



# **Indoor Environment Quality + Classroom Environment Science Teaching Student Services (STSS) (Report 1)**

**March 2014, 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 Science Teaching Student Services facility (STSS) and students' satisfaction with their work environments. The STSS facility was designed using the B3 Guidelines (formerly known as the Minnesota Sustainability Guidelines or ) and completed for occupancy in 2010. The B3 Guidelines track specific state-funded 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 the physical environment. The Sustainable Post-Occupancy Evaluation Survey (SPOES) was developed to assess human outcomes in classroom and workplace settings in compliance with the project tracking requirements for the B3 Guidelines goals. This is the first of two required POE surveys and represents responses at four years post-occupancy. The survey was conducted in March 2014.

This SPOES report focuses on students' satisfaction with the physical environment as related to 15 indoor environment quality (IEQ) criteria (hereafter called categories) 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 learning environment and health are included. Finally, a brief look at students' commuting and physical activities within the building are also reported. The report provides descriptive information about students' perceptions of the IEQ of their learning 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) in studies involving similar facilities and students. 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 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 questions 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:

- 1-3.99 dissatisfied (hinders)
- 4-4.49 neither satisfied (enhances) or dissatisfied (hinders)
- 4.5-7 satisfied (enhances)

An IEQ Score is also calculated for students' satisfaction with IEQ in their primary classrooms. This is a statistical combination of all IEQ scores, which results in a single IEQ score for all students on all IEQ variables and is reported in an IEQ Scorecard.

## 2.1 Description of the Questionnaire

Students first rate their level of satisfaction with the facility 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 the IEQ categories. The questionnaire uses 15 IEQ categories from the B3 Guidelines and relates each of them to students' satisfaction with their physical environment.

Categories include (in alphabetical order):

1. Acoustic Conditions
2. Appearance
3. Cleaning and Maintenance
4. Daylighting Conditions
5. Electric Lighting Conditions
6. Function
7. Furnishings
8. Indoor Air Quality
9. Lighting Conditions
10. Personal Adjustability Conditions
11. Privacy
12. Technology
13. Thermal Conditions
14. Vibration and Movement
15. View Conditions

## 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 Building Description

Built in 2010, the five-story, 118,000 square-foot STSS building houses instructional classrooms and administrative offices that service University of Minnesota (UMN) students (see Figure 1). It was designed according to the B3 Guidelines. The building also received LEED New Construction (NC) Version 2.2 Gold Certification. The STSS building is located along the East Bank of the Mississippi River in the

heart of the UMN Minneapolis campus. The Mississippi River bisects the UMN Minneapolis campus into two campuses that are referred to as the West Bank and East Bank campuses.



Figure 1. STSS building (Photo credit: <http://www1.umn.edu/twincities/maps/STSS/>)

The STSS 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).

### 3.2 Description of Respondents

The STSS response rate to the questionnaire was approximately 12%. Of those responding, 36% were male and 64% were female. Relating to hours spent in STSS, 48.5% of the students spend 3-4 hours per week in their primary classroom; 31.3% spend 1-2 hours per week in their primary classroom; and 20.2% spend 5+ hours per week in their primary classroom. The mean age of respondents was 21 years, with a range of 18 to 69 years. Results indicated that the majority of 77.9% are satisfied with the course they are taking in their primary classroom, 11.9% are neither dissatisfied nor satisfied, and 10.2% are dissatisfied with the course they are taking in their primary classroom.

## 4.0 Findings and Discussion

### 4.1 STSS Facility (site, building, and interior): Overall Satisfaction, Learning experience, and Health

Students responded to questions concerning the STSS 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 and Figure 2 show a summary and interpretation of their responses.

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

STSS Facility (site, building, and interior)	Mean (1-7)	SD	N	Interpretation
Overall satisfaction	6.04	1.05	650	Satisfied
Overall learning experience	5.46	1.15	650	Enhances
Overall health	4.87	1.12	651	Enhances

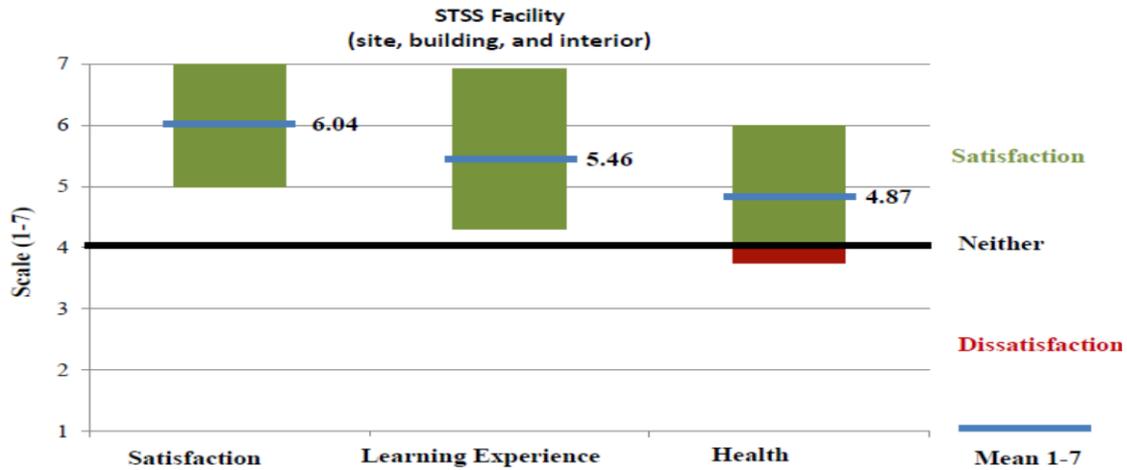


Figure 2. STSS facility - overall satisfaction, learning experience, and health

Results indicated that students were **satisfied** (Mean = 6.04) with the STSS facility (building, site, and interior) and reported that their overall learning experience was **enhanced** (Mean = 5.46) by the facility. Students reported that their overall health was **neither enhanced nor hindered** (Mean = 4.87) 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 (i.e., the one they answered questions about). Table 2 and Figure 3 show a summary and interpretation of their responses.

Table 2. Primary classroom environment - overall satisfaction, learning experience, and health

STSS Primary Classroom	Mean (1-7)	SD	N	Interpretation
Overall satisfaction	5.47	1.39	651	Satisfied
Overall learning experience	5.25	1.32	652	Enhances
Overall health	4.83	1.12	648	Enhances

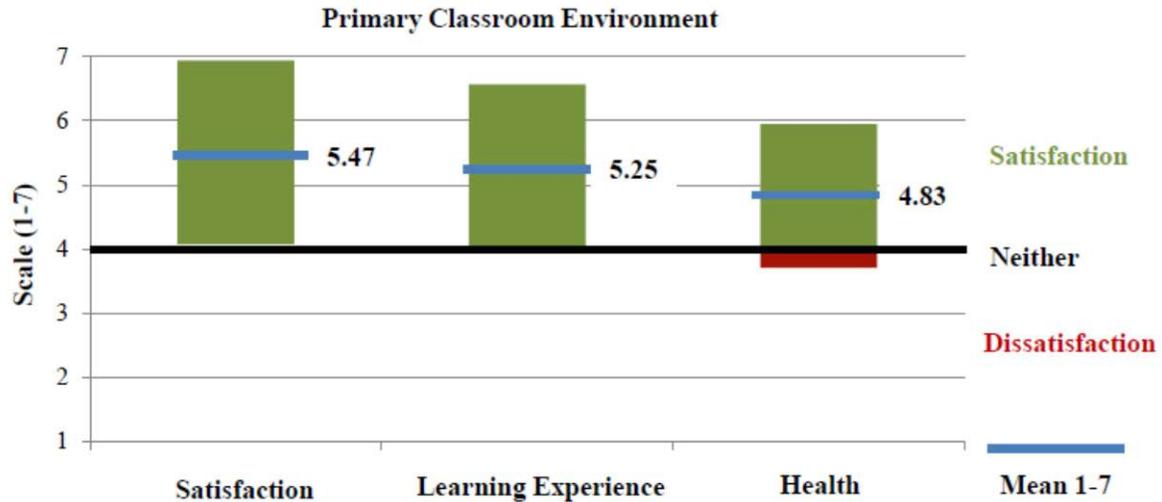


Figure 3. Primary classroom environment - overall satisfaction, learning experience, and health

Results indicated that students were satisfied ( $M = 5.47$ ) with their primary classroom, their overall learning experience was enhanced ( $M = 5.25$ ) by their classroom, and their overall health was neither enhanced nor hindered ( $M = 4.83$ ) by their classroom.

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

Students responded to questions concerning their satisfaction with IEQ categories (thermal conditions, indoor air quality, acoustic conditions, etc.) related to their primary classroom. Table 3 and Figure 4 show a summary of the means, the standard deviations, and interpretation of their responses.

Table 3. Primary classroom environment – satisfaction related to IEQ criteria

	Primary Workspace	Mean (1-7)	SD	N	Interpretation
1	Cleaning and maintenance	6.24	.92	645	Satisfied
2	Indoor air quality	5.99	1.19	644	Satisfied
3	Lighting conditions	5.93	1.20	650	Satisfied
4	Humidity	5.89	1.11	649	Satisfied
5	Vibration and movement	5.89	1.15	652	Satisfied
6	Appearance (aesthetics)	5.86	1.20	651	Satisfied
7	Ability to understand desired sounds	5.84	1.20	649	Satisfied
8	Technology	5.84	1.30	651	Satisfied
9	Thermal conditions	5.84	1.12	651	Satisfied
10	Air velocity	5.83	1.18	652	Satisfied
11	Ability to hear presentations	5.80	1.31	651	Satisfied
12	Acoustic conditions	5.76	1.28	650	Satisfied
13	Temperature	5.74	1.24	652	Satisfied
14	Function	5.72	1.32	650	Satisfied
15	Background noise	5.70	1.34	650	Satisfied
16	Furnishings	5.66	1.40	650	Satisfied
17	Ability to see materials presented	5.57	1.55	647	Satisfied
18	Adjustability of thermal conditions	5.23	1.39	644	Satisfied

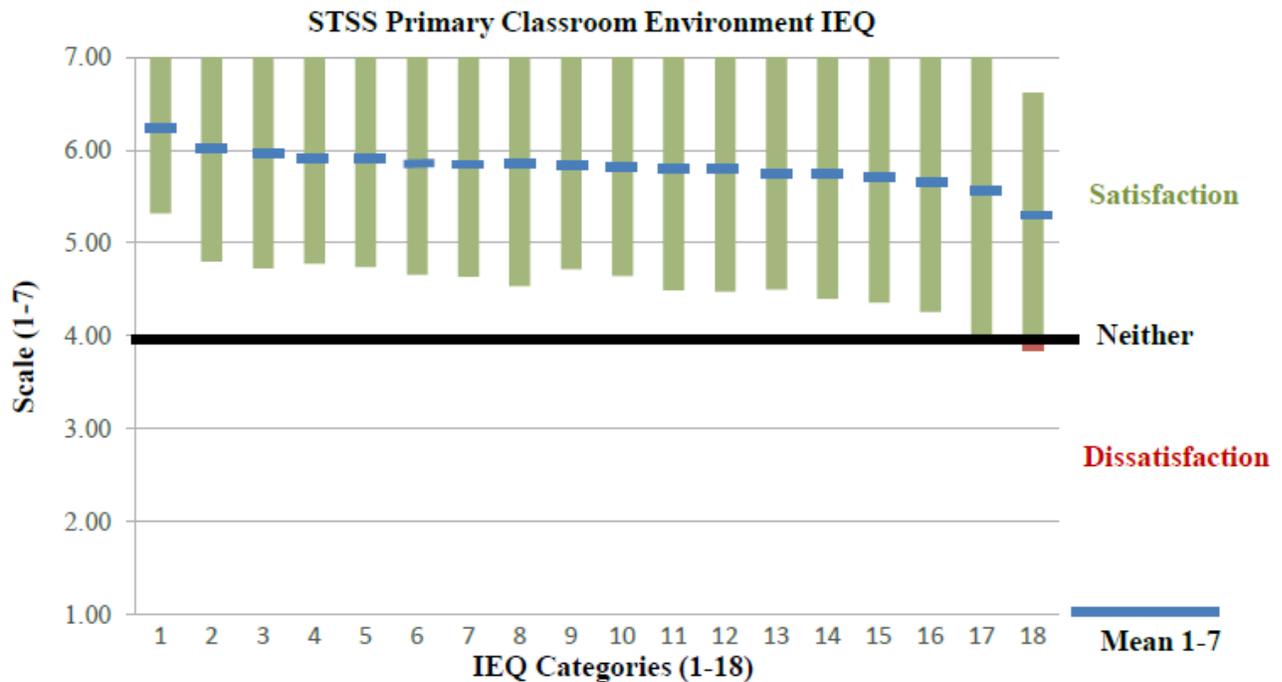


Figure 4 Primary classroom – satisfaction related to IEQ categories (IEQ categories 1-18 are included in Table 3)

Results indicate that students were satisfied with the all IEQ conditions in their primary classrooms. They are listed below in rank order:

- Cleaning and maintenance
- Indoor air quality
- Lighting conditions
- Humidity
- Vibration and movement
- Appearance
- Ability to understand desired sounds
- Technology
- Thermal conditions
- Air velocity
- Ability to hear presentations
- Acoustic conditions
- Temperature
- Function
- Background noise
- Furnishings
- Ability to see materials presented
- Adjustability of thermal conditions

#### 4.4. IEQ Satisfaction Scorecard

The IEQ Satisfaction Score is determined by developing weighted factors of all categories, which is more representative of a fair overall IEQ score. For example, it might be more important for a student to have satisfying thermal conditions than to have satisfying indoor air quality. Thus, if the student gives a high thermal satisfaction score and a lower indoor air quality satisfaction score, the overall IEQ satisfaction will be scored much higher than one with the inverse statistics.

The weighted scoring system was developed by employing the following procedures:

1. **Factor analysis** (a multivariate statistical procedure) was conducted to determine the importance of various IEQ categories.
2. The factor loading of each IEQ category was regarded as the individual weight.
3. The weighted sum score was used to calculate the final mean score illustrating how well a particular building performed in terms of satisfying its occupants' IEQ needs. This becomes the IEQ Score. As shown in Figure 5, the IEQ satisfaction score for the STSS primary classroom environment is **5.87**.

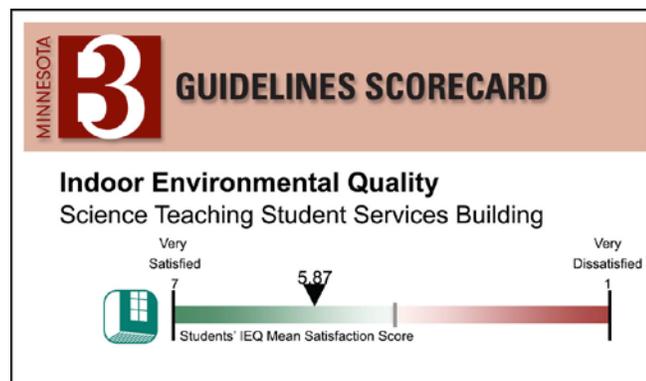


Figure 5. Primary classroom environment - IEQ Satisfaction Score for STSS

Overall, the occupants showed a positive response with a moderately high level of satisfaction with IEQ as indicated by the weighted **mean score of 5.87**. Satisfaction with the **Function** of students' classroom was identified as the category that contributed most to the IEQ Satisfaction Score, followed by satisfaction with **Appearance** of the primary classroom. They determine IEQ satisfaction more strongly than other categories and differ from the ranking of the means scores where **Cleaning and Maintenance, Indoor Air Quality, Lighting Conditions** were the top satisfaction scores. **Furnishings** was the least contributing category to the IEQ Satisfaction Score, whereas **Adjustability of Thermal Conditions** was the lowest ranked satisfaction score, although still showed satisfaction.

This score of 5.87 validates the overall satisfaction score in Table 2 (5.47). They are similar but the IEQ Score is slightly higher because it may reflect some other factors beyond IEQ such as location or size of primary workspace. The IEQ Score gives more refined knowledge.

## 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 STSS (site, building, and interior) and their commuting practices.

## 5.1 Physical Activity Engagement

Providing students with opportunities for alternative paths of travel around the workplace, 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 work environment can be associated with healthier lifestyles.

Table 3. Overall physical activity (walking, stair use, etc.) affected by the STSS facility

STSS facility (site, building, and interior)	Mean (1-7)	SD	N	Interpretation
Overall physical activity (walking, stair use, etc.)	5.47	1.15	638	Enhances

Results indicated that students felt that STSS **enhanced** ( $M = 5.47$ ) their physical activities (walking, stair use, etc.). Further, of the **638** respondents to this set of questions, 78.8% said they were **satisfied** with the facility's influence on their overall physical activity; 19.2% said they were **neither dissatisfied nor satisfied**; and 2% of students were **dissatisfied**.

## 5.2 Commuting Practices

STSS is located on the East Bank of the University of Minnesota. The East Bank campus is located north of metropolitan hub providing bus and light rail transit service through the campus environment. The University provides several parking facilities, bike paths, and sidewalks throughout the campus and adjacent to the STSS facility.

Table 5 provides results on students' commuting mode of transportation. 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 4. Primary mode of transportation

Commuting Practice	Drive alone (or with children < 16)	Carpool or vanpool	Public transit	Bicycle	Walk	Combination (Seasonal)
Primary mode of transportation	11.7 %	1.6%	24.6%	1.7%	59.6%	.8%

The most frequent mode of transportation to STSS was walking, followed by public transit (24.6%), driving alone (or with children under 16) (11.7%), bicycle (1.7%), carpool or vanpool (1.6%), and a combination (.8%).

## 6.0 Conclusions

### 6.1 Summary

A post-occupancy evaluation was conducted of students of STSS at approximately four years after it was first occupied. About 12% of the students 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 = 6.04**); they found the facility **enhances** their overall learning experience (**M = 5.46**), and **enhances** their overall health (**M = 4.87**). In addition, similar results were reported when students were asked these same questions about their primary classrooms. They reported **overall satisfaction** (**M = 5.47**) with their primary classrooms, and that their overall learning experience (**M = 5.25**) and overall health (**M = 4.83**) were **enhanced**. As the range of scores was from 1-7, satisfaction scores are in a positive mid-high range.

Most of the survey questions related to students' satisfaction with the IEQ categories in their primary classrooms. Students' responses showed they were **satisfied** with all of the IEQ categories. The mean satisfaction scores ranged from **5.23** (Adjustability of thermal conditions) to **6.24** (Cleaning and maintenance). Again, this shows a **positive level of satisfaction** as all IEQ category as no means were lower than **4.5**.

From the students' responses, an IEQ Score was developed and shows respondents' **satisfaction** with all categories and the contribution of each category to that satisfaction score. For STSS, the IEQ Satisfaction Score was **5.87**, with satisfaction with **Function** and **Appearance** (aesthetics) of their classrooms as the two categories that influenced students' satisfaction level most. This score reflects the satisfaction level of the other categories. Finally, students reported that STSS **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, improvement may be possible. For IEQ categories that have physical measurement possible, e.g., thermal, acoustic, and lighting, it is recommended that these measurements be taken in both overall classrooms and primary, individual classrooms. Recommendations follow:

### Thermal Conditions

- Determine special thermal comfort requirements or problems that may be encountered in the building due to work activities or sitting or design considerations.
- Determine if any task areas differ now from original intent.
- Review conditions that affect thermal comfort using ASHRAE Standard 55-2004 or Human Factors Design Handbook.
- Measure performance variables on site.
- Log complaints related to thermal conditions.

### Lighting Conditions

- Identify performance criteria that are to be met to achieve goals.
- Determine if any task areas differ now from original intent.
- Develop additional quality lighting criteria as needed for special facility issues such as students' ages, duration of task, influence of daylight quality or quantity.
- Conduct onsite measurements using Illuminating Engineering Society standards for students' tasks.
- Log complaints related to lighting conditions.

**Acoustic Conditions**

- Identify acoustic criteria for overall requirements.
- Determine if any task areas differ now from original intent.
- Develop any additional special acoustical performance requirements to support functional programming of building, 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. Investigate and choose appropriate acoustics modeling software for the project.
- Measure acoustic performance onsite with full systems running.
- Log noise and other sonic environment complaints.

**Privacy Conditions**

- Identify students' privacy concerns via focus groups or log complaints.
- Determine if any task areas or responsibilities differ from ordinal intent.
- Consider adding noise masking equipment and/or visual screening depending on nature of complaints.
- Compare acoustic privacy problem areas with acoustic measurements to pinpoint specific problem areas.

**Personal Adjustability**

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

Though students' satisfaction was deemed positive in every category, there is always room for improvement. The above recommendations can help address change in these categories. Exploring these areas in more detail and making adjustments may increase overall satisfaction with the primary classroom.

This study investigated students' satisfaction with the facility and primary classrooms. IEQ satisfaction is individual, but the results of the survey show a central tendency of moderate to high satisfaction with the facility and all of the IEQ categories. 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. STSS students raised many concerns about the following themes: view, technology, space layout, and building amenities. Many students commented about poor viewing conditions in classrooms due to the room and furniture layout. They also frequently commented on dysfunctional microphones and difficulty of using technology in their classrooms. There were positive comments as well, which included an overall satisfaction with the building and the building services amenities. For example thermal conditions, appearance, IAQ, vibrations/movement, and function reflected positive students' satisfaction in their primary classrooms making the case that the open-ended responses reflect a small sample of the population. The following are a comprehensive list of qualitative responses.

### Building Services Amenities,

- STSS needs better wifi reception, actual tissues in the classroom, those drinking fountains that you can use to fill water bottles, and relocation of the vents on the floors (that was not a good idea).
- Curious if there are any elevators in the building.
- More study spaces with individual desks would be appreciated.
- I wish there are more open study spaces area.
- I just wish it was open later on weeknights (close at the same time libraries close).
- The bathroom doors could use foot openers so hands stay absolutely clean.

### Thermal

- Perhaps huge amounts of open spaces requires unnecessary heating.
- Once again, those floor vents. Drafty and cold all over my legs.
- Too cold!
- Extreme wind when entering the building.
- The temperature is too warm.
- It is a little chilly.
- There is a cold draft of air that hits me in the leg all class period.
- Positioning the air vents underneath the rows of seats is nice aesthetically, but causes my legs to become cold with long periods of sitting during class time.
- Some days it is too hot and some it is too cold.

### Function

- The design of the lecture halls is suited more towards PowerPoint presentations, which does not work well for classes where the instructor uses the white boards only.
- Large, circular tables don't make a lot of sense in a room in which we're supposed to be looking at the whiteboard the whole time; you don't want to be facing away from the whiteboard. It's also very hard to squeeze through the classroom if you're late.
- My classroom is great but a little crowded, it's difficult to get to your table once everyone is seated.
- The screens are a bit small, and the rows are too long for easy ingress and egress if you are a few minutes late.
- Sometimes tables are too close together making it difficult to maneuver between chairs, and it can be difficult to see white boards in some classrooms.
- It's not a great test-taking environment. Not that that's a bad thing.

- The lecture rooms are not well suited for large classes.
- Circular tables with a lecturer in the center of the room is terrible for lectures.
- Science demos difficult in room with no tiled floor.
- The boards in the lecture halls (220 and 230) are way too wide, so it forces professors to use the doc-cams. It isn't inherently bad, but the boards are ideal if you are behind or like to listen and then write.
- Seriously put left handed desks in the middle of the room in the first two rows.
- The round tables with the microphones make big lectures a lot more interactive.

### Space Layout

- Bad flow of people.
- The location and shape of the main staircase is incredibly inconvenient and tedious to climb/descend.
- The actual layout of the building is something I find a bit problematic. The nature of the stairs makes it difficult to get from one floor to another efficiently. In addition, in my opinion there are too few study areas throughout the building; the ones that exist are small and generally overcrowded.
- It also blocks certain exits from the building so that we have to walk all the way around it to go outside after exiting the staircase. Fire hazard?
- The stairs are very poorly designed.
- The stairs may be pretty, but they aren't very well designed as far as traffic.
- flow is concerned when everyone has to use them between class between class periods.
- The stairs are really annoying, but otherwise the building is cool.
- Lack of multiple stairways leads to traffic jams.
- Sometimes the room can feel cramped if almost all students come to class.
- It's hard to see instructor slides given the layout of the room.
- The classroom can sometimes feel cramped as there are too many tables and chairs and bodies competing for space.
- Some of the chairs are a little close so that when people leave early or arrive late, they are pushing into students and their chairs to get through, which is a small distraction.
- The size of the O. Chem class seems too large for this space.
- The tables seems crammed into the room. It's not very easy to move around and walk to a seat on the far side of the room.
- Because of the seating, I sometimes find it bothersome and slightly distracting to constantly change my position in order to best see my instructors when they're giving lecture.
- Seating arrangements in clusters is very distracting. I prefer standard classroom setups. Modern "enhanced learning" and teaching techniques do not fit everyone (ex: auditory learners like me).
- The classroom feels cluttered. It is small and the tables and chairs feel too close together.
- Some tables are far too close to sit comfortably.
- The widely spaced rows is super nice plus!
- The classrooms are laid out interestingly. For the majority of the seats the configuration works well; however, there are a couple of seats that make learning difficult because the seat is located in a place difficult to see a monitor and the teacher.
- Classroom is way too crowded!
- Tables are very close together and it can be hard to get around the room with people in the chairs.
- The room is longer so it should be used as two separate rooms.
- The classroom itself is too wide (it is hard to see the board from extreme ends), this limits the teaching space to the two middle white boards, or to the projector screens.

- The way the seating is set up makes it hard to see the whiteboard in STSS unless you are directly in the front of the classroom.
- It is often difficult to navigate your way through the chairs in the room if you have to move between tables. If the room is almost empty, it's fine. But when the room is full and everyone is sitting in their chairs normally with coats and backpacks, you have to carefully pick your way through everyone.

### **Furnishings**

- Please put in more chairs!
- It seems like some of the classrooms have an excessive amount of TVs in them.
- Could use more lounge seating.
- I think the lecture halls seats are far to low and it would be better if they were raised higher.
- My only complaint is that there are not always enough chairs per table (I believe the standard for room 114 is 9).
- People who are left handed cannot possibly use the desks provided. They are so small and impossible to write on.
- My lower ratings stem from the wish of larger desks.
- Tables are close together. I find myself knocking into people with my backpack.
- Tables and chairs instead of desks are a hindrance to learning because they discourage class interaction as well as make it difficult for students to get to their seats, which causes distractions if students are late.
- Chairs in this classroom are very comfortable, but hard to adjust to a higher or lower level. Have not found the way to do this yet.
- The circular table setup of many of the rooms works well for group work.
- I do wish the desks had updated computer hook ups on them.
- The classrooms with the tables are great for a group work/lab environment, but I've had them for lecture based classes and it's hard when there are so many screens to look at and the professor/students have their backs to each other quite frequently as everyone is facing a difference direction.
- Simple round tables would better facilitate discussion, less distraction.
- The desks are TINY
- Tables do not seem to be able to handle the rigor of daily use over time. They have begun to bend and be uneven.
- Most of the class agrees that more STSS rooms would be more beneficial to be active learning centers with round tables.
- And I am not a fan of the round tables.
- The furniture itself is nice though.
- Chairs are pretty uncomfortable.
- Tables are very small.
- Needs Periodic Tables on the wall.
- I have my organic chemistry class in STSS 220 and the room does not have a periodic table available. This would be extremely beneficial and I hope there is something that can be done to have one there.
- The desks are a bit small and sometimes difficult to work with.
- Taking tests in the STSS lecture halls sucks because the desk surface is so small.
- The chairs are super nice and make it easier to pay attention in class because I'm sitting comfortably.
- Having no posters makes the room bleak and also a giant periodic table of the elements would be super beneficial in class.

- The desks in the lecture rooms are a bit small.
- The seats' arm desks are too small to be practical.

### **Positive**

- Overall the building is beautiful and well maintained. Great job guys :)
- It makes me feel studious.
- The classrooms themselves are very nice and conducive to learning.
- Love it.
- Very cool building with great resources available it's awesome!
- Great building, work on getting more classes there and more out of buildings like Bell Auditorium, which should never be used as a regular lecture hall. The lecture halls in STSS would be great for engineering classes like deformable body mechanics and other ME courses.
- I love it.
- Beautiful building aesthetically and very innovative systems for learning. Great environment and I love spending time in the basement level because it has microwaves and vending machines which means I can eat lunch.
- The design of the building is very appealing, and I think it fosters creativity.
- If the building was a little larger it might be more effective. Good concept and design, relatively small structure.
- Love the site! We have a great view of the city, and I think it reminds students how wonderful Minneapolis and our campus is.
- The Active Learning Classrooms are super cool and if possible should be made more abundant so that more students can benefit from them.
- Overall, the classroom is pretty good.

### **Lighting**

- As far as health goes, fluorescent lights give me a headache, so I'd prefer if there was more natural and less overhead lighting, but it's not as bad as other buildings.
- The lights could be a tad dimmer.
- Room is excessively bright.
- While the rooms are modern and spacious, the lighting is annoying as it is excessively bright.
- The light is mostly artificial since there are only the thin windows along the top of the external wall, making the lighting conditions less than ideal.

### **IAQ**

- The elevators ALWAYS smell like weed. I know it's not me, because I do not smoke. I don't care if others do it recreationally... but don't do it on campus. ESPECIALLY in a classroom building. Tell the evening/night staff to stop hot boxing the elevators. Because that is what I've had explained to me when I asked why the heck the elevators always smell like weed.
- I think the air is not clean.

### **View**

- There is no window.
- The classrooms are too wide, which causes difficulty in seeing everything the professor is presenting.
- It is hard to see the board in lecture because the back seats are not high enough and are at weird angles on the sides.

- The traditional lecture rooms on the 2nd and 3rd (i.e., not the ones with circular desks) floor were poorly designed. Most lecture halls have all the side seats (i.e., not in the left and right of the center aisle) tilted towards the whiteboards. STSS on the other hand has the side seats pointed straight and not tilted. Unless you sit in the center section of seats on each side of the center aisle you are going to have a hard time seeing what the instructor wrote on the whiteboards. The only workaround for instructors is to make sure they use the two projectors that point at the left and right boards. That way everyone can follow lecture. One instructor of mine followed this approach and I had no complaints. Another former instructor of mine did not do this and decided to write on the whiteboards on the far sides of the room. It was very uncomfortable to strain my neck to read her writing. To sum it up, require instructors to use the projectors that point at the far sided whiteboards instead of writing on them with markers.
- When I am sitting on a table at the left side of the room, it is very hard to see what the TA is writing on the whiteboard on the right side of the room.
- More ease to see the far board from the front row
- The classroom is too wide that it does not allow the student to see significant sections of the board when sitting near the ends.
- Seeing the board is a challenge.
- Although the overall active-learning design (small-group tables) facilitates group discussion very well, it makes interacting with the instructor and seeing the main presentation awkward in certain positions around the table.
- It can be difficult to see the white board at times in the lecture hall because there isn't much elevation between the rows of chairs. If someone tall sits in front of me, I often have to frequently shift positions in order to see the board.
- The seating arrangement makes it difficult to see the front of the classroom from the back.
- Its kinda hard to see from the back.
- Unless I sit in the first row of chairs, I have a difficult time seeing the board during class because each row of chairs are not high enough.
- It is hard to see the professor as well as other students in the class. The TV monitors are clearly visible but the set up to have vocal discussion makes it hard as a class.
- Sometimes it was hard to see the presenter who was standing at the podium and writing on the white board from where I was sitting.
- With the small slope to the room, the people in the back can have difficulty seeing the front of the room.
- If prof likes to write on board, far left and right people in the front rows can't see the middle board.
- From my seat I am unable to see basically every part of the white board.
- I also really dislike how you cannot always see the professor/monitors when they speak depending on where you sit.
- There's like 90 flat screens in this classroom, but I can't see any of them very well from my seat :)
- If the professor does not move or look around during lecture, he/she only faces half of the room.
- Students who at the very back of the class face a problem viewing what is written on the board.
- It is hard to see the board if you are sitting, for example, on the right side of the room and the teacher is writing on the left side boards.

### **Daylight Conditions**

- There are very few if any windows in the classroom, making the rooms with the stone and muted tones, almost prisonlike.

- The computer lab next to the one stop office has no windows so sometimes it is hard to print stuff there. It is really annoying!
- I love the windows and the tall ceilings. They make the room seem airy and open.
- My biggest complaints would be lack of natural sunlight in the classrooms.
- The only downside of room 412 is that there are very small windows, so the room does not get a lot of natural lighting. Otherwise it is perfect!
- This room has no way to block direct sunlight and blinds students on the left side of the classroom for evening classes.

### **Acoustics**

- The only problem is all of the construction on the U which you can hear within STSS. You can hear outside noises and other classrooms quite a bit in 530A.

### **Technology**

- Many of the classrooms that have TVs at the tables for connecting to a computer...however many students do not have a converter for Macs to bring to class with them. As so many students use Mac computers, having HDMI converters available so the TVs are accommodating for student computers would be nice.
- I have noticed, in more than one classroom, that the instructors have had technology difficulties many times and sometimes the speakers in the tables make a high pitched sound if slightly turned on which can be distracting.
- In STSS 114, the lecturer mic never works well and always crackles and gives out. In room 230: It's awesome, but hard because I have a three hour night class where I use my laptop, and it never usually makes it that three hours. I completely understand it's almost impossible to add more outlets to that room, but I just thought I'd give you that feedback. Otherwise, STSS is an incredible building, and you all do a phenomenal job with it. I shouldn't complain because it's dang awesome as is.
- I really enjoy the multiple T.V.s and screens to view multimedia presentations on. I'm so used to only writing down a few notes because I can only see certain parts of the projection screen. Now, however, I can just turn to the screen that is merely 4 feet from my table.
- Really happy that there are outlets on each of the tables. That is a HUGE plus.
- The microphones cut out nearly everyday and it is frustrating. Also, there is often a very annoying buzzing sound originating from the microphones. This happens about every other day I have class. It's fairly loud and disruptive to learning.
- I gave low marks for the visual/tech questions because all of the displays are very low resolution, like 480.
- A Mac computer adapter at each table would be helpful, as only VGA output is available.
- Too many screens can be distracting.
- Adapters for apple computers should be provided as well
- The microphones buzz at least once every class.
- Sometimes the table microphones do not turn on, or they are difficult to keep on. Also, when I am talking I cannot hear myself so it can be difficult to tell whether my microphone is working.
- In the classrooms where laptops will be needed, replace VGA cables with HDMI/DVI so that students can actually plug their laptops in to be displayed on the big screens. VGA is so last decade...we have laptops, not desktops...nobody has a port for that anymore. Time to get with the program.
- The mic is sometimes not working
- The cord to connect some computers to the screens is old and does not have a plug in the computer. Otherwise everything else is perfect.

- It would be nice to have another projection screen.
- The microphones break a lot.
- Apple USB cords would be appreciated.
- Technology doesn't always work.
- The audio is frequently low for the lecture. I am not certain if that is a facility issue, or an operator issue.
- At the particular table I sit at the microphones usually don't work and thus my group does not participate as much in discussion.
- I think the set-up with the projector is very awkward because you can't really see it if you are sitting in half of the seats.
- Too many gadgets get in the way of learning.
- There are always issues with the document camera.
- The technology in the classroom feels a bit wasteful and not as useful as some seem to think it is. Yet despite all of those flashy monitors that no one uses there is not an HDMI cord in the front console meaning I don't know how I will be giving my presentation for the class.
- The microphones tend to malfunction regularly.
- There have been several technological issues with this room. Seldom does a week go by in which the instructors' microphone does not cut out mid lecture. The televisions around the room have had several glitches. The microphones for some of the tables have been broken for over seven weeks. Also the microphones randomly emit a pulsing sound which become distracting.
- Microphones cut out.
- I've had many techy issues... Mics have a lot of feedback or cut in and out frequently
- Many teachers I've had become confused with the technology. If there are instructions, I do not know if there are or not, it might be more beneficial to post them somewhere permanent in each space.
- The microphones don't work more than half the time
- There are too many technical difficulties everyday during class.
- The technology provided is fantastic, but it can't be easily, intuitively used by teachers and TAs without some kind of training or clear directions posted.
- It would be nice if there were adapters to connect newer PC computers at the student islands. (HDMI cables).
- The classroom needs adaptors for apple computers to be able to connect to the tvs.
- There needs to be more outlets in the classrooms and in the hallways. With the continuous use of technology, the outlets are prime real estate.
- It would be nice if the projection system would allow for easier magnification of what whatever is being presented.

### **Cleaning and Maintenance**

- Some chairs have stains on them. One particular chair has a blood stain on it. That's pretty gross.
- Classrooms are also very clean.
- A light on the far left, middle from the entrance continually flickers and is distracting.

### **Appearance**

- It looks like a food processor but in a cool way the classroom interior often feels very stale. The lighting is bad, everything is white or cream or gray, and because of that I often feel like I'm being forced back into boring high school classes where I can't wait to leave. I often feel sleepier in any class I've ever had in STSS, and I think it's because of the classrooms.

## 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.

### **Factor analysis**

A multivariate statistical procedure that is used to identify and group together general dimensions or factors that underlie a large number of variables in a set of data. The procedure transforms the variables into new principal components or orthogonal factors. Variables within each factor are related to each other but have no relationship to variables in other factors.

### **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 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).