engage in both connotative and denotative visual research to fully understand the requirement for the scene as described in the text. Assemble materials that a) illustrate each of the visual ideas from the text (denotative research) and b) express your group's mood and feeling response to the described space (connotative research).
3. Create a design plan for scenery that responds through research and discussion within the group to the needs of the text for scenic elements in an end-stage configuration. Design the placement of the elements to make a given area the primary focus of the scene.
4. Place key lights in a lighting design plan that responds to the text.
5. Adapt the design ideas to the tools that are at hand in the studio. Use the tools, furniture, props, and lights to set up the planned design.
6. Extend the key light ideas into a theatrical lighting design where the audience is gathered on one side of the performance (end-stage configuration) by utilizing additional lights to extend or enhance the key lighting to accommodate the audience's need to see the actor's expressions while still supporting the prompted lighting design ideas.

Problem Statement:

Break into groups of three or four learners. Read through the given scene together. Identify and list the needs of the given scene. Create a list of items from the text that require further denotative or definitional research. Create a list of terms to use for connotative visual research to illustrate possible feelings or moods of the scene. Work together to find visual images for these terms. Design a layout for the entire space that prioritizes the poker table but also considers all the elements described in Williams' text for an audience in an end-stage configuration. Make a schematic (not to scale) design plan (overhead view) showing the arrangement of furniture, walls, and lighting instruments for an end-stage configuration. Using the plan, set up the lighting and the scenic elements, adapting the available tools from the studio. Look at the scene with the key lighting set up. Take turns standing in as performers in the scene at each acting position around the poker table and in the kitchen around the poker table. Now, place fill lights in areas in front of the stage space. Consider how the angle and color of the fill light can support the ideas of the key light while also filling in shadows. Place the fill light to help the audience see the performer's faces while also supporting key light ideas. Extinguish all other lights (for instance, classroom lights, work lights, or daylight) in the space for the setting and presentation of the scene lights. Present the design to the larger group for discussion and critique.

Scene three, "The Poker Night," from Tennessee Williams' *A Streetcar Named Desire*

There is a picture of Van Gogh's of a billiard-parlor at night. The kitchen now suggests that sort of lurid nocturnal brilliance, the raw colors of a childhood's spectrum. Over the yellow linoleum of the kitchen table hangs an electric bulb with a vivid green glass shade. The poker players—Stanley, Steve, Mitch, and Pablo—wear colored shirts, solid blues, a purple, a red-and-white-check, a light green, and they are men at the peak of their physical manhood, as coarse and direct and powerful as the primary colors. There are vivid slices of watermelon on the table, whisky bottles and glasses. The bedroom is relatively dim with only the light that sills between the portieres and through the wide window on the street. For a moment, there is absorbed silence as a hand is dealt (Williams, 1953, emphasis in original).

Reflection Questions:

1. Discuss the effectiveness of the lighting design as a communications tool. Does the lighting effectively convey Williams' text?
2. Discuss the meanings and associations the light acquires within the scene's context. Does the light's distribution, color, or intensity convey ideas about who has power or agency in the scene?
3. Look at the scene with and without the fill lights turned on. Discuss the role of the fill light in enhancing or detracting from Williams' description of the scene.
4. The resulting design for each team is one possible realization of the scene script. Discuss variability in possible design solutions for a given playscript resulting from the collaborative problem-solving action of a team of theatre-makers. What are the resulting insights from these differing solutions?

through research, conceptualization, and realization of their designs:

Goal: Engage in both connotative and denotative visual research to fully understand the requirements for the scene. Assemble denotative research materials that illustrate each of the visual ideas from the text. Then, find connotative research materials to express the group's response to the mood and feeling of the described space.

Problem Statement Addition: Read through the given scene together. Identify and list the needs of the given scene. Create a list of items from the text that require further denotative or definitional research. Create a list of terms to use for connotative visual research to illustrate possible feelings or moods of the scene. Work together to find visual images for these terms.

Analyze the Context: Examine the problem in terms of its authenticity to the learners. Authenticity dictates that the learners' work in the studio should be directly applicable to their future careers (Hung 2006). This example is an authentic problem because it is like other problems practicing designers must solve in their future careers. Authenticity in the context description, the play choice in this example, should also be considered alongside the learners' cultures, identities, and connection to the play. In this example, a facilitator could replace the context description with a different playscript to make it more authentic for a particular group of learners.

Analyze the Connections: Look at how this problem connects to the conceptual framework of the course (Hung 2006). A problem designer should view each problem as a part of a series of problems that build on each other, repeating critical knowledge in new ways. Each problem should meet learners where they are in their current problem-solving capacity (Hung 2006). After learners complete a group of problems like this, they could proceed to more open-ended problems, for instance, using play scripts without scene-setting descriptors.

Reflection-in-Action

The concept of reflection-in-action is an essential component of all studio-based learning (Schön 1985, p. 24), and reflection is a significant component of all problem-based learning (Hung 2006).

Dewey (1933) writes that “data and ideas are correlative and indispensable factors in reflection” (104). Here, the data is the experience of working through the design problem. The ideas are the possible solutions for the scene’s arrangement of furniture and lighting. The reflective process is often called a critique; however, its purpose is not to find errors but to guide reflection and build knowledge. This process increases learner retention of the material (Hung 2006). See the sidebar on page 22 for some initial reflection questions. Consider three additional enhancing factors when designing problems: affect, difficulty, and teamwork.

Affect: Problem-based learning does not necessarily act as a motivator for learners (Hung 2019). Even authentic problems may need to be more motivating. Affect is a concept related to proximity (Hung 2019). In the context of theatrical lighting design, proximity considers the lab setup and how effectively it models a working stage. Affect is also related to “subject presence.” Determine if the subject of the problem is present in the problem-solving process (Hung 2019). In this

Facilitator’s Guide

Denotative research items from Williams’ text include:

- Van Gogh’s painting of a billiard parlor, *Night Café*. This painting provides a stark visual image of the scene that complements and goes beyond Williams’ detailed textual description. In addition, there is critical research on this painting and its relationship to the play. The experience of seeing the image of the painting may then provide material to the learners for further connotative research.
- The entire playscript of *A Streetcar Named Desire* provides further understanding of this excerpted scene and could inform the choices in the lighting design.
- Potentially unfamiliar words and phrases that could prompt further research include:
 - Billiard parlor: In addition to the Van Gogh painting, other visual sources for billiard parlors may aid in learner understanding of the nature of the prompted environment.
 - Yellow linoleum: a specific color of yellow that is not currently in everyday household use.
 - Green glass shade: a specific color of glass that was fashionable in the mid-20th century.
 - Portieres: curtains hung over a door or doorway.
 - The street: specific types of light that would be present in New Orleans’ streets at the play’s time.

Connotative terms from Williams’ text to prompt feeling and mood research:

- Lurid nocturnal brilliance
- The raw colors of a childhood’s spectrum
- Coarse and direct and powerful as the primary colors
- Relatively dim with only the light that spills between the portieres and through the wide window

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Using the Liz Lerman Critique Process

The purpose is to become more articulate in our thinking about lighting design and all aspects of engineering from the perspective of the production electrician, as well as overall leadership and comfort in public speaking and presentation.

Consider a 90-minute+ critical response process adapted for lighting department critiques. Note that the term responders refers to the entire lighting department and other interested participants in the critique. All responders must be qualified to speak by having seen the show and understanding the protocol. Each of these sessions will have a facilitator from the lighting faculty to keep time and guide the action within each step.

Step 1: 5 minutes

Introduction by the facilitator to the process. Introduce the designer and production electrician to the responders.

Step 2a: 15 minutes

The lighting designer makes a statement of intent for the design and presents the work. If it is possible (i.e., the critique is happening in the theatre before the strike), the designer can show aspects of the work, like lighting systems or specific cues. It is possible that the designer could speak at this time about something that they were working on in this show or something that they learned about design through this process.

Step 2b: 10 minutes

Production electrician makes a statement about the challenges presented by the show. If possible, the electrician may show an example of a particular engineered solution or another example of the work or something they learned while doing the show.

Step 3: 10 minutes

Statements of meaning: Responders state what was exciting, compelling, meaningful, memorable, or evocative about the work of either the designer or production electrician (or the teams that they represent).

Step 4: 15 minutes

The lighting designer and the production electrician pose questions of the responders.

Step 5: 15 minutes

Responders ask questions phrased neutrally. Lighting designer and production electrician respond.

Step 6: 15 minutes

Responders ask permission from the designer to express opinions about their work. If the designer accepts, responders state opinions.

Step 7: 5 minutes

Wrap up by facilitator.

example, the subject relates to the audience's need to see faces by applying fill light. In Western theatrical practice, the principal spokesperson for the audience is the show's director (Hodge & McLain 2016). Therefore, the subject could be made more present by inviting a stage director to the reflection period to discuss the problem of the visibility of the actors. The presence of a stage director could solidify the designers' understanding of the use of the fill lights. A facilitator with domain expertise could also take on the director's role.

Difficulty: Carefully consider problem

difficulty: if a problem is too complex for a learner or a group of learners to solve, they may not want to invest the cognitive energy to try to solve it (Hung 2019). Consider these parameters in evaluating problem complexity:

- Required general knowledge: library and internet search skills, the experience of seeing other plays onstage to understand concepts like end-stage better.
- Required domain knowledge and the learner's attainment level of that knowledge: concepts like key light or fill light.

- General work: conceive the visual space of a scene or a play in an end-stage configuration.
- Detail mastery: how the lights operate and how to obtain the necessary props for setting up the scene. The problem should be solvable within the abilities and means of the learners (Ertmer & Glazewski 2019).

Teamwork: A significant benefit of SBL is the acculturation of each learner into a practice (Boling 2016). Working on problems collaboratively builds social development and binds learners into a practical culture (Ferreira & Trudel 2012). Rotating responsibilities between problems is vital to increase individual responsibility (Blumberg 2019).

Problem-based learning has been increasingly used in the undergraduate program in lighting design at the University of North Carolina School of the Arts (UNCSA) over the past four years. During this time, the program doubled the physical size of the light lab, equipped it with positions that approximate those found in a proscenium theatre, dedicated lighting inventory to the lab space, and implemented an online scheduling system for 24-hour access. The program has moved all lighting design classes to the light lab, and lighting design learners have permanent workspaces in rooms near the lab.

The change to PBL has been challenging, mainly in acquiring problem design skills and the time needed to design and analyze each problem for each course level. However, a commitment to hands-on studio-based learning, the increased size and capacity of the light lab, and the 3C3R PBL model have all contributed to greater learner engagement and enthusiasm. The lighting design program at UNCSA is committed to continuing to increase the implementation of PBL. UNCSA also implemented learner-led critiques for all lighting design works during this period based on the Liz Lerman Critical Response Process (LLCRP). This formal critique method effectively encourages broad participation and learner-centered reflections (Lerman & Borstel 2003). See the sidebar on page 24 to learn how the program has fit the Lerman method into its lighting critiques.

While UNCSA benefits from institutional investment in studio spaces that enable problem-based learning to work in conjunction with ideally realized

studio-based learning, PBL techniques and elements of studio-based learning still can be used in the many academic settings where a lighting lab or equipped studio is not available. In lesson plans that Studio School of Design has been developing for use in schools without labs, effective problem-solving can be accomplished with very inexpensive and easily obtained equipment like clip-lights and ladders to stand in for a full studio with theatrical lights. More important than fancy theatrical equipment, a facilitator should create an environment where students can work with light on human performers at full scale. This can be accomplished in almost any classroom, and it is more effective than a computer simulator because it more accurately models the future working environment. Real-world problems of extreme import to a lighting designer, like working with different skin tones, costume fabrics, and scenic treatments, are all nearly impossible to simulate effectively in a computer-based environment. While pre-visualization in the computer-based environment has an important place in theatrical lighting and lighting training, its proper place is at an advanced level when learners already have experience in real theatrical environments to transpose and contextualize the experience of the computer simulation to an actual stage with performers.

Additionally, PBL can help to address the reality that many instructors are not experts in all areas of theatre, particularly at the high school level. Studio School of Design (SSD), a non-accredited theatrical lighting design school in New York, has begun offering professional development workshops for high school theatre educators who are not subject-matter experts in design (Studio School of Design 2022). The target participants are schools with one, usually non-technical, theatre teacher. Designing PBL prompts for non-expert facilitators is crucial for the success of this program because many schools use theatrical lighting in their stage productions and have learners interested in theatrical lighting but lack the means to employ a technical theatre teacher. The SSD program empowers teachers without technical theatre experience to facilitate lighting design learning in their classrooms and school play productions. SSD has written the course materials to

meet New York and New Jersey learning standards. These experiential initiatives have benefitted teachers and learners in Title 1 high schools with little access to any other theatrical lighting design training (Studio School of Design 2022).

Knowing by Doing

The 3C3R model can be used to refine the processes and design of problems in theatrical lighting design education. Benefits of problem-based learning in theatrical lighting design training include better modeling of the profession, increasing “knowing-by-doing” (Schön 1985, 22) in a scaffolded and ordered environment, increasing social and collaborative skills, and increasing general problem-solving skills.

In other fields, educators have worked together to create commonly accessible repositories of PBL problems. Currently, there are no such repositories of problems for TLD. However, much of this work is already being practiced informally in TLD programs. Many programs may benefit from better problem designs afforded through rigorous analyses across all the parts of the enhanced 3C3R model. Well-designed PBL has the potential to democratize design learning, an original goal of Gropius and the Bauhaus school, to center it on learners’ experiences. TLD as a profession arose from a practice of craft less than 100 years ago (Rosenthal & Wertenbaker 1972). The profession’s strengths have always been this history of craft and learning by doing. The evidence-based application of SBL and PBL can invigorate and nurture learners within the classroom and open the profession to a broader group of practitioners.



Clifton Taylor is a practicing theatrical designer and an associate professor of lighting design at UNCSA. He is also one of the founders of the Studio

School of Design in New York, a 501c3 organization dedicated to providing cost-effective and no-cost design training to a broad population of educators, secondary-school learners in Title 1 public institutions and early and mid-career professionals. Taylor received a BFA in theatrical design from New York University and has 35 years of internationally recognized professional practice. He is the author of the book Color & Light: Navigating Color Mixing in the Midst of an LED Revolution, A Handbook for Lighting Designers.

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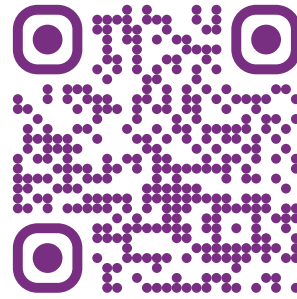
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