Appendix D

Teacher Survey Numerical Trends and Comments

This report summarizes the major findings from the analysis of the teacher comfort surveys for the PIER Classroom Lighting Control System (ICLS) lighting research project. AEC evaluated the questionnaire data according to three different cases. The first was an overall evaluation of the ICLS lighting system compared to the base case lighting system. The second compared two rows of fixtures to three rows of fixtures. The last case looked at rooms with the dimming control compared to rooms without the dimming control. The demographic portion of the survey found that on average 64% of the teachers wear glasses, their average age is 41, and they have been teaching for 13 years with the last 5 years being in the same classroom.

Note: When the reader sees a comment in italics such as this, the comment was added in preparation for the final report. For example, since the questionnaires were originally analyzed, teacher feedback helped identify several parts of the ICLS for redesign. Examples include:

1. *Location of the sensor was moved from the corner of the room to the center of the room.*
2. *The Quiet Time - 1 Hour On feature was added to the Teacher Control Center at the front teaching wall.*
3. *The ballast manufacturer redesigned their .77 BF ballast to reduce hum.*
4. *Components in the low voltage, remodel system that was used to retrofit classrooms were changed to cut out a 10-second delay that occurred on entering the room. (This was due to a power-up cycle that was changed.)*
5. *A high-performance, dedicated whiteboard luminaire was developed and will be introduced in 2005 to provide more light on the main teaching wall. When this luminaire is used, the run length can be reduced from 24 feet to 20 feet.*

Teacher satisfaction levels were taken BEFORE these changes were implemented. We anticipate that that satisfaction levels for the enhanced ICLS will be measurably higher than the high satisfaction levels already documented.

Also, please note that the analysis was done at a point where the system was often referred to as a Classroom Lighting and Control System (CLCS.) This label is shown on the graphs and is imbedded in them. Accordingly, the reader should interpret CLCS and ICLS as the same thing. CLCS only refers to the original manifestation of the system.

Base Case Lighting Compared to ICLS

The analysis between the baseline and the Integrated Classroom Lighting System found a number of interesting trends within the data. As illustrated in Figures 1-4, the ICLS case (on average for all installations) compared favorably to the base case according to occupant satisfaction. According to the surveys, the ICLS reduced glare and eye fatigue while increasing overall lighting levels on the teaching surfaces compared to the base case. In addition, the lighting from the ICLS was deemed a higher quality light that increased the overall satisfaction with the lighting system. The ICLS lighting system was also considered more user-friendly and convenient than the base case system.

On the other hand, Figure 3 shows that the ICLS was considered to have marginally increased the ceiling brightness and the fixtures were also noted to be brighter and more noticeable than the base case. Additionally, there were some comments from individual teachers regarding decreased lighting levels. In reality, average lighting levels were indeed reduced, yet the results of the survey show a majority of teachers actually felt the lighting levels were increased. See Figure 1 on the next page. Quantitatively, specific footcandle measurements at Heritage School showed the base case produced an average of 73 fc, the 2 rows (with only the uplight lamps illuminated) produced an average of 57 fc, and the 3 rows (with only the uplight lamps illuminated) produced an average of 52 fc. The major findings are summarized below and Figures 1-4 follow.

Summary of Findings for the Base Case Compared to ICLS

- Reduced glare with ICLS
- Increased control of lighting system with ICLS
- Decreased eye fatigue with ICLS
- Increased lighting on front teacher wall with ICLS
- Increased lighting on student desks with ICLS
- Increased lighting on teacher desk with ICLS
- Lighting levels improved on walls and desktops with ICLS
- ICLS was noted to have increased ceiling brightness and overall the fixture was brighter (to some degree too bright)
- The ICLS lighting fixtures are more noticeable
- More convenient with ICLS
- Higher quality of light with ICLS
- Increased overall lighting system satisfaction with ICLS
- ICLS is more user friendly

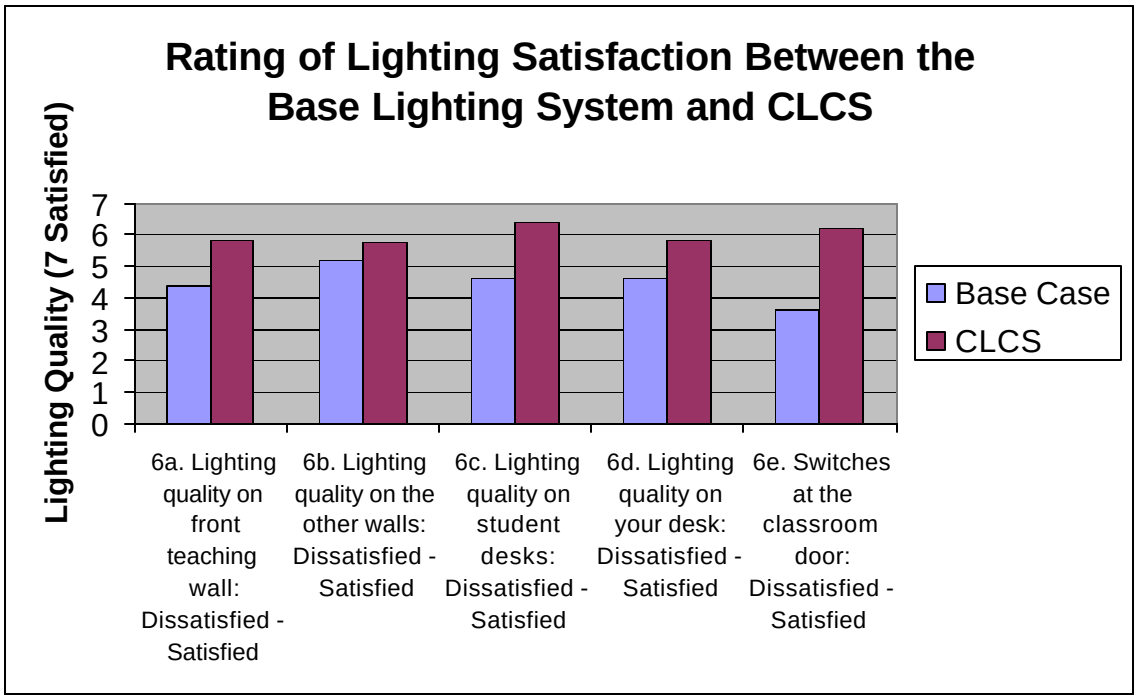

Figure 1

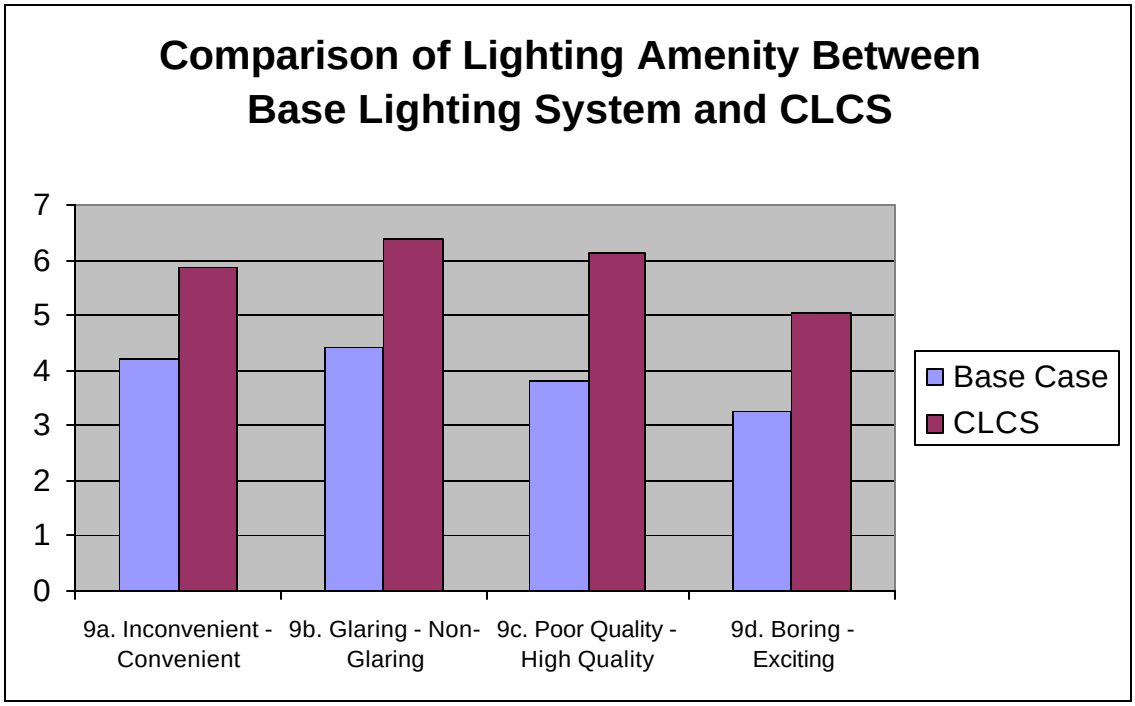

Figure 2

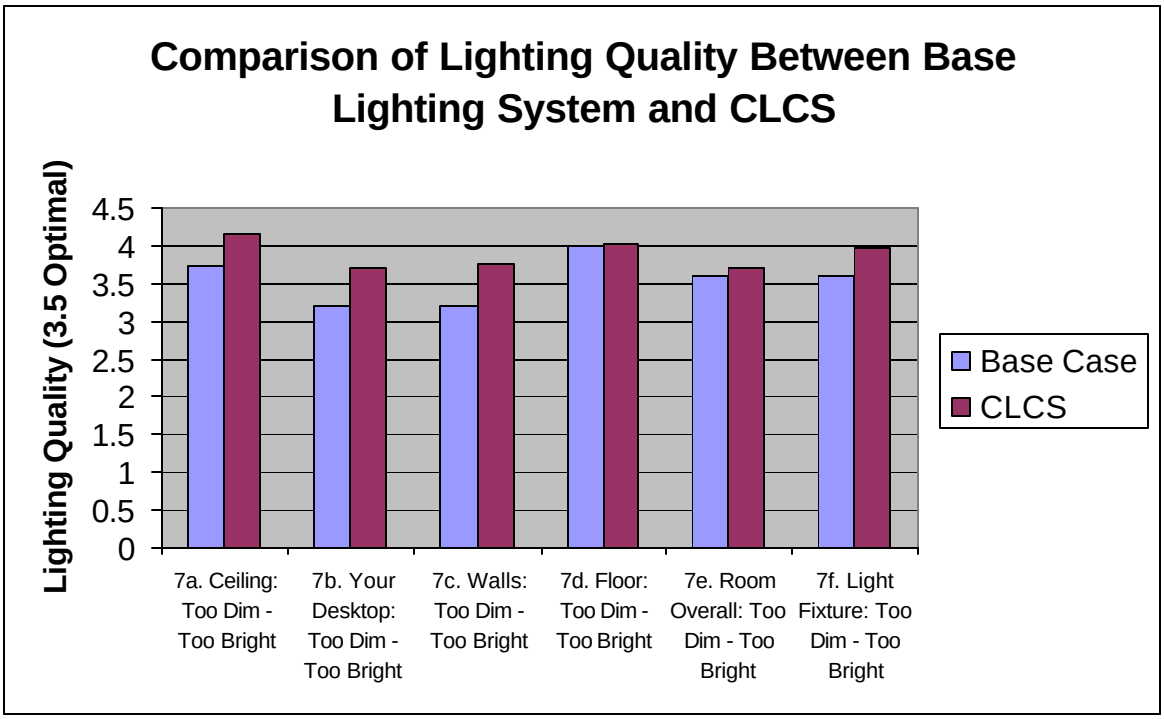

Figure 3

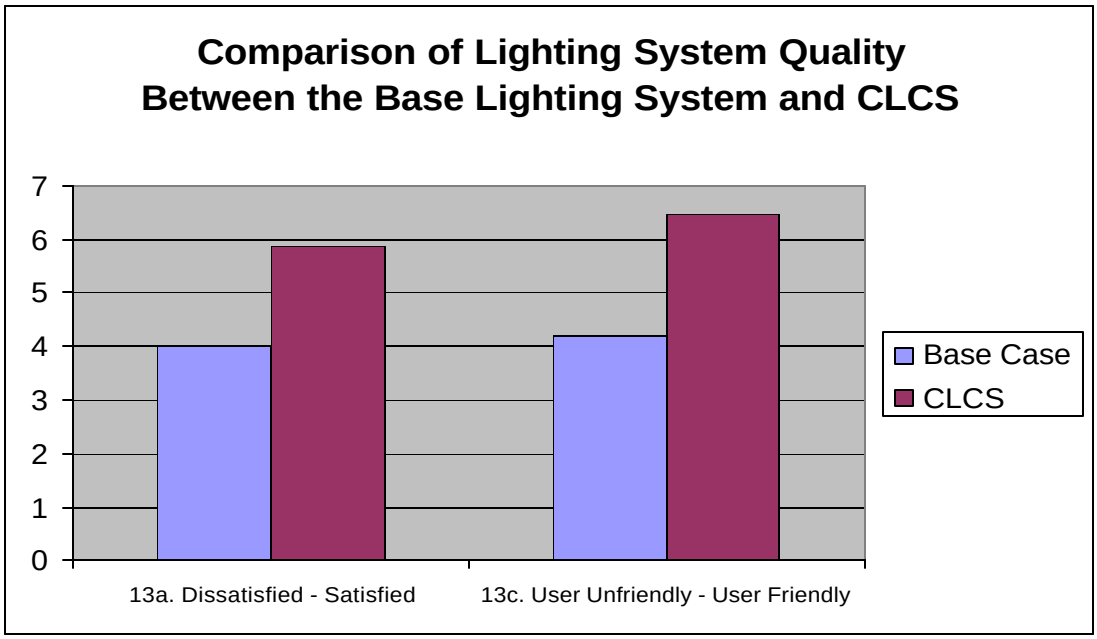

Figure 4

Two Rows of Lighting Compared to Three Rows

A comparison between two rows and three rows of indirect/direct lighting showed a preference for three rows. Increased lighting levels on all walls as well as on the teacher desktop were the most noted differences between the two cases. Foot-candle measurements at Heritage School support these findings since the three-row configuration produced higher average desktop illumination with lower contrast ratios. The measurements show decreased overall fc levels directly underneath the fixtures (high of 88 fc for three rows compared to 111 fc for two rows) and increased illuminance near the walls (low of 30 fc for three rows compared to 22 fc for two rows). Aside from these differences, both cases scored well on overall lighting levels and teacher satisfaction. The major findings are summarized below. Figures 5 and 6 on the next page demonstrate graphically the findings of the analysis.

Summary of Findings for the Two Row vs. Three Row Case

- Higher lighting levels on main teaching wall with 3 rows
- Higher lighting levels on non teaching walls with 3 rows
- Higher lighting levels on teacher desk with 3 rows
- Both cases significantly reduced glare, had better control, and reduced eye fatigue

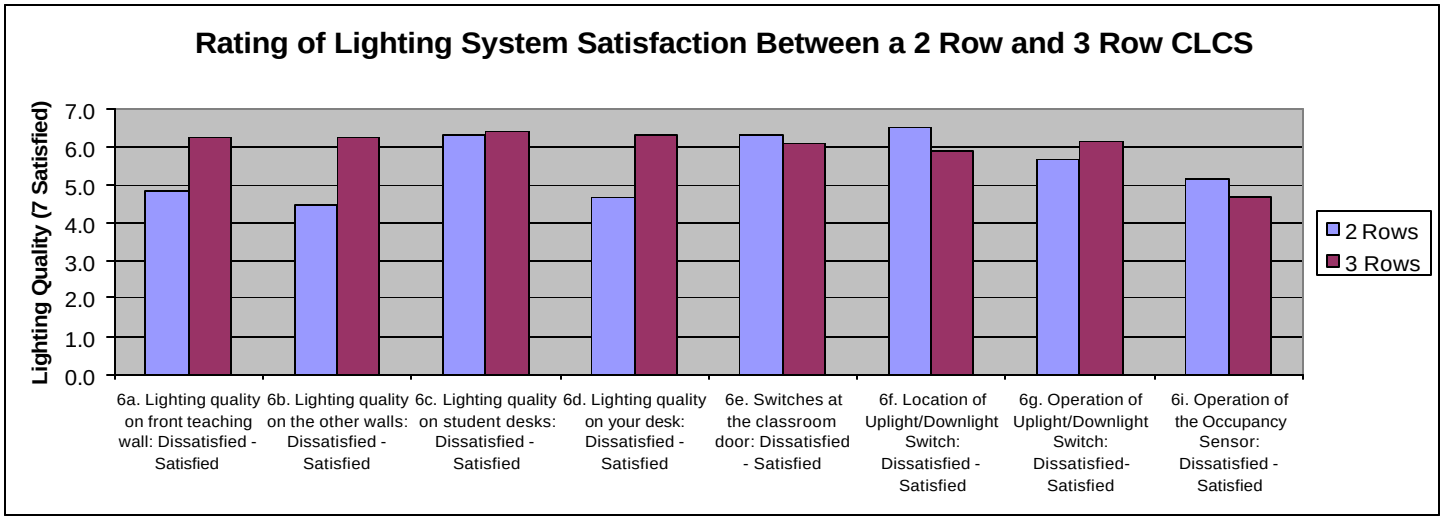

Figure 5

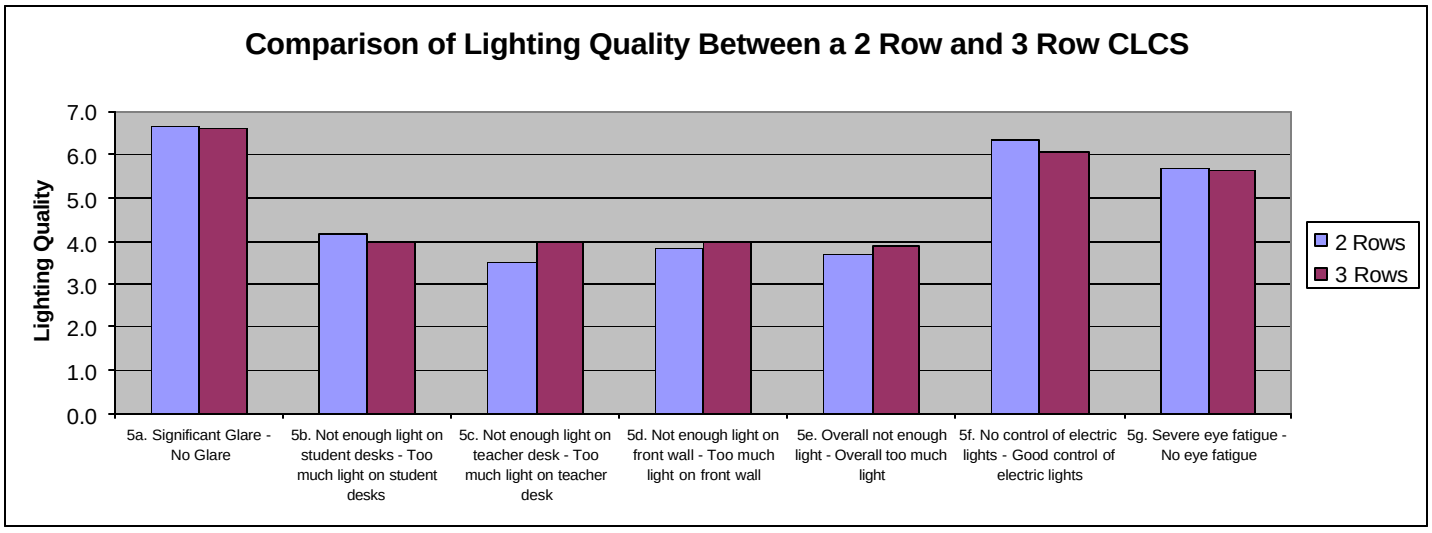

Figure 6

This section describes the analysis between the classrooms that received dimming control and those that did not. The teacher written comments showed that the dimming function was rarely used. A few teachers noted the calming effect on the students and these teachers used the dimming in the mornings and after breaks. In general, the teachers only used the downlights during A/V presentations or for small focused periods.

The most prominent findings showed that the dimming allowed for increased lighting control and there was a high level of overall satisfaction with the dimming function. Figure 7 shows these results. It should also be noted that the dimming case was more convenient and provided a higher quality of light according to the teachers surveyed.

Dimming Control Compared to No Dimming Control

- Very high level of satisfaction with operation of dimming switch
- An improved control of the lighting system compared to no dimming control
- Dimming case was found to be more convenient and provide a higher quality of light
- Higher level of overall satisfaction with dimming case

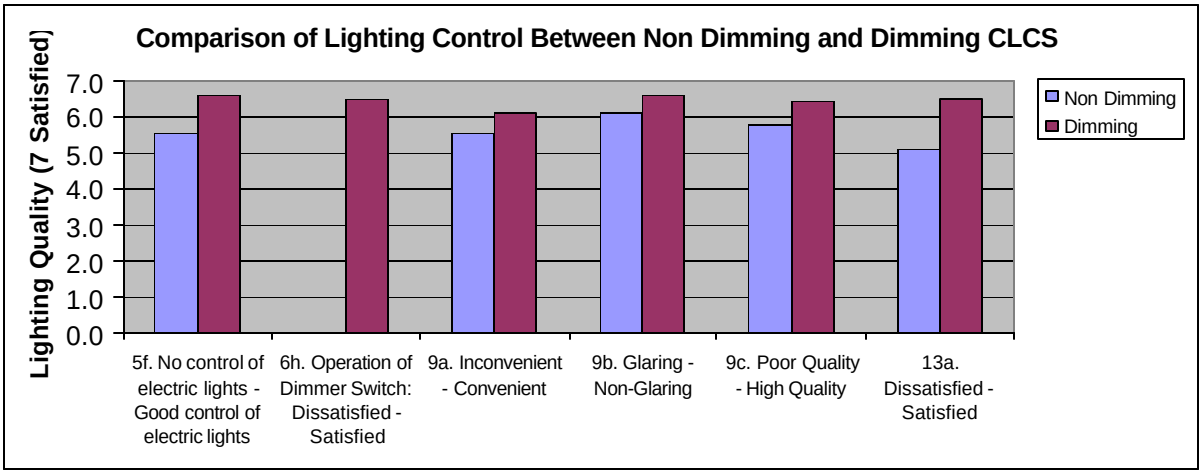

Figure 7

The participating teachers filled out the Questionnaire below.

CEC - PIER 4.5 **Classroom Lighting Questionnaire**
9/22/03

School Name: _____
Room Number: _____
Date: _____

This confidential survey is to get your feedback on the PIER lighting system that was recently installed in your classroom. Your answers are confidential. When all the results are compiled, we will send you a summary of the research findings. Thank you for helping with this important California Energy Commission sponsored research.
Indicate your response by circling choice or by placing an X between the colons as follows:
:_X_:

1. Gender (F, M) Age: 20-29, 30-39, 40-49, 50-59, 60-69 Do you wear glasses? (Yes / No)
2. How many years of teaching experience do you have? 1-2, 3-5, 6-10, 11-15, 16-20, over 20
3. How many years have you been teaching in this same classroom? _____
4. Describe your classroom **before** the installation of the PIER lighting system.
   a. Significant Glare :___:___:___:___:___:___:___:___: No Glare
   b. Not enough light on student desks :___:___:___:___:___:___:___:___: Too much light on student desks
   c. Not enough light on teacher desk :___:___:___:___:___:___:___:___: Too much light on teacher desk
   d. Not enough light on front wall :___:___:___:___:___:___:___:___: Too much light on front wall
   e. Overall not enough light :___:___:___:___:___:___:___:___: Overall too much light
   f. No control of electric lights :___:___:___:___:___:___:___:___: Good control of electric lights
   g. Severe eye fatigue :___:___:___:___:___:___:___:___: No eye fatigue
5. Describe your classroom **after** the installation of the PIER lighting system. Circle if Not Applicable
   a. Significant Glare :___:___:___:___:___:___:___:___: No Glare
   b. Not enough light on student desks :___:___:___:___:___:___:___:___: Too much light on student desks

c. Not enough light on teacher desk :___:___:___:___:___:___:___: Too much light on teacher desk

d. Not enough light on front wall :___:___:___:___:___:___:___: Too much light on front wall

e. Overall not enough light :___:___:___:___:___:___:___: Overall too much light

f. No control of electric lights :___:___:___:___:___:___:___: Good control of electric lights

g. Severe eye fatigue :___:___:___:___:___:___:___: No eye fatigue

6. Please let us know your opinion about the following specific areas of your current classroom.

a. Lighting quality on front teaching-wall Dissatisfied :___:___:___:___:___:___:___: Satisfied

b. Lighting quality on the other walls Dissatisfied :___:___:___:___:___:___:___: Satisfied

c. Lighting quality on student desks Dissatisfied :___:___:___:___:___:___:___: Satisfied

d. Lighting quality on your desk Dissatisfied :___:___:___:___:___:___:___: Satisfied

e. Switches at the classroom door Dissatisfied :___:___:___:___:___:___:___: Satisfied

f. Location of Uplight/Downlight Switch Dissatisfied :___:___:___:___:___:___:___: Satisfied

g. Operation of Uplight/Downlight Switch Dissatisfied :___:___:___:___:___:___:___: Satisfied

h. Operation of Dimmer Switch Dissatisfied :___:___:___:___:___:___:___: Satisfied

i. Operation of the Occupancy Sensor Dissatisfied :___:___:___:___:___:___:___: Satisfied

7. Indicate your perception of the brightness for each of the different areas of your classroom.

a. Ceiling Too Dim :___:___:___:___:___:___:___: Too Bright

b. Your Desktop Too Dim :___:___:___:___:___:___:___: Too Bright

c. Walls Too Dim :___:___:___:___:___:___:___: Too Bright

d. Floor Too Dim :___:___:___:___:___:___:___: Too Bright

e. Room Overall Too Dim :___:___:___:___:___:___:___: Too Bright

f. Light Fixture Too Dim :___:___:___:___:___:___:___: Too Bright

8. How do you usually arrange the window blinds/curtains? ? No blinds/curtains in classroom.

   a. Never Open, Sometimes Open, Open In Morning Only, Open In Afternoon Only, Always Open

   b. What percentage of classroom time do you close the window blinds/curtains for:

   Too much sun _____, Simple light reduction _____, Exterior distraction _____,

   Reading time _____, Relaxation time _____, Overhead projection _____,

   LCD projection from computer _____, TV_____, Other _____.

9. Please evaluate your experience with the current lighting system.

   a. Inconvenient : ___:___:___:___:___:___:___: Convenient

   b. Glaring : ___:___:___:___:___:___:___: Non-Glaring

   c. Poor Quality : ___:___:___:___:___:___:___: High Quality

   d. Boring : ___:___:___:___:___:___:___: Exciting

10. When and why do you use the Uplight option (general instruction, reading, relaxation, A/V presentations, etc)?

    a. _____ _____

11. When and why do you use the Downlight option (general instruction, reading, relaxation, A/V presentations, etc)?

    a. _____ _____

12. When and why do you use the Dimmer option (general instruction, reading, relaxation, A/V presentations, etc)?

    a. _____ _____

13. Please indicate your overall impression of the lighting and lighting control in your classroom.

    a. Dissatisfied :___:___:___:___:___:___:___: Satisfied

    b. Not Energy Efficient :___:___:___:___:___:___:___: Energy Efficient
    Don't know:_____

    c. User Unfriendly :___:___:___:___:___:___:___: User Friendly

14. Do you have any additional comments about the lighting in your classroom that you want to share?

_____ _____

_____ _____

_____
_____
_____
_____
_____
_____

Thank you.

Please return this questionnaire in the attached preaddressed and stamped envelope.