



**Indoor Environment Quality + Classroom Environment
Health Sciences Building
St. Cloud Technical and Community College
St. Cloud, MN
Report 1**

**April 2015, Minneapolis, MN
Sustainable Post-Occupancy Evaluation Survey (SPOES)
B3 Guidelines**

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1.0 Overview

The purpose of this report is to examine the connection between sustainable design criteria used in the design of the Health Sciences Building (HSB) and occupants' satisfaction with their classroom and laboratory environments located in the HSB. HSB is located on the St. Cloud Technical and Community College campus in St. Cloud, MN. The HSB facility was renovated using the B3 Guidelines (formerly known as the Minnesota Sustainability Guidelines or MSBG) and completed for occupancy in 2011. The B3 Guidelines track specific state-funded, B3 buildings as a means of demonstrating real outcomes aimed at the conservation of energy resources, creation and maintenance of healthy environments, and occupants' satisfaction with their classroom and laboratory environments. The Sustainable Post-Occupancy Evaluation Survey (SPOES) was developed to assess human outcomes in workplace, classroom/laboratory, and residence hall settings in compliance with the B3 Guidelines project tracking requirements. This is a report of occupants' (hereafter called students) responses at 3.5 years post-occupancy. The survey was conducted in April 2015 and is the first of two required survey events for this building.

This SPOES report focuses on students' satisfaction with the physical environment as related to 25 indoor environment quality (IEQ) criteria such as lighting, thermal, and acoustic conditions in their primary classrooms and laboratories. Students' satisfaction with the facility (site, building, and interior) and the effect of the facility's physical environment on their perceptions of their learning experience and health also are included. Finally, a brief look at students' commuting and physical activities within the building are reported. The report provides descriptive information about students' perceptions of the IEQ of their classroom environments. In addition, this information serves the broader development of knowledge regarding the influence of IEQ on students.

2.0 Method

SPOES consists of a self-administered, Internet-based, questionnaire submitted to and completed by students. The SPOES questionnaire has been tested for **validity** (measures what it is intended to measure) and **reliability** (repeatability or replicability of findings). Students rate their level of satisfaction on a **Likert-type scale** (measurement scale) from 1 (very dissatisfied) to 7 (very satisfied) with IEQ of the facility and their primary classrooms/laboratories. They also rate the influence of their physical environment on their perception of their learning experience and health on a scale from 1 (hinders) to 7 (enhances). There were no physical measurements taken of environmental conditions such as temperature or acoustic level. This study is limited to students' perceptions.

The report provides a descriptive summary of the results stated as a **mean** (average of all responses), **standard deviations** (SD) (how different scores are from each other and the mean), and **number of responses** (N) for each question analyzed. The mean for a 7-point scale is 4.00. Lower or higher means reflect stronger tendencies towards dissatisfaction/satisfaction and hinders/enhances. Means that are close to the center of the scale (4) are considered to be neither dissatisfied/hinders or satisfied/enhances.

When interpreting **mean** responses, the following labels were used:

- 1.00 - 3.50 dissatisfied (hinders)
- 3.51 - 4.50 neither satisfied (enhances) nor dissatisfied (hinders)
- 4.51 - 7.00 satisfied (enhances)

An IEQ Score is also calculated for students’ satisfaction with IEQ in their primary classrooms. This is a statistical combination of category-level IEQ scores, which results in a single IEQ score for all respondents and is reported in an IEQ Scorecard.

2.1 Description of the Questionnaire

Students first rate their level of satisfaction with the facility (site, building, and interior) and the influence of their physical environment on their perception of their learning experience and health. Then they respond to questions about their satisfaction with their primary classrooms in relation to IEQ criteria from the B3 Guidelines. Additionally, students’ physical activities and commuting practices are investigated.

In the SPOES questionnaire, the 25 IEQ criteria listed below are evaluated. There are two levels of criteria, categories and attributes. As shown in the list, the ‘overall’ criteria are boldfaced and called ‘categories’ or ‘category level’ criteria. A category is broader or more general such as Overall Appearance or Overall Indoor Air Quality. Some categories have ‘attributes’ or ‘attribute level’ criteria and provide greater detail about the category. For example, Overall Thermal Conditions is a category level question, and there are four attribute level questions related to thermal conditions such as adjustability, air velocity (draft), humidity, and temperature. Overall Acoustic Conditions is a category with attributes of students’ ability to hear presentations and the extent of background noises. There are 10 category-level and 15 attribute level questions. Means are calculated and reported for all category and attribute-level criteria.

An IEQ Satisfaction Score is also calculated for students’ satisfaction with IEQ in their primary classrooms. This is a statistical combination of the 10 category-level criteria only and results in a single, mean IEQ Satisfaction Score for all students’ satisfaction with the physical conditions of their primary classrooms. Attribute-level criteria are not included in the IEQ Score because unequal weight would be given to criteria that have both category and attribute-level questions.

In the following list, **category (boldface)** criteria are listed in alphabetical order. If a category has attributes, they are listed with the category.

Overall Acoustic Quality

- Ability to understand desired sounds
- Ability to hear presentations
- Ability to limit background noise

Overall Appearance (aesthetics)

Overall Cleaning and Maintenance

Overall Daylighting

- Amount of daylighting
- Ability to adjust daylighting

Overall Electric Lighting

- Amount of electric lighting
- Ability to adjust electric lighting

Overall Furnishings

- Function of furnishings
- Ability to adjust furnishings

Overall Indoor Air Quality

Overall Technology

- Ability to see materials presented
- Access to electric outlets

Overall Thermal Conditions

- Adjustability of thermal conditions
- Air velocity (drafty/stagnant))
- Humidity (dry or moist)
- Temperature (hot or cold)

Overall Vibration and Movement

2.2 Limitations

Students' participation is voluntary, and responses are self-reported. As is true with all survey research, the responses indicate students' perceptions. There were no physical measurements, e.g., temperature, humidity, or lighting levels, of the environment taken.

3.0 Sample Description

3.1 Description of Building

The HSB is located at 1245 15th St. North, St. Cloud, MN. It is in a walkable community that is in close proximity to other campus buildings, open green space, and limited public transportation. The building was formerly a Health Partners clinic; its interior was renovated to serve as a teaching facility for the Health Sciences program. It is 53,000 square feet and contains classrooms, clinic spaces, laboratories, exam rooms, offices, and other supporting work spaces for students, faculty, and staff. The renovation was completed in August 2011 (see Figure 1).



Figure 1. Health Sciences Building, St. Cloud State University (photos courtesy of SCTCC)

The HSB building integrates both classrooms and student service offices into one facility. The building is occupied throughout the year by students, faculty, staff, and other transient individuals; however, the building has its highest occupancy loads during the fall and spring semesters (September through May). Some of the floors in the building have classrooms adjacent to student services and office areas. Floors 2, 4, and 5 have both classrooms and office areas. Floor 1 contains 10 classrooms. Floor 3 contains four classrooms, student common areas, and the One Stop student service counter (registration, grades, degree planning, and student accounts). Classrooms in this facility include large and small active learning classrooms and small and large lecture presentation classrooms.

3.2 Description of Respondents

The HSB - SCTCC had approximately 184 students taking classes in the facility during the spring semester period and administration of the survey event. Several of the students on the email distribution list were working in off-site locations under the direction of their program of study. The response rate to the questionnaire was less than 3%. Of those responding, 17% were male and 83% were female. The median age of respondents was 26 years; with a range of 21 to 31 years.

Students responded that 100% of them spend more than 5 hours per week in their primary classroom or laboratory environment. Regarding the amount of time students spend in other parts of the HSB facility, 50% of students reported they spend 1-2 hours per week in other parts of HSB; 50% spend 3-4 or more hours in HSB other than their primary classroom or laboratory environment.

Next, students were asked about their satisfaction with the course they were taking in the HSB classroom and the amount they learned in this class. Results indicated that students were **satisfied (M = 6.67)** with the course and were very satisfied with the amount learned (**M = 7.00**).

Finally, students are exposed to concerns for the environment and sustainable initiatives throughout social media, initiatives on campus, and courses of study. Students were asked how important sustainability was to their own point of view. The mean score relating to the importance of sustainability was **6.50**.

4.0 Findings and Discussion

4.1 HSB Facility (Site, Building, and Interior): Overall Satisfaction, Learning Experience, and Health

Students responded to questions concerning the HSB facility (site, building, and interior) and their overall satisfaction with the facility, overall perceptions of their learning experience in relation to the facility, and their overall perception of their health in relation to the facility. Table 1 shows the means and standard deviations of their responses as well as how the responses are interpreted. Figure 2 is a graph that shows the mean for each question with a blue mark. The standard deviation is represented by a green/red, vertical bar with green representing satisfied (or enhanced) and red representing dissatisfaction (or hindered). Gray represents the 'neither/nor' range of responses. In cases where there were no dissatisfied responses, the bar will be all grey and green. This graph is simply a visual image of the findings from Table 1.

Table 1. HSB facility - overall satisfaction, learning experience, and health

HSB Facility (site, building and interior)	Mean	SD	N	Interpretation
Overall Satisfaction	6.00	0.89	6	Satisfies
Overall Learning Experience	5.33	1.21	6	Enhances
Overall Health	5.17	0.98	6	Enhances

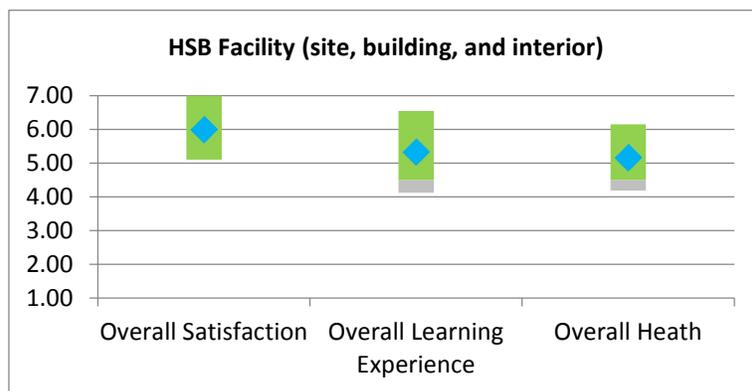


Figure 2. HSB - SCTCC facility - overall satisfaction, learning experience, and health

Results indicated that students were **satisfied (M = 6.00)** with the HSB facility (building, site, and interior) and reported that their overall learning experience was **enhanced (M = 5.33)** by the facility. Students also reported that their overall health was **enhanced (M = 5.17)** by the facility.

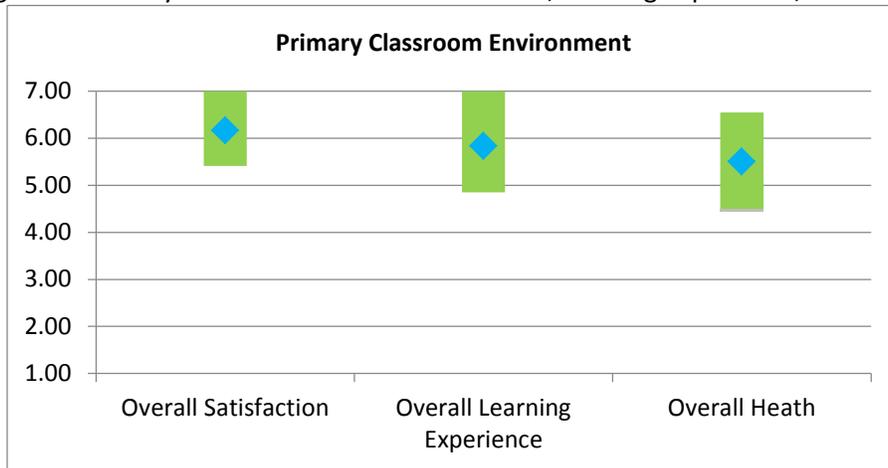
4.2 Primary Classroom: Overall Satisfaction, Learning Experience, and Health

Students responded to questions concerning their overall satisfaction and overall perceptions of their learning experience and health as related to their primary classroom. Table 2 shows the means and standard deviations of their responses as well as how the responses are interpreted. Figure 3 is a visual image of the findings from Table 2.

Table 2. HSB Primary classroom – overall satisfaction, learning experience, and health

HSB Primary Classroom Environment	Mean	SD	N	Interpretation
Overall Satisfaction	6.17	0.75	6	Satisfies
Overall Learning Experience	5.83	0.98	6	Enhances
Overall Health	5.50	1.05	6	Enhances

Figure 3. Primary classroom - overall satisfaction, learning experience, and health



Results indicated that students were **satisfied (M = 6.17)** with their primary classroom, their overall learning experience was **enhanced (M = 5.83)** by their primary classroom, and their overall health was **enhanced (M = 5.50)** by their primary classroom.

4.3 Primary Classroom: Satisfaction with Indoor Environment Quality (IEQ)

Students responded to questions concerning their satisfaction with IEQ criteria (thermal conditions, indoor air quality, acoustic conditions, etc.) related to their primary classroom. Table 3 shows the means and standard deviations of their responses as well as how the responses are interpreted. It must be noted that all responses, regardless of the classroom, were combined so these are composite means of all classrooms in HSB. Figure 4 is a visual image of the findings in Table 3.

Table 3. Primary classroom - satisfaction with IEQ conditions

#	IEQ Criteria (1-25) (Category level criteria are bold face)	Mean	SD	N	Interpretation (D = Dissatisfied) (S = Satisfied)
1	Overall cleaning and maintenance	6.67	0.52	6	Satisfied
2	Humidity (dry or moist)	6.50	0.55	6	Satisfied
3	Air velocity (drafty or stagnant)	6.50	0.55	6	Satisfied
4	Overall furnishings	6.33	0.52	6	Satisfied
5	Overall vibration and movement	6.33	0.82	6	Satisfied
6	Ability to see materials presented	6.33	0.82	6	Satisfied
7	Ability to adjust electric lighting	6.33	0.82	6	Satisfied
8	Amount of electric light	6.33	0.82	6	Satisfied
9	Overall electric lighting conditions	6.33	0.82	6	Satisfied
10	Ability to understand desired sounds	6.33	0.82	6	Satisfied
11	Ability to limit background noise	6.33	0.82	6	Satisfied
12	Overall acoustic quality	6.33	0.82	6	Satisfied
13	Overall appearance (aesthetics)	6.17	0.75	6	Satisfied
14	Function of furnishings	6.17	0.41	6	Satisfied
15	Ability to hear presentations	6.17	0.98	6	Satisfied
16	Overall indoor air quality	6.17	1.17	6	Satisfied
17	Ability to adjust furnishings	6.00	0.89	6	Satisfied
18	Ability to adjust daylighting	6.00	1.26	6	Satisfied
19	Overall daylighting conditions	6.00	1.26	6	Satisfied
20	Amount of daylighting	5.83	1.47	6	Satisfied
21	Overall technology	5.67	1.86	6	Satisfied
22	Ability to adjust thermal conditions	5.50	1.64	6	Satisfied
23	Overall thermal conditions	5.33	1.63	6	Satisfied
24	Temperature (hot or cold)	5.33	1.51	6	Satisfied
25	Access to electric outlets	5.00	1.67	6	Satisfied

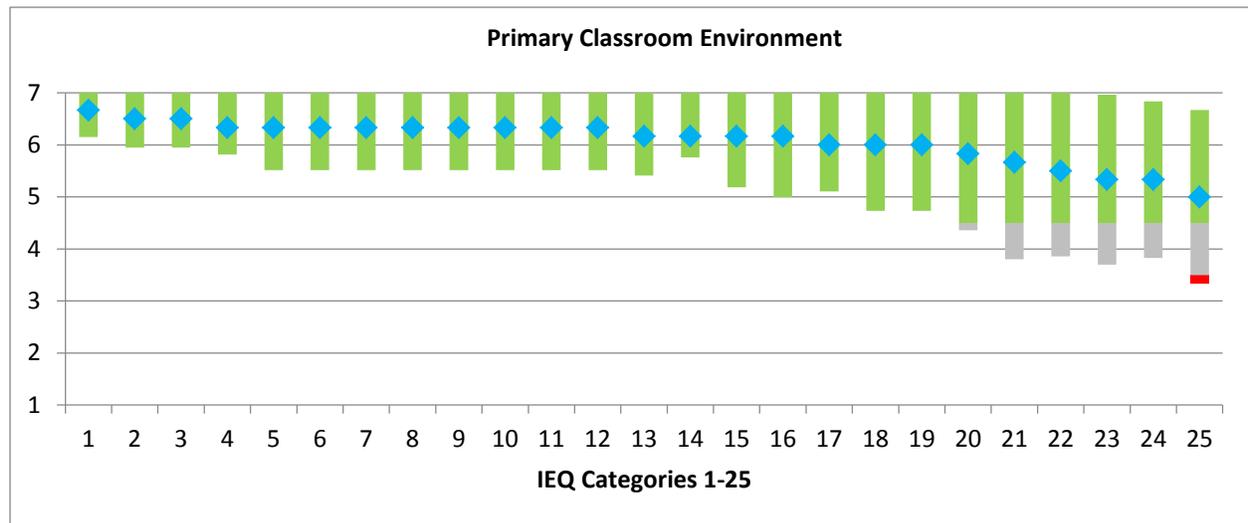


Figure 4. Primary classroom - satisfaction with IEQ criteria (IEQ 1-25 are listed in Table 3 above)

Results indicate that students were satisfied with all of the IEQ criteria in their primary classrooms. Satisfaction with IEQ criteria ranged means of 5.00 to 6.67. These findings support the **moderate to high**

level of student satisfaction with the IEQ of their classrooms. Further information about their perceptions can be found in Appendix A. Open-Ended Responses.

4.4 IEQ Satisfaction Scorecard

The IEQ Satisfaction Score is determined by calculating a mean of all 10 category level IEQ criteria. At this time, all variables are weighted equally in this calculation as little evidence exists that provides rationale for weighting some variables heavier than others. The IEQ mean is representative of a fair overall IEQ score and can serve as a benchmark of students' satisfaction with the physical environment of their primary classroom. As shown in Figure 5, the **IEQ Satisfaction Score** for HSB is **6.13**.

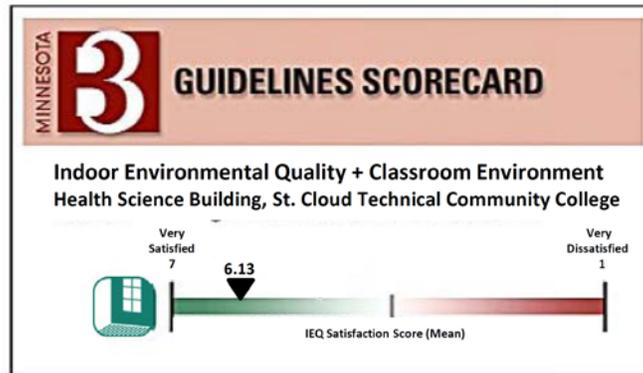


Figure 5. Primary Classroom - IEQ Satisfaction Score

Overall, the students showed a high satisfaction level with the IEQ of HSB classrooms as indicated by the IEQ Score of **6.13**. As shown in Table 3, seven IEQ categories were above **6.13** and helped to increase the IEQ Score. Categories over 6.13 include Overall cleaning and maintenance (**M = 6.67**), Overall furnishings (**M = 6.33**), Overall Vibration and Movement (**M = 6.33**), Overall electric lighting conditions (**M = 6.33**), Overall acoustic quality (**M = 6.33**), Overall appearance (aesthetics) (**M = 6.17**), and Overall indoor air quality (**M = 6.17**). Three category level IEQ criteria fell below the overall mean but are still moderately high means. Those categories include Overall daylighting conditions (**M = 6.00**), Overall technology (**M = 5.67**), and Overall thermal conditions (**M = 5.33**). Please note that the IEQ Satisfaction Score only uses the category level criteria (those labeled 'Overall'; see section 2.1, paragraph 3 for explanation). This high IEQ score sets a high benchmark for continued assessment of students' satisfaction.

5.0 Physical Activity Engagement and Commuting Practices

In the final section of the survey, students responded to questions regarding their overall physical activity while at HSB (site, building, and interior) and their commuting practices.

5.1 Physical Activity Engagement

Providing students with opportunities for alternative paths of travel around the classroom building, e.g., taking stairs as opposed to the elevator, provides opportunities to engage in additional types of physical activities. Engaging in physical travel throughout the learning environment can be associated with

healthier lifestyles.

Table 4. Overall physical activity (walking, stair use, etc.) affected by the HSB facility

HSB Facility (Site, Building, Interior)	Mean	SD	N	Interpretation
Overall physical activity (walking, stair use, etc.)	4.83	1.17	6	Enhances

Results indicate that students felt that HSB **enhanced (M = 4.83)** their physical activities (walking, stair use, etc.).

5.2 Commuting Practices

HSB is located in St. Cloud, MN, on a walkable campus that is in close proximity to other campus buildings, open green space, and limited public transportation. The College provides several parking facilities, bike paths, and sidewalks throughout the campus and adjacent to the HSB facility.

Table 5 provides results on students’ primary mode of transportation; Table 6 summarizes commuting distances between home and the HSB facility; and Table 7 summarizes students’ ability to commute using alternative choices (walk, public transit, bike, van, or carpool, etc.). These results, although not related to IEQ, do offer the College insight into students’ commuting behaviors and opinions. These data can provide important information about commuting practices that can reduce transportation energy consumption.

Table 5. Commuting Practices – HSB Primary mode of transportation

Commuting Practices to HSB	Drive alone (or with children <16)
Students commuting mode (%)	100%

Related to primary modes of transportation, 100% of students drive alone (or with children under 16). There were no results for public transit, bicycle, car van pool, and or others.

Table 6. Commuting Practices – HSB Commuting distance traveled

Miles Traveled One Way	0-5 miles	6-15 miles	16-45 miles	46 + miles
Students commuting distance (%)	17%	50%	0%	34%

Results indicated that 17% students commuted 0-5 miles one-way between home and HSB, followed by 50% who commute 6-15 miles, followed by 34% commuting over 46 miles to HSB. There were no students that commuted between 16 to 45 miles one-way.

Table 7. Commuting practices – HSB location and alternative commuting behaviors

HSB Facility (Site, Building, Interior)	N	Mean	SD	Interpretation
Ability to commute in alternative ways	6	4.00	2.53	Neither Hinders / Enhances

Results indicated that the location of the HSB **neither hindered / enhanced (M = 4.00)** students’ ability to commute to class in alternative ways, e.g., walk, bicycle, public transit, van or carpool, etc. Further, of the respondents to this question, 33% said the location **enhanced** their commuting options, 17% felt that this location neither enhanced nor hindered their ability to commute in alternative ways, and 50% felt this location hindered alternative commuting options.

6.0 Conclusions

6.1 Summary

A post-occupancy evaluation was conducted of students of HSB at approximately 3.5 years after its renovation in 2011. Less than 3% of the students who are enrolled in classes in HSB responded to the survey. With such a small response rate and total number of responses, the results are questionable in their ability to represent any larger part of the sample.

The survey included questions related to students' overall satisfaction with the facility (site, building, and interior) and influence of the facility on their overall learning experience and health. Students were **satisfied** with the facility (**M = 6.00**); they found the facility **enhances** their overall learning experience (**M = 5.33**) and **enhances** their overall health (**M = 5.17**). When students were asked these same questions about their primary classroom, they reported overall **satisfaction** (**M = 6.17**) with their primary classrooms. They also reported that their overall learning experience was **enhanced** (**M = 5.83**) by their primary classrooms, and their overall health was **enhanced** (**M = 5.50**) by their primary classroom. As the range of scores was from 1-7, these scores indicate satisfaction is moderately high to high.

Most of the survey questions related to students' satisfaction with the IEQ criteria in their primary classrooms. Students' responses showed they were **satisfied** with all of the IEQ criteria. There were no mean satisfaction scores below 5.00 (Access to electric outlets), and the highest was 6.67 (Overall cleaning and maintenance). This is a high level of satisfaction for most IEQ criteria.

From the students' responses, an IEQ Score was developed and shows respondents' satisfaction with the IEQ of all category level criteria. For HSB, the IEQ Satisfaction Score was **6.13**. This score reflects a high satisfaction level with IEQ categories. Finally, students reported that HSB **enhances** their physical activity, which is one of the sustainable design criteria that influences occupant behavior.

6.2 Recommendations

The satisfaction scores are certainly in the positive direction, however, it is important to maintain a high level of satisfaction as the building continues to age. It is appropriate to consider a continuing assessment, especially considering the low number of respondents. Recommendations below can assist in this plan. For IEQ categories that have physical measurement possible, e.g., thermal, acoustic, and lighting, it is recommended that these measurements be taken in all classrooms. Recommendations follow:

Acoustic Conditions

- Identify acoustic criteria for overall requirements.
- Determine if any task areas differ now from their original spatial layout/use (study rooms adjacent to noisy spaces).
- Develop specialized acoustical performance requirements to support functional programming residents' tasks (e.g., sources of recurrent noise that need to be controlled, special user populations that may have distinct auditory performance limitations, or multiple uses of building spaces that may have different acoustic criteria). Identify and apply appropriate acoustics modeling software for the project.

- Measure acoustic performance onsite with full building systems (heating, ventilation, air conditioning; HVAC) running.
- Identify residents' privacy concerns via focus groups and/or log complaints relative to acoustical conditions for further evaluation.
- Consider residents' tasks within shared spaces to determine if spatial layout changes can be made for increased acoustic control.

Lighting Conditions

- Identify residents' lighting performance criteria that are to be met to achieve goals by conducting onsite measurements of existing illumination and compare them to standards for residents' tasks as identified by the Illuminating Engineering Society (IES).
- Determine if any task areas differ now from original intent to be sure illumination quantity and quality are not impeded by physical changes to the space (i.e., walls, ceilings, furnishings, fixtures, or equipment).
- Develop additional quality lighting criteria as needed for special facility (e.g., influence of daylight quality or quantity) or employee (e.g., age, task duration) issues.
- Log complaints related to lighting conditions for further evaluation.
- Identify poor lighting conditions in the workspace caused by a lack of control over daylighting, which can cause glare and eyestrain.

Personal Adjustability

- Determine if adjustability issues arise with temperature, lighting, or furnishings via a focus group.
- Identify personal, individual problem areas and relate them to other IEQ issues via log of complaints relative to adjustability.
- Provide education to residents about any existing/achievable adjustment options, e.g., furnishings, air diffusers, lighting, temperature control, etc.

Privacy Conditions

- Identify residents' privacy concerns via focus groups or log complaints relative to privacy to determine if visual or audio privacy is most affected.
- Determine if any task areas or responsibilities differ from original intent and develop alternatives or modifications.
- Consider adding noise masking equipment and/or visual screening depending on the nature of the complaints.
- Document and compare acoustic privacy problem areas with acoustic measurements to pinpoint specific problem areas.

Thermal Conditions

- Measure thermal performance conditions on site.
- Log complaints related to thermal conditions for further evaluation.
- Determine special thermal comfort requirements or problems that may be encountered in the building due to physicality of work activities, duration of sitting, or design/layout considerations. Focus groups can be useful in identifying problem locations.
- Determine if any residents' task areas differ now from original layout to determine if air flow is meeting systems design intent.
- Review conditions that affect thermal comfort using ASHRAE Standard 55-2004 or *Human Factors Design Handbook* (see B3 Guidelines).

This study investigated students' satisfaction with the facility and primary workspaces. IEQ satisfaction is individual, but the results of the survey show a central tendency of moderately high satisfaction with the facility and all IEQ criteria. The results can be used as a diagnostic tool to aid in improving IEQ conditions for students and to set the benchmarks from which improvement can be measured in the future.

Appendix A. Open-Ended Responses

Students had the opportunity to raise specific concerns on the overall facility and their primary classrooms. Important information can be gleaned from the open-ended responses. It should be noted that these responses may be helpful in pinpointing both positive and negative aspects of the facility or classroom, it does not mean they represent the overall sentiment from students. Following is a summary of the responses to the criteria.

Building Services Amenities - Restrooms

- Bathrooms need work
- I would like paper towels in bathrooms instead as they are renewable and aid less in the spreading of germs (even if hands have been washed).

Building Services Amenities – Computer Labs

- There needs to be regular help in the computer lab. There have been 3 cases this semester when the ink was running low with the new printers and it took a while for someone to fix the problem. I personally called the main campus and let them know of the situation personally and it still took a couple of days to fix. Also, it would be nice to have a person for computer help when there are technical issues.

Overall Positive

- I love how in the classroom there are simulated ER rooms, and an ambulance. This was great for learning!

Electrical Lighting

- Always very well lit.

Appendix B. Glossary

Descriptive statistics

Statistics used to summarize large sets of data (i.e., means, frequencies, medians). Descriptive statistics describe only the sample under consideration and are not intended to infer results to the larger population.

Frequency

A descriptive statistic that provides information about how many of a particular response or measurement are observed.

Likert-type scale

A measurement technique, employed in questionnaires and interviews, that utilizes a range of standardized response categories such as strongly agree, agree, etc.

Mean

The average score of a set of data calculated by adding all scores together, then dividing by the number of scores.

N

The number of subjects or participants responding to the questions, or a single question, in the study.

Reliability

The repeatability or replicability of findings; the same results are produced each time. Instruments and procedures should produce the same results when applied to similar people in similar situations, or on a second occasion.

Standard deviation

A statistic used to measure the variability of a group of scores (how different scores are from each other and the mean). For example, if the range of scores is 1-7 and the mean (average) is 5.0 with a standard deviation of 1.0, then the scores are closely clustered around the mean, i.e., there is one unit of variation among all scores. If the mean was 5.0 and the SD was 3.0, there is a broader range of variation among the scores...a smaller SD means the scores are similar and the mean score is likely to be more accurate and more useful (this is better!).

Validity

The extent to which an instrument or procedure measures what it is intended to measure (internal validity). The generalizability of results to another population (external validity).