Indoor Environmental Quality + Classroom Environment
Metropolitan State University Science Education Center (MSU-SEC)
Saint Paul, MN

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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 Metropolitan State University Science Education Center (MSU-SEC) facility and occupants' satisfaction with their classroom environments located in this building. The MSU-SEC facility was designed using the 2009 B3 Guidelines (formerly known as the Minnesota Sustainable Building Guidelines or MSBG), which were in effect at the time that the new facility was completed for occupancy in December 2015. 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 environments. The Sustainable Post-Occupancy Evaluation Survey (SPOES) was developed to assess human outcomes in workplace, classroom, and residence hall settings in compliance with the B3 Guidelines project tracking requirements. This is a report of occupants' (hereafter called students) responses at 15 months post-occupancy. The survey was conducted in late-March through early-April 2017.

This SPOES report focuses on students' satisfaction with the physical environment as related to 23 indoor environmental quality (IEQ) criteria such as lighting, thermal, and acoustic conditions in their primary classrooms. Students' satisfaction with the facility (site, building, and interior) and the effect of the facility's physical environment on their perceptions of their academic performance 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. As an incentive to participate, students who chose to self-identify had the ability to have their name included in a pool from which names were drawn at random to win one of four $25 Target gift cards. Also, MSU administration sent out a robodial reminder to students encouraging them to participate midway through the survey period.

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. They also rate the influence of their physical environment on their perception of their academic performance and health on a scale from 1 (hinders) to 7 (enhances).

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 (or hinders)
- 3.51 - 4.50 neither dissatisfied (or hinders) nor satisfied (or hinders)
- 4.51 - 7.00 satisfied (or 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 academic performance 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 23 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 View Conditions 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 an attribute of students' ability to hear desired sounds. There are 11 category-level and 12 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 11 category-level criteria only and results in a single, mean IEQ Satisfaction Score for 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 hear desired sounds (lecture, video, discussions, etc.)

Overall Appearance (aesthetics)

Overall Cleaning and Maintenance

Overall Daylighting Conditions
- Ability to adjust daylighting
- Amount of daylighting

Overall Electric Lighting Conditions
- Ability to adjust electric lighting
- Amount of electric lighting

Overall Furnishings
- Ability to adjust furnishings

- Function of furnishings

Overall Indoor Air Quality

Overall Technology (presentation, laptop support, etc.)
- Access to electric outlets

Overall Thermal Conditions
- Ability to adjust thermal conditions
- Air velocity (drafty/stagnant)
- Humidity (dry or moist)
- Temperature (hot or cold)

Overall Vibration and Movement

Overall View Conditions (ability to see instructor, screens, etc.)

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. The classrooms are shown as a congregate measure, not analyzed individually. This study is limited to students' perceptions.

3.0 Sample Description

3.1 Description of Building

The MSU-SEC facility resides on the campus of Metropolitan State University, a part of the Minnesota State Colleges and Universities system (MnSCU), and is located just northeast of Mounds Boulevard and US Highway 61 on the southeast edge of the campus at 664 East 6th Street, St. Paul, MN 55106. The MSU-SEC facility (see Figure 1) consists of 14 teaching and research labs (114,116, 118, 120, 121, 209, 211, 212, 214, 221, 309, 310, 314, 321), five active learning/general classrooms (115, 216, 308, 311, 316), and two seminar rooms (224, 324), as well as spaces for faculty offices, common and student spaces, and other support areas. These areas are distributed across this three floor facility. The labs, active learning/general classrooms, and seminar rooms comprise 24,813 square feet of an overall construction project of 57,469 square feet. MSU-SEC is the main classroom building for science classes. Only the overall facility, lab, and active learning/classroom spaces were included in this study. It should be noted that as there were no responses regarding the two seminar spaces, the analysis does not include them in the findings.

Figure 1. MSU-SEC (Photo courtesy of MSU)

3.2 Description of Respondents

The MSU-SEC had 598 students with classes in the constructed facility during the spring semester administration of the survey. The response rate to the questionnaire was approximately 13%. Of those responding, 69% were female, 29% were male, and 2% were other. The mean age of respondents was slightly under 29 years; the range was 16 to 60 years.

Students responded that in their primary laboratory or classroom environment, 13% spend 1-2 hours per week in their primary laboratory or classroom environment, 32% spend 3-4 hours, and 55% spend 5+ hours per week in their primary classroom or laboratory environment. This indicates how much they are exposed to the classrooms' IEQ.

4.0 Findings and Discussion

4.1 MSU-SEC Facility (Site, Building, and Interior): Overall Satisfaction, Learning Experience, and Health

Students responded to questions concerning the MSU-SEC 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. MSU-SEC facility - overall satisfaction, learning experience, and health

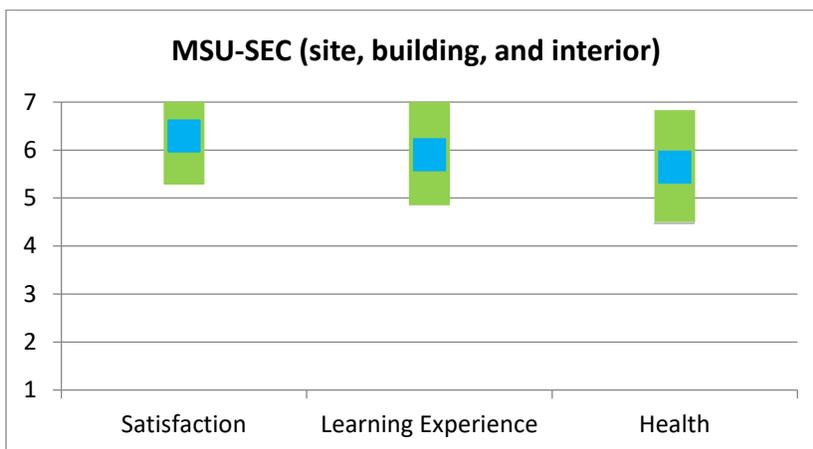| Overall	Mean	SD	N	Interpretation
Satisfaction	6.29	1.02	85	Satisfied
Learning Experience	5.91	1.06	85	Enhanced
Health	5.65	1.19	85	Enhanced

Figure 2. MSU-SEC facility - overall satisfaction, learning experience, and health

Results indicate that students were **satisfied** (**M = 6.29**) with the MSU-SEC facility (building, site, and interior) and reported that their overall learning experience was **enhanced** (**M = 5.91**) by the facility. Students reported that their overall health was **enhanced** (**M = 5.65**) 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. MSU-SEC primary classroom – overall satisfaction, learning experience, and health

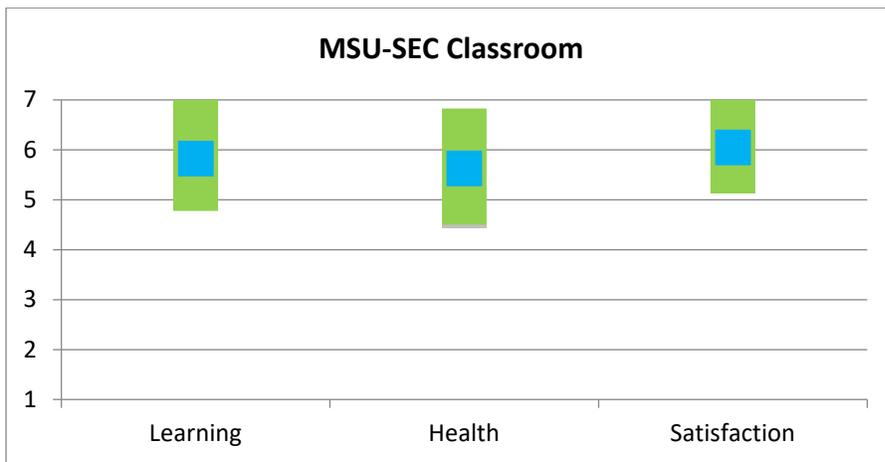| Overall	Mean	SD	N	Interpretation
Satisfaction	5.83	1.05	81	Satisfied
Learning Experience	5.63	1.20	81	Enhanced
Health	6.05	.93	79	Enhanced

Figure 3. MSU-SEC primary classroom - overall satisfaction, learning experience, and health

Results indicate that students were **satisfied** (**M = 5.83**) with their primary classroom, their overall learning experience was **enhanced** (**M = 5.63**) by their primary classroom, and their overall health was **enhanced** (**M = 6.05**) by their primary classroom.

4.3 Primary Classroom: Satisfaction with Indoor Environmental 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 in order from highest to lowest mean, 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 MSU-SEC. Figure 4 is a visual image of the findings in Table 3.

Table 3. MSU-SEC primary classroom - satisfaction with IEQ criteria

| #	IEQ Criteria (1-23) (Category level criteria are bold face)	Mean	SD	N	Interpretation (S = Satisfied) (D = Dissatisfied)
1	Adjustability of thermal conditions	6.31	1.28	80	Satisfied
2	**Overall daylighting**	**6.25**	**1.10**	**80**	**Satisfied**
3	Ability to hear desired sounds	6.23	1.03	81	Satisfied
4	**Overall thermal conditions**	**6.22**	**1.03**	**81**	**Satisfied**
5	**Overall acoustic quality**	**6.20**	**1.12**	**81**	**Satisfied**
6	Adjustability of daylighting	6.14	1.14	81	Satisfied
7	**Overall cleaning and maintenance**	**6.10**	**1.10**	**81**	**Satisfied**
8	**Overall appearance (aesthetics)**	**6.09**	**1.28**	**81**	**Satisfied**
9	Adjustability of furnishings	6.09	1.32	81	Satisfied
10	Humidity (dry or moist)	6.07	1.21	81	Satisfied
11	**Overall technology conditions**	**6.02**	**1.24**	**81**	**Satisfied**
12	**Overall vibration and movement**	**6.01**	**1.28**	**79**	**Satisfied**
13	Function of furnishings	5.94	1.52	81	Satisfied
14	**Overall electric lighting conditions**	**5.94**	**1.38**	**80**	**Satisfied**
15	Temperature (hot or cold)	5.91	1.35	81	Satisfied
16	Access to electric outlets	5.81	1.48	80	Satisfied
17	Amount of daylighting	5.80	1.51	79	Satisfied
18	**Overall furnishings**	**5.77**	**1.57**	**81**	**Satisfied**
19	**Overall view conditions**	**5.74**	**1.59**	**81**	**Satisfied**
20	Amount of electric light	5.72	1.46	81	Satisfied
21	Ability to adjust electric lighting	5.60	1.59	81	Satisfied
22	**Overall indoor air quality**	**5.44**	**1.72**	**81**	**Satisfied**
23	Air velocity (drafty or stagnant)	5.42	1.67	79	Satisfied
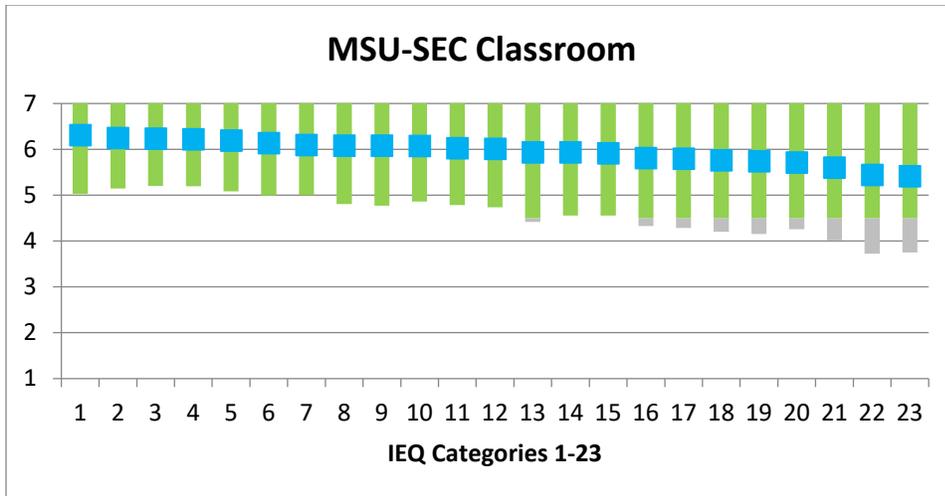
Figure 4. MSU-SEC primary classroom - satisfaction with IEQ criteria (IEQ 1-23 are listed in Table 3)

Results indicate that students were **satisfied** with all of the IEQ criteria in their primary classrooms. Means ranged from **5.42** (air velocity, drafty or stagnant) to **6.31** (adjustability of thermal conditions). These findings support a **consistently positive 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 11 category level IEQ criteria. At this time, all criteria are weighted equally in this calculation as little evidence exists that provides rationale for weighting some criteria heavier than others. The IEQ mean is representative of a moderately high 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 MSU-SEC is **5.98,** which falls at the moderately high end of the satisfied range. The large number of criteria with scores above the mean contribute to this high IEQ Score**.**

Figure 5. MSU-SEC primary Classroom - IEQ Satisfaction Score

Overall, the students showed a positive satisfaction level with the IEQ of MSU-SEC classrooms as indicated by the mean score of **5.98**. As shown in Table 3, all IEQ categories were at or above **5.44;** eight categories were at or above **5.94** and helped to increase the IEQ Score. 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 IEQ score sets a positive 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 MSU-SEC (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 MSU-SEC facility

MSU-SEC Facility (Site, Building, and Interior)	Mean	SD	N	Interpretation
Overall physical activity (walking, stair use, etc.)	5.94	.98	79	Enhanced

Results indicate that students felt that MSU-SEC **enhanced** (**M = 5.94**) their physical activities (walking, stair use, etc.).

5.2 Commuting Practices

MSU-SEC is a facility within Metropolitan State University in St. Paul, MN. The MSU-SEC is located on the southwest edge of the campus and is across 6th Street from Founders Hall. The University provides parking locations throughout the campus in various surface lots and in a parking ramp to the northwest of MSU-SEC. Public transportation via Metro Transit is available. Also, the University offers bicycle racks.

Table 5 provides results on students' primary mode of transportation; Table 6 summarizes commuting distances between home and the MSU-SEC 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 University 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 – MSU-SEC primary mode of transportation

Commuting Practices Home to MSU-SEC (N=80)	Drive alone (or with children <16)	Public Transportation	Car or Van Pool	Motorcycle or Moped	Walk	Other
Students commuting mode (%)	83%	8%	6%	1%	1%	1%

Related to primary modes of transportation, 83% of students drive alone (or with children under 16), 8% utilize public transportation, 6% participate in a car or van pool, 1% ride a motorcycle or moped, 1% walk, and 1% travel by other means not identified.

Table 6. Commuting practices – MSU-SEC commuting distance traveled

Miles Traveled One Way (N=80)	0-5 miles	6-15 miles	16-30 miles	31-45 miles	46-75 miles
Students commuting distance (%)	18%	46%	25%	9%	3%

Results indicate that 18% of students commute 0-5 miles one-way between home and MSU-SEC, followed by 46% who commute 6-15 miles, 25% commute 16-30 miles, 9% commute 31-45 miles, and 3% commute 46-75 miles to MSU-SEC. All commuting mileage is reported as one-way miles. Note that the overall percentage may not total 100% due to rounding.

Table 7. Commuting practices – MSU-SEC location and alternative commuting behaviors

MSU-SEC Facility (Site, Building, Interior)	Mean	SD	N
Ability to commute in alternative ways	4.9	1.62	80

Results indicate that the location of the MSU-SEC **enhanced (M = 4.9)** students' ability to commute to class in alternative ways, e.g., walk, bicycle, public transit, van or carpool, etc.

6.0 Conclusions

6.1 Summary

A post-occupancy evaluation was conducted of students of MSU-SEC at approximately 15 months after its construction in 2014. About 13% of the students who are enrolled in classes in MSU-SEC responded to the survey.

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 = 6.29**); they found the facility **enhances** their overall learning experience (**M = 5.91)** and **enhances** their overall health (**M = 5.65**). When students were asked these same questions about their primary classroom, they reported overall **satisfaction** (**M = 5.83**) with their primary classrooms. They also reported that their overall learning experience was **enhanced** (**M = 5.63**) by their primary classrooms, and their overall health was **enhanced** (**M = 6.05)** by their primary classroom. As the range of scores was from 1-7, these scores indicate satisfaction is moderately 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 23 of the IEQ criteria. The scores ranged from **5.42** (air velocity, drafty or stagnant) to **6.31** (adjustability of thermal conditions). This is moderately high level of satisfaction and the consistently positive satisfaction scores are admirable.

From the students' responses, an IEQ Score was developed and shows their **satisfaction** with the IEQ of all category level criteria. For MSU-SEC, the IEQ Satisfaction Score was **5.98.** This score reflects a **moderately high satisfaction** level with IEQ categories. Finally, students reported that MSU-SEC **enhances (5.94)** 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 continuously work on IEQ criteria before there is dissatisfaction. Specifically, for the MSU-SEC, a closer look at air velocity and overall indoor air quality might be beneficial. For example, for IEQ categories that have

physical measurement possible, e.g., thermal, acoustic, and lighting, it is recommended that these measurements be taken in classrooms. Other recommendations follow that could help the University keep occupants' satisfaction positive.

Acoustic Conditions
- Identify acoustic criteria for overall requirements.
- Determine if any task areas differ now from their original spatial layout/use (e.g., classrooms adjacent to noisy spaces).
- Develop specialized acoustical performance requirements to support functional programming occupants' 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, and air conditioning) running.
- Identify occupants' privacy concerns via focus groups and/or log complaints relative to acoustical conditions for further evaluation.
- Consider occupants' tasks within shared spaces to determine if spatial layout changes can be made for increased acoustic control.

Lighting Conditions
- Identify occupants' lighting performance criteria that are to be met to achieve goals by conducting onsite measurements of existing illumination and compare them to standards for occupants' tasks as identified by the Illuminating Engineering Society (IES).
- Determine if any task areas differ now from original intent to be sure illumination level and quality of lighting 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 occupant (e.g., age, task duration) issues.
- Log complaints related to lighting conditions for further evaluation.
- Identify poor lighting conditions 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 a log of complaints relative to adjustability.
- Provide education to occupants about any existing/achievable adjustment options, e.g., furnishings, air diffusers, lighting, temperature control, etc.

Privacy Conditions
- Identify occupants' 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 occupants' 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 MSU-SEC facility and primary classrooms. IEQ satisfaction is individual, but the results of the survey show a central tendency to moderately high satisfaction with the facility and 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.

<h1 style="text-align:center">Appendix A. Open-Ended Responses</h1>

Students had the opportunity to raise specific concerns on the overall facility and their primary classrooms. Important information can be gleaned from the numerous, open-ended survey responses. MSU-SEC students raised a wide variety of concerns, but most of those raised related to furnishings, lighting/daylighting, security, and technology. Generally, the comments are shown exactly as written.

Overall Positive

- I also really like study rooms and use them regularly, thanks.
- I appreciate the classroom and lobby area being so clean!
- It is a good environment!
- I love my science room. It has everything I need, I can move stuff around, it's got multiple plug-ins, and adjusting indoor/outdoor light is a breeze.
- Overall it is a really good environment for students.
- Good environment!
- It is a very bright, inviting space. If there was an area for an actual coffee shop instead on vending machines it would be perfect.

Acoustics

- The room [no room name provided] is rather large and long and can be hard to hear.
- The main issue I run into is not having enough small silent study rooms in the building. There seem to be only 6 small rooms to the one side of the building and are always occupied sometimes by the same person/people for a few hours at a time.

Aesthetics

- It would be nice if there were more science-related furnishings/ posters/ demonstrations in the room. It is very empty and bare, almost like any class can be taught there.

Equipment

- Put more trashcans in the lab room.
- I would appreciate a natural waste/compost waste bin.
- Need gas to heat chemicals faster.
- Add gas to lab rooms.

Furnishings

- The chairs and tables should be changed so we can adjust and sit comfortably.
- Chairs are somewhat uncomfortable and hard.
- Change the chairs to the black mesh chairs with arm rest on the side.
- Classroom chairs are hard to be sitting for 4 hours.
- Largest problem I have is how uncomfortable the chairs are. Hurts to sick down for more than 10 minutes, I've tried sitting on them and nothing helps. It can be very distracting.
- Swivel chairs don't properly fit against the tables from the ends.
- The chairs are my main issue in the classroom. I am not of an average height, and I often have a hard time getting comfortable in them.
- The tables wiggle tremendously which can be distracting.
- There should be more tables, not the high tables on the ground level.

Lighting/Daylighting
- The natural sunlight is appreciated.
- Like the very bright environment.
- The generous amount of natural light we receive is a great improvement.
- The electrical lights on the ceiling flickers on and off during class.
- It would be best if the controls to lower and raise the window blinds in the building were accessible to students so that we can block excessive light from the sun when using the study rooms. Students are unable to access the window blind controls when professors have left the building and the space to their offices has been locked after their shifts.
- I appreciate the amount of natural light in my classroom and how light bulbs in some areas are turned off when not in use, such as the bathrooms.
- More natural lighting in the classrooms would be wonderful.

Maintenance
- Need to vacuum the floors and wipe down the desk/tables.

Security
- Access doors from the street lock too early in the afternoon and some classes go until 9pm and people may need to leave and come back through that door to return to class.
- The street level doors have been kept locked on Saturday mornings. This presents a gigantic inconvenience to me, having to walk to a completely different building to access a skyway entrance.
- Please keep the street entrance unlocked. It is a huge inconvenience to have to go to a different building to access the skyway to get to class when I am simply expecting a door to function properly.

Spatial Layout
- Some of the lab spaces, specifically the chemistry labs, feel too small for the class size. More equipment and lab space would be nice so that crowding, waiting for instruments, and bumping into people wouldn't be an issue.
- In room 311, the computer screen and professor's working station blocks the view to the students who sit in the front row. Especially those who sit on the right of side of the classroom.

Technology
- Access to electricity for charging laptops is excellent.
- I enjoy having projectors in the classroom.
- The group rooms don't have a USB connector to the TV.
- Sometimes the power point electronic pointer is not functioning.
- It would be nice to have computers and printers in the building.
- There are no student-use computer labs, we need them.
- The pull down power outlets are extremely clumsy when in use and pose a serious tripping hazard.
- Electric outlets are on the ceiling and that take too much time to get it down.

Thermal Conditions
- This building is always so cold (like the rest of the school).
- The temperature in the classroom seems cold on most days. Sometimes, I have to keep my coat on.
- Labs are cold.
- The science building is always too cold, even around summer time.

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).