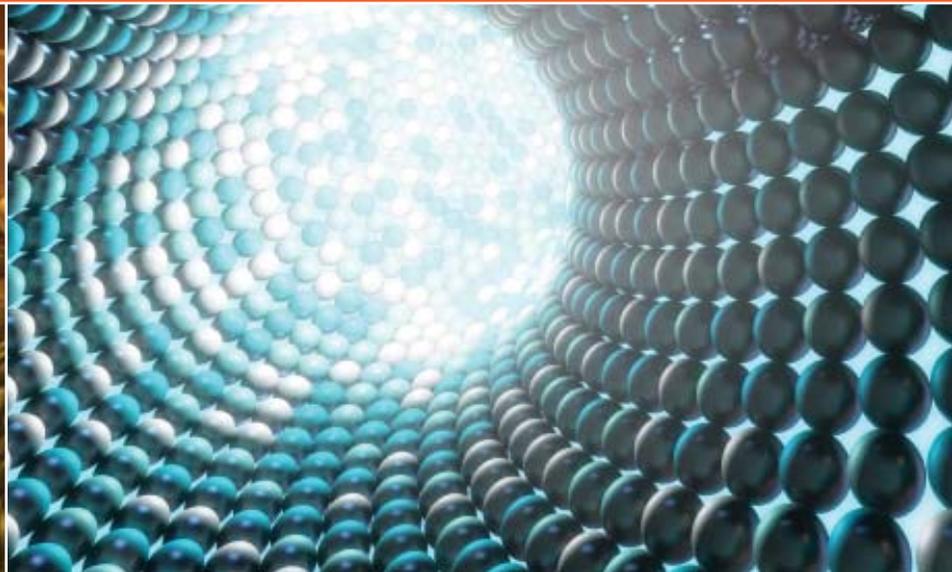
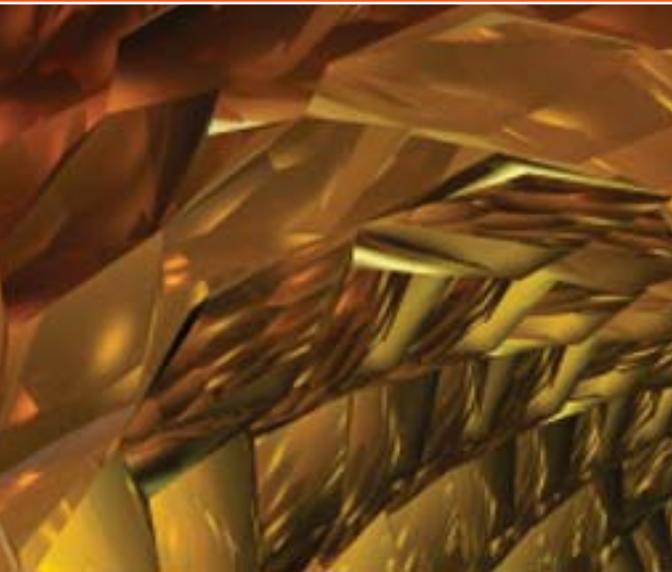




EYP/ research

Evaluating the Impact of STEM Buildings on College and University Campuses

Volume 2: Pilot Assessment- College of the Holy Cross
2011



Volume 2: Pilot Assessment with the College of the Holy Cross

This report analyzes the research results of the pilot assessment conducted at the College of the Holy Cross. The methodology and dimensions of assessment for the study are described in Volume 1 in this series.

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Confidentiality Statement

This report concerns the impact of science buildings on college campuses. The report has been developed by EYP, Inc. (EYP) at significant expense, devotion of resources, and time. As such, EYP considers the report as its proprietary information.

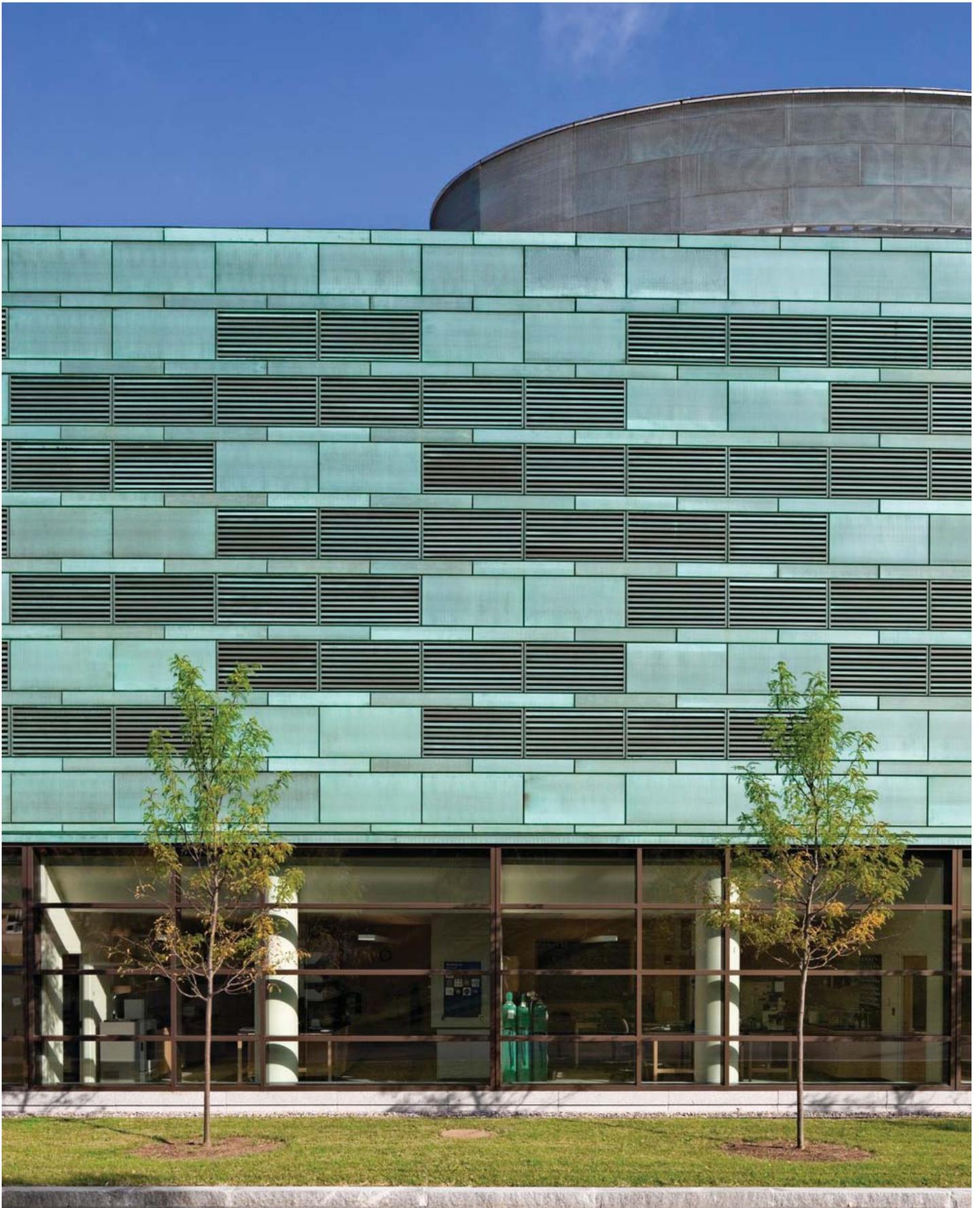
Executive Summary

To enable the College of the Holy Cross to upgrade its science facilities, EYP designed one new building (Smith Laboratories) and the complete renovation of another (Haberlin Hall). Together, these twin projects connected existing structures to create an Integrated Science Complex (ISC) linking six natural science and social science departments. As one means of evaluating the impact of these projects, EYP conducted two post-occupancy surveys, one of faculty and the other of students, in spring 2011. Based on survey responses, the new ISC has succeeded in accomplishing several goals:

- On average, about 40 percent of faculty and students are aware of sustainable measures employed in the ISC. Evidence suggests that an active display monitor in the Smith Labs atrium, where viewers can learn about the Complex's energy consumption and environmentally sensitive design, may be contributing to this awareness.
- Faculty members perceive that the new ISC classrooms have enhanced the quality of the teaching environment, and students rate these classrooms as far superior to other classrooms on campus.
- The new laboratories have enhanced the faculty's ability to conduct research, increased its productivity, and created a safer working environment.
- Students make extensive use of the ISC, choosing public spaces throughout the Complex to study alone, study or work with other students, or just hang out and get something to eat or drink. To students and faculty, the ISC is a comfortable place. The Science Café is a major source of attraction. In addition, both students and faculty find the ISC aesthetically pleasing; both like its spaciousness and lighting; and students like its numerous study areas.
- Public areas in the ISC facilitate learning and intellectual discourse. An estimated 60 percent of Holy Cross students describe the ISC as a "good" or "favorite place" to get together with others to engage in various learning activities, including working on problems and group projects and discussing ideas from class. Similarly, faculty members often meet students and colleagues in the ISC, where conversations turn to teaching, research, or other scholarly subjects.
- Lab activities made visible through glass walls and the

building as a whole appear to pique students' interest in science and create a stimulating environment in which to work.

- Most faculty are very satisfied with the ISC overall, and nearly all faculty and students believe it projects a favorable image of Holy Cross.
- In making suggestions for improvement, students generally proposed ways of gaining greater access to the ISC, such as keeping it open later, and extending its resources, such as adding study areas. The most frequent suggestion from faculty was to address the ventilation problem caused by odors from the Science Café. Some faculty wanted tables added to the front of lecture halls; others wanted to improve navigation throughout the ISC and the connections between Smith Labs and Beaven Hall.



Introduction

In designing STEM buildings, EYP establishes several goals. Some goals, worked out in collaboration with clients, are specific to particular projects; other goals apply to virtually all designs. Assessing these goals requires various methods, applied both before and after building construction. This report, summarizes results related to project goals, and presents findings from two post-occupancy surveys conducted at the College of the Holy Cross in spring 2011.

At Holy Cross, construction involved the addition of one building, Smith Laboratories, and the complete renovation of another, Haberlin Hall, which housed the departments of chemistry and physics. Smith Laboratories was positioned between existing structures to create an “integrated science complex” of connected buildings linking six different academic departments. On one side, in Beaven Hall, were psychology and sociology/anthropology; on the other side, in O’Neil Hall, was biology; between, in Haberlin, Smith Labs, and Swords Hall, were chemistry, physics, and mathematics. The construction occurred in two stages: Smith Labs was completed in December 2008, with classes beginning in January 2009; Haberlin was ready for occupancy in December 2009, with classes beginning in January 2010.

Methods

Overview

Two questionnaire surveys targeted the principal users of the buildings, faculty and students. The faculty survey was designed primarily to assess the impact of the new Integrated Science Complex (ISC) on teaching and research. The student survey was designed primarily to assess the impact of the multiple new learning spaces throughout the Complex: how often students visit the Complex; why they go there; what areas they use; how attractive they find it as a place to study and meet others.

Sample

The faculty survey was administered to all tenured and tenure-track members of the six departments connected to or part of the ISC and to all other faculty members who had taught in one of the new ISC classrooms. Of 88 faculty contacted, 77 completed the survey, for a response rate of 87.5 percent. The student survey was administered to a stratified random sample, stratified by science/non-science major, of all students enrolled and on campus in spring 2011. A total of 500 students, 250 science and 250 non-

science majors, were contacted; 331 students—171 science majors and 160 non-science majors—completed the survey, for an overall response rate of 66.2 percent.

Results

A post-construction survey of occupants can reveal much about the impact of a building, but the full measure of this impact requires a range of methods applied before and after the building is completed. Surveys are a useful means of assessing occupants’ perceptions and, to a lesser extent, their patterns of using the building. We need other methods, however, to determine many effects, such as whether the number of applicants to the college or number of science majors has increased since building construction or if the building complies with ADA and OSHA standards or has achieved the highest level of energy efficiency. In addition, survey results must be interpreted with caution; as we note below, some results require further information or data for valid assessment.

Goal 1. Create an energy-efficient, sustainable environment.

- *Are users aware of sustainable measures employed in the Integrated Science Complex?*
- *Do instructors use the Integrated Science Complex to teach about sustainability?*

With the support of college officials, EYP designed Smith Labs and the Haberlin renovation to achieve the highest level of energy efficiency and environmental responsibility. By incorporating an energy-recovery wheel for the laboratory exhaust system as well as several other design elements, the project succeeded in earning a LEED Gold certification from the U.S. Green Building Council, emblematic of buildings that promote a healthy environment.

According to Rev. Michael McFarland, S.J., president of Holy Cross, the “entire design and construction project” was “meant to teach sustainability as well as embody it.” One way of teaching about sustainability is through an active display monitor in the Smith atrium lobby, where visitors can learn about the Complex’s energy consumption and environmentally sensitive design. Three in five survey respondents reported that they had stopped to look at the active display monitor.

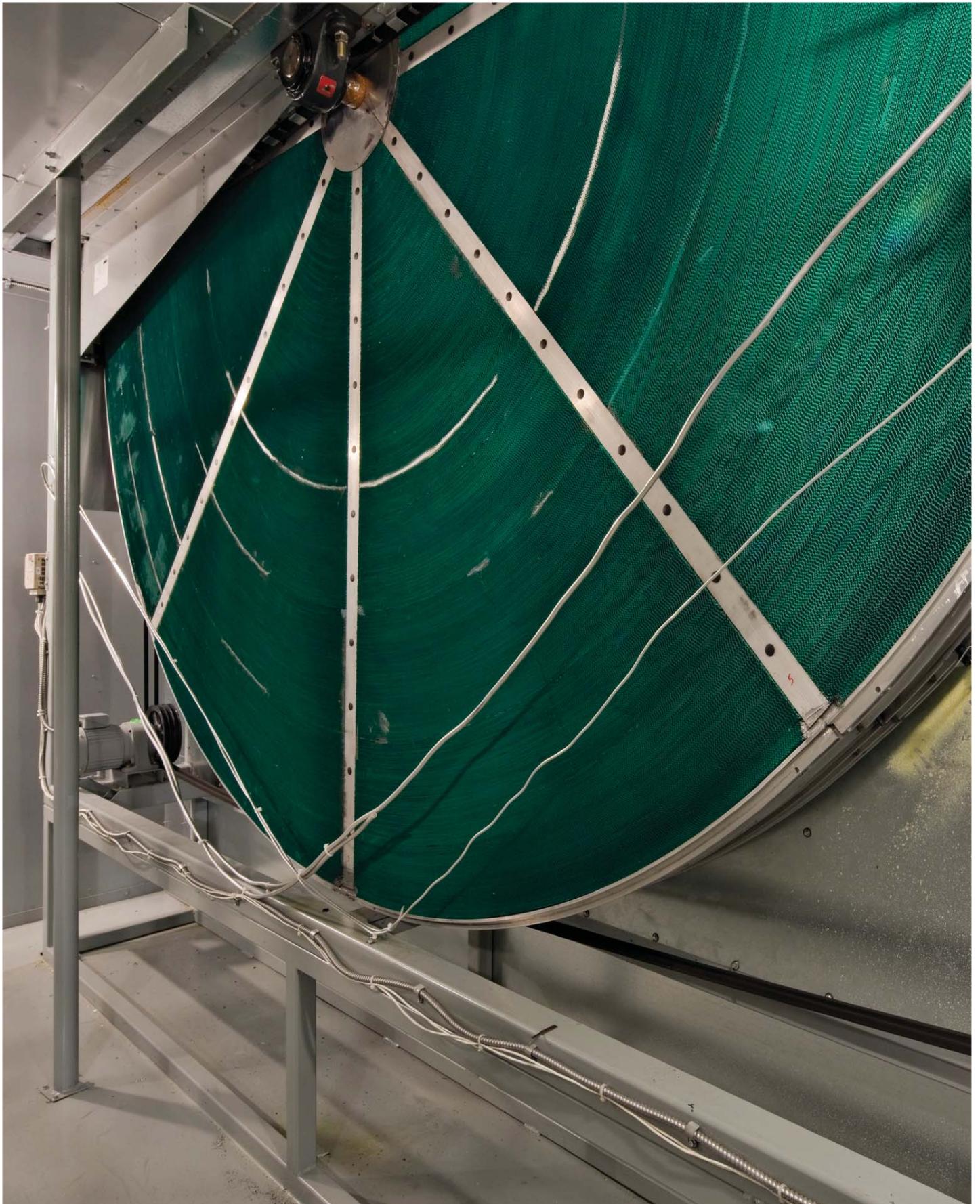
Through the display monitor and other sources, occupants and visitors become aware of the Complex’s sustainable features.

To gauge faculty and students' knowledge of these features, we asked if respondents were aware of five sustainable measures employed in the new Integrated Science Complex. Table 1 shows the results for both faculty and students. Among faculty, chemists and biologists were far more likely to be aware of each measure than members of other departments; and on every item student science majors were more likely to report awareness than non-science majors. Although the overall level of professed awareness was similar for faculty and students, students were more likely than faculty to report that the Complex had increased their "awareness of strategies and actions that may be taken to promote a healthy environment": 55.4 percent of students, as compared with 33.8 percent of faculty, indicated that their awareness increased "somewhat" or "a great deal." Of course, faculty members may have been more aware of such strategies than were students before the new construction. In addition, only one faculty member reported that he had used the Complex's sustainable measures to teach about sustainability.

On every knowledge item, respondents—both faculty and students—who had "ever looked at the active display monitor" were more likely to report awareness of the sustainable measure than those who had not looked at the monitor. For example, over twice as many faculty who had looked at the monitor (46.7% vs. 19.4%) and 50 percent more students who looked at the monitor (49.8% vs. 32.8%) were aware that recycled materials were used in nearly 40 percent of building construction. Although we cannot be sure of the causal direction, this may mean that building users are learning about sustainability at least partly through the display monitor.

Table 1. Percent Faculty (N=77) and Students (N=319) with Knowledge of Sustainable Measures Employed in Integrated Science Complex

Sustainable Measure	Faculty	Students
Recycled materials used in nearly 40% of building construction	35.5	43.6
Energy recovery wheel	39.0	25.7
Low-flow fume hood system	56.0	40.7
High-performance lighting system	50.6	53.5
Reflective roof to reduce heat gain	32.9	43.9
Average	42.8	41.5



Goal 2. Enhance the effectiveness of science teaching.

- *Have the new classrooms and laboratories enhanced the quality of the teaching environment?*
- *Have the new classrooms and laboratories enabled instructors to change their teaching methods, introduce new courses, or teach new course topics?*
- *Have the new classrooms and laboratories enabled instructors to use the time devoted to teaching more productively?*
- *Are instructors more likely to become involved in collaborative teaching?*

Classrooms

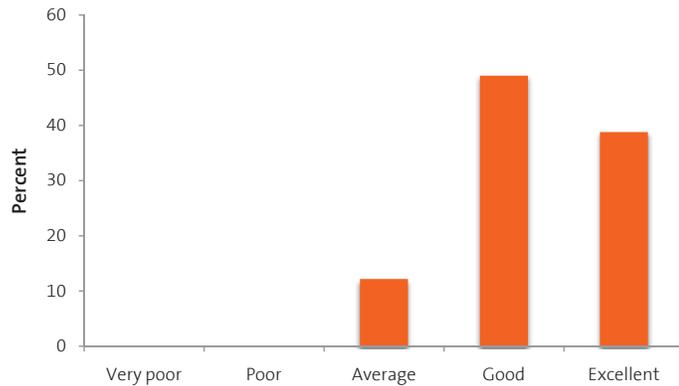
The construction and renovation produced 10 new classrooms, two more than were in the old Haberlin building; however, classrooms in the old building, including a lecture hall with a seating capacity of 175, tended to be larger, so there was a net loss of about 120 seats. To assess the quality of the new classrooms, we asked faculty members to rate the new classroom in which they most recently had taught on several criteria. Table 2 shows faculty ratings across all new classrooms. On every criterion, the vast majority of instructors rated the new classroom in which they had taught as “good” or “excellent.” Over 90 percent gave these ratings to the quality of lighting and acoustics; nearly 90 percent assigned the same ratings to the accessibility of technology and, most importantly, as illustrated in Figure 1, to the overall quality of the classroom as a teaching environment. As a humanities professor summed it up, “I love the classroom space—it has significantly enhanced my experience as a teacher.”



Table 2. Faculty Ratings of All New ISC Classrooms Combined in Percents (N=49)

Criterion	Very poor	Poor	Average	Good	Excellent	Mean	S.D.
Flexibility in accommodating different teaching strategies	0.0	4.2	27.1	45.8	22.9	3.88	.815
Sightlines between you and your students	0.0	8.2	14.3	30.6	46.9	4.16	.965
Accessibility of technology to instructors	0.0	4.3	6.4	31.9	57.4	4.43	.801
Placement and visibility of blackboards and whiteboards	0.0	2.1	12.8	38.3	46.8	4.30	.778
Size or spaciousness	0.0	2.0	18.4	40.8	38.8	4.16	.800
Quality of lighting	0.0	0.0	8.2	38.8	53.1	4.45	.647
Quality of acoustics	0.0	2.1	0.0	44.7	53.2	4.49	.621
Overall quality as a teaching environment	0.0	0.0	12.2	49.0	38.8	4.27	.670
Average	0.0	2.9	12.4	40.0	44.7	4.27	.762

Figure 1. Faculty Ratings of Overall Quality of New ISC Classrooms as a Teaching Environment (N=49).



New classrooms in the ISC range in seating capacity from 20 to 72. Four of these classrooms (Haberlin 219, Smith Labs 154 and 155, and Swords 321), with 40 to 72 seats, are set up in a traditional lecture format, with seats arranged in rows in front of a lectern. Two classrooms, seating 20 or fewer (Haberlin 021 and Swords 209), have seats arranged around a central table. One of the new classrooms, with 36 seats, consists of the mathematics and computer science computer lab. Table 3 shows the average rating on each criterion for different classrooms rated by 10 or more instructors. Instructors rated every classroom or combination of classrooms as “good” to “excellent”; moreover, there is no appreciable difference in ratings across classrooms.

These ratings indicate a high level of satisfaction with the quality of the teaching environment in the new ISC classrooms. The ratings do not tell us, however, whether that environment is an improvement over the classrooms replaced by the Haberlin renovation. We therefore asked those who had taught in Haberlin prior to its renovation to compare the quality of the new ISC classrooms with that of the old Haberlin classroom in which they most often taught. Of the 27 instructors with teaching experience in Haberlin, 22 or 81.5 percent rated the quality of the teaching environment in the new ISC classrooms as “much better.”

Instructors tend to teach in very few classrooms; in fact, they often teach in the same classroom semester after semester. So, they have little basis for comparing one classroom with another. On the other hand, students have a solid foundation for making comparative judgments because they take courses in multiple classrooms across the campus. We therefore asked students whether they had taken a course in one of the new ISC classrooms and, if so, to compare the “quality and feel” of that classroom “with most other classrooms at Holy Cross.” As another point of comparison, we asked students to make the same judgment of a classroom in Stein Hall in which they most recently had taken a course. Completed in 1985, Stein Hall contains 27 classrooms, far more than any other building on campus. Table 4 reports these ratings. Overall, nearly two-thirds (64.1%) of the respondents rated the new ISC classroom as “one of the best classrooms at Holy Cross.” By comparison, the majority of students rated the Stein classroom as “average” or less than average. Figure 2 shows the contrasting ratings of classrooms in the two buildings.

Table 3. Mean Faculty Ratings of Selected New ISC Classrooms

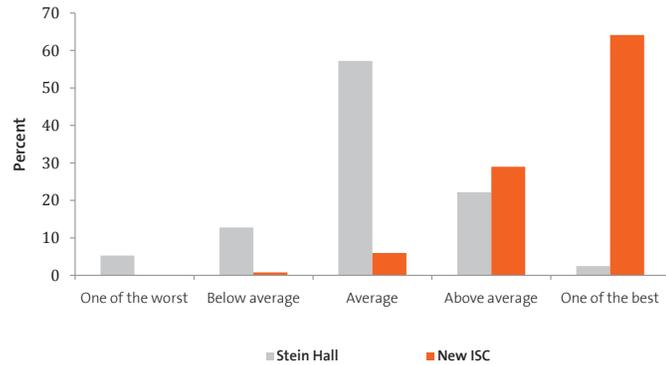
Criterion	Lecture Halls ¹	Seminar Rooms ²	Swords 321	Smith Labs 154 & 155
<i>N</i>	31	11	10	16
Flexibility in accommodating different teaching strategies	3.97	4.00	4.22	4.00
Sightlines between you and your students	4.23	4.45	4.50	4.25
Accessibility of technology to instructors	4.53	4.60	4.78	4.63
Placement and visibility of blackboards and whiteboards	4.45	4.45	4.44	4.67
Size or spaciousness	4.29	4.00	4.30	4.25
Quality of lighting	4.58	4.27	4.70	4.56
Quality of acoustics	4.55	4.45	4.67	4.60
Overall quality as a teaching environment	4.39	4.27	4.60	4.44
Average	4.37	4.31	4.53	4.42

5 = Excellent
 4 = Good
 3 = Average
 2 = Poor
 1 = Very Poor

¹Haberlin 219, Smith Labs 154 and 155, and Swords 321.

²Haberlin 021 and Swords 209.

Figure 2. Student Ratings of New ISC Classrooms (N=248) and Stein Hall Classroom (N=243) Compared with Most Other Classrooms at Holy Cross.



There is substantial variation in the size and layout of classrooms in both the ISC and Stein Hall. A few common difference, however, may explain why the new classrooms are rated superior. Structurally, Stein classrooms tend to have more depth and less breadth in relation to instructor lecterns and blackboards than the new ISC classrooms. By contrast with almost all Stein classrooms, all the new ISC lecture halls are multi-tiered, creating better sightlines among students and between students and instructor. The new classrooms can be more easily set up for group work. They also have better acoustics as, unlike Stein Hall, they were designed so that voices could be heard at normal speaking volume throughout the classroom space.

Table 4. Student Ratings¹ of New ISC Classroom and Stein Hall Classroom in Percents

Classroom	N	One of worst	Below average	Average	Above average	One of best	Mean	S.D.
Haberlin 021	15	0.0	0.0	0.0	53.3	46.7	4.47	.516
Haberlin 136	18	0.0	0.0	11.1	50.0	38.9	4.28	.669
Haberlin 207	4	0.0	0.0	25.0	0.0	75.0	4.50	1.00
Haberlin 219	21	0.0	0.0	4.8	14.3	81.0	4.76	.539
Haberlin 225	20	0.0	0.0	10.0	40.0	50.0	4.40	.681
Smith Labs 154	75	0.0	0.0	2.7	9.3	88.0	4.85	.425
Smith Labs 155	45	0.0	0.0	0.0	22.2	77.8	4.78	.420
Swords 209	9	0.0	11.1	0.0	55.6	33.3	4.11	.928
Swords 210	4	0.0	0.0	0.0	50.0	50.0	4.50	.577
Swords 321	35	0.0	2.9	17.1	54.3	25.7	4.03	.747
ISC classroom	248	0.0	0.8	6.0	29.0	64.1	4.56	.646
Stein Hall ²	243	5.3	12.8	57.2	22.2	2.5	3.04	.815

¹Compared with most other classrooms at Holy Cross, which of the following best describes the quality and feel of [this] classroom?

²Asked of students who rated a new ISC classroom.

We asked instructors who had taught in both the old and new classrooms if the move had resulted in changes in their teaching. No one reported that he or she had taught a course with another faculty member as a result of the move; however, this rarely occurs at Holy Cross, especially in the sciences. One person reported that he/she had introduced new topics within an existing course; another reportedly had introduced a new course; and five persons indicated that they had changed teaching methods. Two of the latter had introduced more collaborative or group work into the classroom; two others were making greater use of technology. Finally, almost half of this group (46.2%) reported that, in comparison with the old classrooms, the new classrooms had enabled them to use class time more productively.



The new complex has many glass walls intended to make science teaching and research visible to everyone. The walls are most evident in laboratories, but also exist in offices and a few classrooms. Haberin 021 has a glass wall directly across from an entrance to the building; the wall sits at the back and to the side of students but in front of the instructor as he or she addresses the class. Swords 321 has glass walls on either side of the classroom; and a section of one side of Swords 209, at the back of the room near the entrance, has glass from floor to ceiling. These classrooms were controversial in that some faculty members thought they would be distracting to them and their students. We therefore asked instructors who had taught in one of these classrooms (N=24) the extent which they thought their students were distracted by people peering through the glass walls into the classroom; 20.8 percent reported “moderately distracted,” 50 percent “slightly distracted,” and 29.2 percent indicated “not distracted at all.” When asked how much they themselves were distracted, 16.7 percent reported being “moderately,” 33.3 percent reported “slightly,” and 50 percent reported “not at all.” No one reported being either “very” or “extremely” distracted.



Teaching Laboratories

The new construction replaced six chemistry and physics teaching laboratories in Haberlin. These laboratories are designed for the teaching of general chemistry (Smith Labs 256), inorganic chemistry (Smith Labs 257), physical, analytical, and advanced inorganic chemistry (Haberlin 319/322), general physics (Haberlin 221), and intermediate and advanced courses in physics such as optics and electronics (Haberlin 123/125). In addition, one classroom (Haberlin 225) serves as both a lecture/discussion area and laboratory for the course General Physics in Daily Life. As with the new classrooms, we asked faculty members to rate the new lab in which they most recently had taught. Table 5 shows the ratings of all new teaching laboratories combined, excluding Haberlin 225. The ratings are very positive on every criterion. Averaged across all items, 90 percent of instructors rated the new labs as “good” or “excellent”; and, as shown in Figure 3, 80 percent rated the lab’s “overall quality as a teaching environment” as “excellent.”

Figure 3. Faculty Ratings of All New Teaching Labs (N=15) and New Chemistry Teaching Labs (N=11).

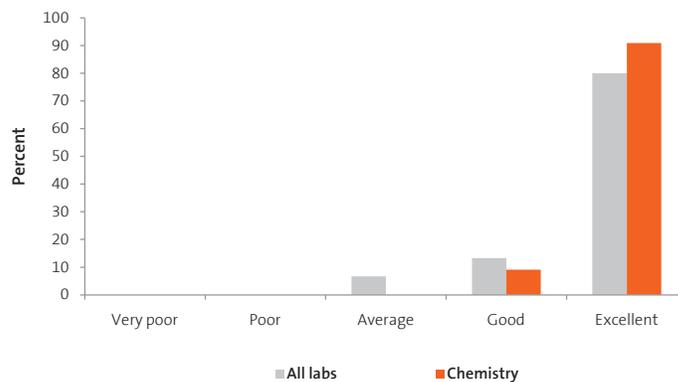


Table 5. Faculty Ratings of New Teaching Labs Combined in Percents (N=15)

Criterion	Very poor	Poor	Average	Good	Excellent	Mean	S.D.
Accessibility of laboratory instruments	0.0	0.0	0.0	40.0	60.0	4.60	.507
Safety of working environment	0.0	0.0	0.0	13.3	86.7	4.87	.352
Flexibility in accommodating different teaching strategies	0.0	0.0	13.3	40.0	46.7	4.33	.724
Ease of sharing lab space with other instructors/courses	0.0	0.0	33.3	25.0	41.7	4.08	.900
Ease with which students can perform assigned tasks	0.0	6.7	0.0	26.7	66.7	4.53	.834
Size or spaciousness	0.0	0.0	6.7	6.7	86.7	4.80	.561
Quality of lighting	0.0	0.0	6.7	20.0	73.3	4.67	.617
Quality of acoustics	0.0	0.0	6.7	13.3	80.0	4.73	.594
Overall quality as a teaching environment	0.0	0.0	6.7	13.3	80.0	4.73	.594
Average	0.0	0.7	8.2	22.0	69.1	4.59	.638

Only one or two physics instructors had taught in each of the new labs, whereas up to six different chemistry instructors had taught in one of the new chemistry labs. Therefore, in Table 6 we present the ratings across the three new chemistry labs. As the table shows, chemists gave very high ratings. On four dimensions—safety of working environment, size or spaciousness, quality of lighting, and quality of acoustics—100 percent rated the new lab as “excellent”; and over 90 percent rated the “overall quality” of the laboratory as “excellent.”

Twelve of the 15 instructors who taught in one of the new laboratories also taught in Haberlin prior to its renovation. One half of this group reported that they had changed their pedagogy as a direct result of the move. Three instructors indicated that they had introduced new laboratory exercises or assignments within an existing course. Three others indicated that they had changed the way they conducted the laboratory, such as by allowing students help themselves to instruments and supplies and having more space to demonstrate the use of instruments. One person believed that he could now run experiments more safely.



Table 6. Faculty Ratings of New Chemistry Teaching Labs in Percents (N=11)

Criterion	Very poor	Poor	Average	Good	Excellent	Mean	S.D.
Accessibility of laboratory instruments	0.0	0.0	0.0	18.2	81.8	4.82	.405
Safety of working environment	0.0	0.0	0.0	0.0	100.0	5.00	.000
Flexibility in accommodating different teaching strategies	0.0	0.0	9.1	36.4	54.5	4.45	.688
Ease of sharing lab space with other instructors/courses	0.0	0.0	22.2	22.2	55.6	4.33	.866
Ease with which students can perform assigned tasks	0.0	0.0	0.0	18.2	81.8	4.82	.405
Size or spaciousness	0.0	0.0	0.0	0.0	100.0	5.00	.000
Quality of lighting	0.0	0.0	0.0	0.0	100.0	5.00	.000
Quality of acoustics	0.0	0.0	0.0	0.0	100.0	5.00	.000
Overall quality as a teaching environment	0.0	0.0	0.0	9.1	90.9	4.91	.302
Average	0.0	0.0	3.5	11.6	85.0	4.81	.296

Goal 3. Advance faculty research.

- *Do the laboratories enhance scientists' ability to conduct research?*
- *Have the new laboratories increased scientists' level of productivity?*
- *Are faculty members more likely to become involved in collaborative research?*

Twelve faculty members—nine chemists and three physicists—currently have research laboratories in the ISC. These researchers reported that they had spent from 10 to 26 months in their new labs. All but one had students working in the lab. During the academic year, faculty members were in their research labs anywhere from 2 to 15 hours a week; during the summer, when classes were not in session, number of hours in the lab ranged from 8 to 45 a week, with a median of 30.

Table 7 reports ratings of the research laboratories on several criteria. As the table shows, these ratings are uniformly positive. Of 108 ratings (12 instructors X 9 criteria), only two—both “average”—are less than “good” or “excellent.” Every faculty member rated the labs as “excellent” on three criteria: “safety of working environment,” “ease with which students can perform

assigned tasks,” and, most importantly, “overall capability of supporting a research program.” At least three quarters of the researchers rated the lab as “excellent” on every other criterion except “environmental control.”



Table 7. Faculty Ratings of Research Labs Combined in Percents (N=12)

Criterion	Very poor	Poor	Average	Good	Excellent	Mean	S.D.
Accessibility of laboratory instruments	0.0	0.0	0.0	16.7	83.3	4.83	.389
Safety of working environment	0.0	0.0	0.0	0.0	100.0	5.00	.000
Environmental control	0.0	0.0	8.3	33.3	58.3	4.50	.674
Ease of sharing lab space with other researchers	0.0	0.0	0.0	25.0	75.0	4.75	.452
Ease with which students can perform assigned tasks	0.0	0.0	0.0	0.0	100.0	5.00	.000
Size or spaciousness	0.0	0.0	0.0	25.0	75.0	4.75	.452
Quality of lighting	0.0	0.0	0.0	25.0	75.0	4.75	.452
Quality of acoustics	0.0	0.0	8.3	8.3	83.3	4.75	.622
Overall capability of supporting a research program	0.0	0.0	0.0	0.0	100.0	5.00	.000
Average	0.0	0.0	1.8	14.8	83.3	4.81	.338

Eleven of the 12 faculty members with a research lab in the ISC also had a research lab in Haberlin prior to its renovation. When asked to compare the new lab with the old, this group reported that the new lab had had a positive impact in several ways. As shown in Table 8, everyone agreed or strongly agreed that in the new lab “it is easier to access laboratory instruments” and the “new laboratory is a safer working environment.” Most importantly, as indicators of enhanced productivity, over 60 percent agreed or strongly agreed that “my research output is greater,” and over 90 percent agreed or strongly agreed with these statements: “I can carry out research more quickly and efficiently” and “My new lab has given me renewed optimism about my research.” Finally, over 80 percent found it easier to collaborate with other faculty.

Goal 4. Create a safe environment

- *Do users perceive the Integrated Science Complex and science laboratories to be safe places to study and work?*

As reported above, 86.7 percent of lab instructors, including 100 percent of those in chemistry, rated the safety of the teaching laboratories as “excellent,” and 100 percent of the faculty rated the safety of their research laboratories as “excellent.” We also asked students who had taken a laboratory course to tell us whether they were ever concerned about their safety while working in the lab. Nearly all (98.1%) of the 161 students who had taken a lab course reported that they were “never” concerned; three students, all reporting on the organic chemistry lab, said that they were “sometimes” concerned.

Students also indicated that safety was one of the criteria that made the ISC an attractive place to study. Among 268 respondents, 85 percent indicated that it was “moderately,” “very,” or “extremely important” to them that the ISC was a “safe place to be.”

Table 8. Faculty Comparison of New Research Labs with Old Research Labs in Percents (N=11)

Criterion	Disagree strongly	Disagree	Neither	Agree	Agree Strongly	Mean	S.D.
It is easier to access laboratory instruments	0.0	0.0	0.0	72.7	27.3	4.27	.467
New laboratory is a safer working environment	0.0	0.0	0.0	45.5	54.5	4.55	.522
It is easier to share lab space with others	0.0	0.0	27.3	45.5	27.3	4.00	.775
It is easier to collaborate with other faculty	0.0	0.0	18.2	45.5	36.4	4.18	.751
I have more options in designing research	0.0	0.0	36.4	54.5	9.1	3.73	.647
Greater environmental control has increased reproducibility of experiments	0.0	0.0	18.2	27.3	54.5	4.36	.809
I carry out research more quickly and efficiently	9.1	0.0	9.1	54.5	27.3	3.91	1.136
My research output is greater	9.1	0.0	27.3	54.5	9.1	3.55	1.036
I have pursued new lines of research	9.1	18.2	63.6	9.1	0.0	2.73	.786
Students are better able to perform research tasks	0.0	0.0	18.2	54.5	27.3	4.09	.701
My new lab has given me renewed optimism about my research	0.0	0.0	9.1	63.6	27.3	4.18	.603
Average	2.5	1.7	20.7	47.9	27.3	3.96	.748

Goal 5. Create a welcoming place to congregate, study, and learn

- How heavily used is the Integrated Science Complex?
- Why do students choose to come to the Integrated Science Complex?
- Do users perceive the Integrated Science Complex and spaces within it as attractive places to meet, study, and work?

As part of the construction and renovation, the atrium connecting Haberlin to Swords Hall was redesigned. Numerous study spaces were added on each level; a café replaced a small food kiosk; and extensive glass and improved lighting created a sense of openness. Although no systematic data exist on the use of the old Swords atrium, considerable anecdotal evidence suggests that both student and faculty use of this area has increased dramatically. One faculty member commented, for example, that the “many open areas and [café] have brought many more students to the complex to study and to socialize. The building is alive with people compared to how it was before the new complex was built.”

Data from the post-occupancy surveys show that the ISC is heavily used. Nearly 90 percent of student respondents reported that they had been in the ISC more than 20 times since coming to Holy Cross; and during the current semester, over half of these students reported entering the Complex every day or almost every day of the week. While the majority of these daily visitors were science majors, more than half of the non-science majors reported visiting the Complex at least 2 – 3 times a week.



Students go to the ISC for many reasons. Table 9 and Figure 4 show the percentage of students who reported going to the ISC for nine different purposes. To estimate percentages for all currently enrolled students, we calculated a weighted average that adjusts for the oversampling of science majors.

Four purposes demand that students come to the building to accomplish a specific task: attend class, conduct independent research, meet with a faculty member outside class, and perform a work/study job. For all other purposes, with the possible exception of using the science library, students choose to come to the ISC rather than some other place on campus. Thus, almost two-thirds (64.2%) of Holy Cross students who frequent the ISC use it as a place to study alone, 43.8 percent use it to study or work with other students, 29.7 percent hang out there with others, and 78.0 percent go there to get something to eat or drink. An estimated 64.6 percent of all students described the ISC as either “a good place to study” (32.9%) or one of their “favorite places to study” (31.7%); and a third reported studying in the ISC at least 2 – 3 times a week. Sizeable percentages of students also described the ISC as either “a good place to meet” (39.2%) or one of their “favorite places to meet others” (22.9%).

Figure 4. Why Students Go to the Integrated Science Complex in Percents (N=306)

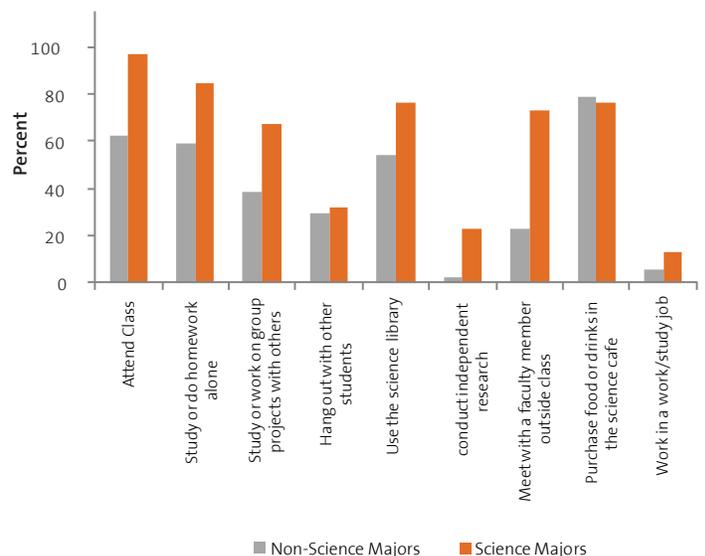


Table 9. Why Students Go to the Integrated Science Complex in Percents (N=306)

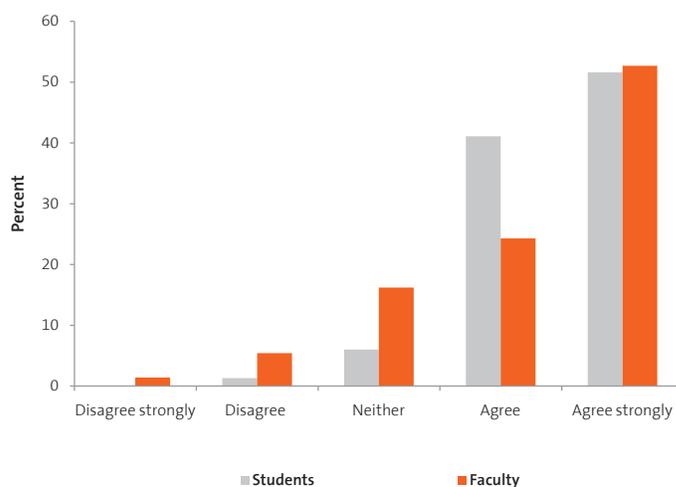
Purpose	Non-Science Majors	Science Majors	Weighted Average
Attend class	61.9	97.1	68.9
Study or do homework alone	59.0	84.8	64.2
Study or work on group projects with others	38.1	67.3	43.8
Hang out with other students	29.1	32.2	29.7
Use the science library	53.7	76.6	58.2
Conduct independent research	2.2	22.8	6.0
Meet with a faculty member outside class	22.4	73.1	32.4
Purchase food or drinks in the Science café	78.4	76.6	78.0
Work in a work/study job	5.2	12.9	6.7

Responses to other questions confirmed that students and faculty find the ISC a welcoming place to study, learn, and work. Over 90 percent of student respondents—and an estimated 86 percent of Holy Cross students—“agreed” or “agreed strongly” with the statement “The Integrated Science Complex is a comfortable place to study and learn.” Similarly, three-quarters of faculty respondents “agreed” or “agreed strongly” with the statement “The Integrated Science Complex is a comfortable place to work.” (See Figure 5.) Further indicative of the ISC’s attraction, students have clamored to have it open for longer hours. Indeed, when we asked respondents to give us their suggestions for improving the Complex, the most frequent responses were to keep the Café open later, to add more study or work spaces, and to keep the Complex open later. In other words, students wanted greater access to the ISC and they wanted more of what it provided. Given the multiplicity of common areas in the ISC, we were interested in where students tend to go. Table 10 shows the general areas where students reported that they most often study and meet with others. Students most often chose the science library as a place to study and the Science café tables as a place to meet others; however, they also chose many other

areas throughout the Complex, on every level of the atrium and elsewhere.

The data clearly show that students are drawn to the ISC. To find out what draws them, we asked students to rate the importance of several features “in making the ISC an attractive place to study” and “meet with other students.”

Figure 5. Agreement with the Statement "The ISC Is a Comfortable Place to Work" (Faculty; N=74) and "The ISC Is a Comfortable Place to Study and Learn" (Students; N=316).



As Tables 11 and 12 show, most students deemed every aspect of the ISC at least “moderately important” in attracting them. The ISC’s most important aspects as a place of study were its lighting and proximity to classes and that it is generally quiet. Making it appealing as a place to meet others were the availability of tables and chairs, location, and proximity to class. In open-ended comments, such as the following, students also referred repeatedly to the number and variety of public spaces:

“I love the amount of space there is to do work and to meet with other students. It allows for a space in which people can both work together when called for, as well as a quiet space to get work done alone.”

“I like all of the different studying spaces most of all. I like the nooks, study areas, and classrooms.”

“The Integrated Science Complex is by far my favorite building on campus. It has so many different areas to meet with other students and to work independently on homework and other projects.”

Table 10. Where Students Most Often Study (N=305) and Meet Others in the ISC (N=261) in Percents

Location	Study	Meet others
Science library	60.7	42.5
Science Café tables/chairs	40.3	67.4
Swords Atrium Level 1 chairs next to library	16.1	18.0
Swords Atrium Level 2 tables/chairs	30.8	23.8
Swords Atrium Level 3 tables/chairs	16.7	10.3
Math/CS student common room	18.7	16.5
Chemistry pre-lab room	10.8	12.6
Chemistry write-up area	3.6	4.6
Physics student tutorial/workshop room	3.9	2.3
Some other area	29.5	28.7

Table 11. Importance of Various Features in Making the Integrated Science Complex an Attractive Place to Study in Percents (N=268)

Feature	Not at all Import	Slightly Import	Moderately Import	Very Import	Extremely Import	Mean	S.D.
Availability of food and drinks in Science Café	6.3	11.6	25.4	29.1	27.6	3.60	1.19
Convenient place to be before and after class	1.9	3.4	15.7	42.7	36.3	4.08	.906
Comfortable furniture in public spaces	1.5	5.2	22.8	38.1	32.5	3.95	.947
Good lighting	0.0	2.2	17.9	38.8	41.0	4.19	.804
Generally quiet	1.1	5.2	21.2	37.2	35.3	4.00	.936
Safe place to be	6.3	9.0	16.8	33.6	34.3	3.81	1.19
Pleasant décor	4.1	14.9	31.6	29.7	19.7	3.46	1.09
Openness and spaciousness of public spaces	2.2	8.2	27.5	36.1	26.0	3.75	1.00
Many friends go there	13.4	20.8	32.0	21.2	12.6	2.99	1.21
Average	4.1	8.9	23.4	34.1	29.5	3.76	1.03

Table 12. Importance of Various Features in Making the Integrated Science Complex an Attractive Place to Meet with Other Students in Percents (N=268)

Feature	Not at all Import	Slightly Import	Moderately Import	Very Import	Extremely Import	Mean	S.D.
Availability of food and drinks in Science Café	6.5	10.8	27.7	21.9	33.1	3.64	1.23
Comfortable furniture in public spaces	0.8	5.8	20.5	38.4	34.5	4.00	.925
Good lighting	1.2	10.1	19.4	38.8	30.6	3.88	.998
Availability of tables and chairs	0.0	1.5	12.0	38.6	47.9	4.33	.745
Convenient location	1.6	8.1	19.8	36.8	33.7	3.93	1.00
Close to classes and labs	2.7	8.9	16.6	37.1	34.7	3.92	1.05
Availability of enclosed study rooms to meet	3.9	12.4	22.1	28.7	32.9	3.74	1.16
Average	2.4	8.2	19.7	34.3	35.3	3.92	1.01

Also shedding light on what makes the ISC attractive to students and faculty are responses to the open-ended question: What do you like best about the Integrated Science Complex? As shown in Tables 13 and 14, faculty and student answers overlap a fair amount; both mention the Science Café most frequently; both tend to find it aesthetically pleasing; and both also tend to like its spaciousness and lighting.

Table 13. What the Faculty Like Best about the Integrated Science Complex (N=58)

Feature	N	Percent of responses	Percent of cases
Science café	16	15.0	27.6
Spaciousness/openness	13	12.1	22.4
Lighting	10	9.3	17.2
Atrium/public space	8	7.5	13.8
Aesthetically pleasing	8	7.5	13.8
Science laboratories	7	7.5	12.1
Classrooms	7	6.5	12.1
Draws students	7	6.5	12.1
Welcoming environment	5	4.7	8.6
Plethora of study spaces	4	3.7	6.9
Offices	4	3.7	6.9
Glass walls	3	2.8	5.2
Clean	3	2.8	5.2
Eco-friendly	2	1.9	3.4
Other	10	9.3	17.2
Total	107	100.0	184.5

As noted above, many student respondents also liked the numerous places to study in the Complex; similarly, looking at it from a different perspective, several faculty members reported that they liked the atrium or public space best. “The atrium and new dining area are very appealing places to spend time,” one faculty member stated. “[The atrium is] much improved visually and as a social space,” stated another.

Table 14. What Students Like Best about the Integrated Science Complex (N=218)

Feature	N	Percent of responses	Percent of cases
Science café	64	16.4	29.4
Numerous places to study	44	11.3	20.2
Aesthetically pleasing	33	8.5	15.1
Spaciousness/openness	31	7.9	14.2
Newness of building	31	7.9	14.2
Comfortable/inviting	28	7.2	12.8
Lighting/brightness	18	4.6	8.3
Classrooms	16	4.1	7.3
All-inclusive	15	3.8	6.9
Science library	14	3.6	6.4
Laboratories	13	3.3	6.0
Clean	12	3.1	5.5
Quiet	12	3.1	5.5
Location	7	1.8	3.2
Eco-friendly	7	1.8	3.2
Makes a favorable impression	7	1.8	3.2
Design/layout	5	1.3	2.3
Specific feature (e.g., waterfall)	14	3.6	6.4
Other	19	4.9	8.7
	390	100.0	100.0

Goal 6. Promote interaction among students and faculty.

- *Do the public areas in the Integrated Science Complex facilitate interactions among students?*
- *How often do students use public areas in the Integrated Science Complex as learning spaces?*
- *Do the public areas in the Integrated Science Complex facilitate interactions among the faculty?*
- *How often do faculty members interact with colleagues?*
- *How often do faculty members meet with students outside their office, classroom or laboratory?*

The only valid means of estimating the impact of the ISC on student and faculty interaction is to compare interactions before and after its construction. Short of that, we asked faculty respondents the extent to which they agreed that “public areas in the Integrated Science Complex make it easy to socialize with colleagues” and “easy to socialize with students.” Over 60 percent of respondents “agreed” or “agreed strongly” with both statements; very few disagreed.

We further found that faculty respondents often use these public spaces to meet others. A majority reported meeting students in the ISC outside their office, classroom, or laboratory; about one-third did this at least a few times each semester. In addition, over 80 percent reported interacting with a faculty colleague from another department. Not surprisingly, the closer a faculty member’s office was to the center of the Complex, the more often he or she met others, especially students. Thus, 78 percent of chemists and physicists, as compared with 57 percent of mathematicians, biologists, and psychologists and 35 percent of faculty members from other departments, reported that they had interacted with students in public spaces in the ISC.

The most popular meeting place was the Science Café. Faculty members tended to meet colleagues either there or in the Swords Faculty Lounge. Meetings with students, however, were more dispersed, occurring at every level of the Swords atrium in numerous locations. To determine the extent to which faculty interactions went beyond mundane greetings and exchanges, we asked faculty members how often their conversations with colleagues in the ISC were about research, teaching, or some other scholarly subject. Over 90 percent reported that this occurred at least once or twice, and almost 40 percent reported that it happened a few times a month or more.

In addition, we asked students how often they meet other

students and what they do when they get together in the Complex. As reported earlier, an estimated 60+ percent of Holy Cross students consider the ISC to be a good place or their favorite place on campus to get together with other students.

We asked students who reported that they had met others in the ISC how often they engaged in several activities. Adjusting for the oversampling of science majors, Table 15 presents frequency estimates for all Holy Cross students on campus in the spring semester. When getting together with others in the ISC, students are most likely to study independently and get a drink or something to eat. But an estimated 50 percent of Holy Cross students study or work on problems together in the ISC; over 40 percent spend at least some of the time working on group projects for class; and over a third discuss ideas from class. In short, a good deal of learning takes place in the ISC as students meet informally outside the classroom. Furthermore, students acknowledged this in their comments about what they liked best about the ISC, describing it as “a great environment to study and learn in,” “a good environment for learning,” and “a quiet, open space that is generally conducive to learning.”

Although we cannot say whether informal interactions were more likely to occur as a result of the increase in common areas throughout the atrium and adjacent buildings, the data show that students and faculty are making extensive use of these areas to meet others.

Table 15. Estimated Frequency of Students Engaging in Various Co-Acting or Group Activities in the ISC in Percents (N=261)

Activity	Never	Rarely	Some of the time	Most of the time	Always
Work on group project for a class	41.2	17.3	26.0	10.8	4.7
Study or work on problems together	38.3	10.1	26.0	19.6	6.0
Study on your own	36.6	6.6	16.5	28.3	12.0
Discuss ideas from class	43.3	21.6	22.4	9.6	3.1
Just hang out	43.1	14.6	21.3	13.9	7.2
Get a drink or something to eat	36.4	11.9	19.3	18.4	14.0

Goal 7. Enhance students' interest in and attitude toward science.

- *Do students have a more favorable attitude toward science?*
- *Does the visibility of laboratories and scientific instruments pique students' interest in science?*

Without knowing student attitudes toward science prior to construction, we cannot know for sure how much the ISC has affected those attitudes. We do know that the vast majority of students, including non-science majors, find the ISC a comfortable place to study and learn. And while there, they can see science in action as they peer into the many glass-walled laboratories. To get some sense of how much the ISC kindles students' interest in science, we asked respondents how much they agreed with two statements: "Seeing students working in the science labs arouses my interest in science"; "Being in the Integrated Science Complex inspires me to learn more about science." About half of the respondents "agreed" or "agreed strongly" with each of these statements; most of the remaining students were neutral, and very few disagreed. One student commented, "The high quality of the building really motivates me to pursue my interest in science." Another stated, "Everything about it truly inspires me."

Such views are likely to be tempered by pre-existing attitudes toward science. To get a sense of how attitudes affect the impact of the ISC, we created an "attitude toward science" index by summing responses to three items, to which respondents indicated their level of agreement: "I enjoy taking science courses"; "Science is boring"; and "I am not very interested in science." As expected, science majors and those with more positive attitudes toward science were much more likely to report that the labs aroused their interest in and the building inspired them to learn more about science. Yet, perhaps indicative of the building's effect, between 30 and 40 percent of non-science majors also were aroused or inspired.

The physical environment, especially the glass-walled laboratories (and classrooms), also positively affect faculty. Similar to piquing students' interest in science, the majority of faculty respondents agreed or agreed strongly that "glass walls in the ISC create a stimulating place to work."

General Impressions

Beyond survey items that addressed specific goals and questions, we included a few items that measured general impressions of the Integrated Science Complex. Thus, we asked faculty

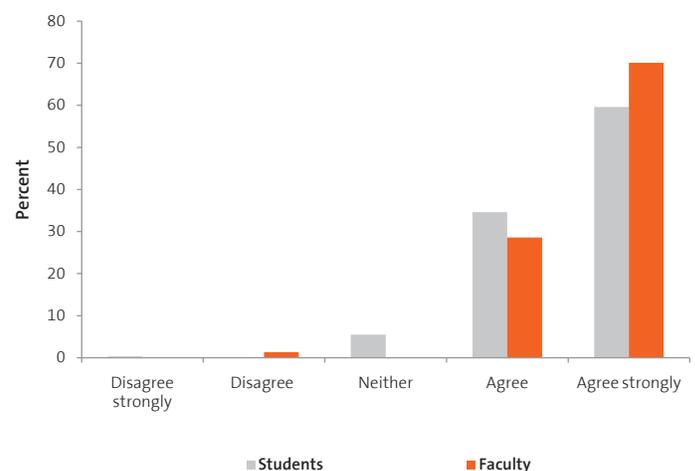
respondents, "How satisfied are you with the new Integrated Science Complex overall?" Nearly 80 percent reported that they were either "very" or "extremely satisfied"; 95 percent reported that they were at least "moderately satisfied." As Figure 6 further shows, 99 percent of the faculty respondents and 94 percent of the students agreed or agreed strongly with the following statement: "The Integrated Science Complex projects a favorable image of Holy Cross." In a similar vein, the ISC evoked a sense of pride in many students, who commented:

"I love showing off the science building on tours or when my friends come to visit. It makes me feel like I am really at a top institution."

"It always makes me very proud to be a science major knowing how beautiful our science complex is."

"I absolutely love the new Integrated Science Complex. I am always so proud of it when I see tour groups coming through."

Figure 6. Faculty (N=77) and Student (N=327) Agreement with the Statement "The ISC Projects a Favorable Image of Holy Cross."



Suggestions for Improvement

When we asked, “What suggestions do you have for improving the Integrated Science Complex?” we got divergent responses from students and faculty. As shown in Table 16, students’ suggestions centered on extending the ISC’s resources for studying and meeting others. Given the long hours they spend in the Complex, students want to be able to get food and drinks at any time. And because the café closes at 2:00 p.m., over 40 percent of respondents suggested that the College extend its hours. Students also wanted the Complex as a whole, the science library, and classrooms to be open later. Currently, classrooms are locked around 6 p.m., and the Complex, including the science library, closes at midnight. Several students wished that the Complex “could stay open all night” or “24/5 like Dinand [the main library].”

Table 16. Student Suggestions for Improving the Integrated Science Complex (N=167)

Suggestion	N	Percent of responses	Percent of cases
Keep café open later	73	34.8	43.7
Add more study/work spaces	21	10.0	12.6
Keep complex open later	19	9.0	11.4
Expand/improve café menu	14	6.7	8.4
Expand science library	8	3.8	4.8
Reduce café food prices	7	3.3	4.2
Improve navigation within complex	7	3.3	4.2
Add computers	6	2.9	3.6
Provide better temperature control	6	2.9	3.6
Keep science library open later	5	2.4	3.0
Provide better/newer furniture	3	1.4	1.8
Keep classrooms open at night	3	1.4	1.8
Other	38	18.1	22.8
Total	210	100.0	100.0

Other suggestions for enhancing resources included adding spaces to study and work in groups, and providing additional computers. “More study areas” were needed, students explained, because “some days it’s really difficult finding an open seating area” and “it gets to be quite crowded.”

Table 17 summarizes suggestions for improvement made by faculty respondents. The most frequent suggestion was to improve ventilation to eliminate odors from the Science Café. For some faculty, this was a major problem, which they described as “unbearable,” “a daily annoyance,” and “disgusting.” One person explained, “Anybody who cooks knows that non-vented hoods do not work—never have and probably never will. The smell of burnt oil from the panini machines and other aromas is disgusting at best and it results in a poor work environment.”

Besides the ventilation problem, faculty members most often offered suggestions regarding the classrooms. Several persons wanted a table placed in the front of the lecture halls where students could hand in work and instructors could place class notes. As one person explained, “the podiums are a bit big and bulky and don’t allow for spreading out notes when teaching.” “Swords 321 has a terrible teacher station,” stated another, “that doesn’t provide the instructor with sufficient space to put out

Table 17. Faculty Suggestions for Improving the Integrated Science Complex (N=36)

Suggestion	N	Percent of responses	Percent of cases
Improve building ventilation	9	18.4	25.0
Add instructor tables in classrooms	5	10.2	13.9
Improve navigation within building	5	10.2	13.9
Provide better access to Beaven Hall	4	8.2	11.1
Improve temperature control	3	6.1	8.3
Address classroom AV problems	2	4.1	5.6
Address problems with Haberlin 136	2	4.1	5.6
Increase classroom seating capacity	2	4.1	5.6
Other	17	34.7	47.2
Total	49	100.0	100.0

papers or notes.” Other faculty members mentioned classroom audio-visual problems, sightline issues in Haberlin 136, and the need to place chalk reservoirs in classrooms. Two persons lamented the loss of the large lecture hall as a result of the Haberlin renovation.

Finally, three other suggestions were made by more than one faculty member. First, five faculty members mentioned the difficulty in navigating the Complex. As one person described, the new layout, especially “the lack of a bridge across the atrium,” “makes getting around the place unnecessarily convoluted.” Another noted, “lost visitors and students stop at my door frequently to ask how to get [from one floor to the next] . . . Perhaps some signage would help.” Second, four faculty members recommended, if possible, that the College devise some “way to better integrate and connect Beaven with the complex.” One person wanted the doors that lead to Beaven Hall on the first and fourth floors to remain open. “Currently,” he said, “it is like going through a series of airlocks to get to and from Beaven.” Another person offered a more elaborate analysis:

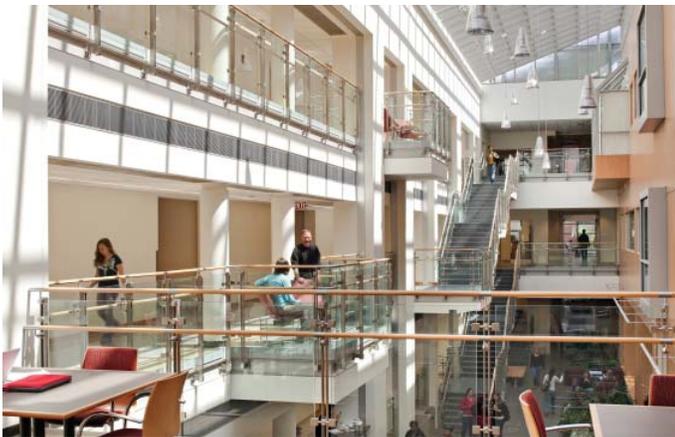
“The spaces where the Science Complex connects to Beaven could benefit from a little more attention. Both connection points have multiple doors very close to each other. To the extent possible, it would be nice to open that space up a little more to facilitate an easier flow between the buildings. The area space just outside the door to Beaven has promising . . . places that students could use as social/study space, but it would help to make it more inviting.”

Third, three faculty members mentioned a problem of temperature control; two complained about cold offices and the third claimed, “some rooms in Swords are over 100 degrees in April.” It is worth noting that a half dozen student respondents also noted this problem, with some reporting that it was too cold and others that it was too warm.

Conclusions

Findings from post-occupancy surveys at the College of the Holy Cross indicate that the new Integrated Science Complex has had a very positive impact on students and faculty. For students, the ISC is a hub of activity; almost two-thirds of the student body use it as a place of study, and many students go there to study or work with others, or just hang out and get something to eat or drink in the café. Indeed, students find the ISC so attractive that they want it to be open later and they want more study areas. Although no comparable, pre-occupancy data exist on the renovated building and atrium, anecdotal information strongly indicates that the new construction has transformed this space, creating a campus center of learning for what was formerly a nearly vacant space.

Likewise for faculty, especially those with offices nearby, the new ISC has become a welcoming place to meet students and colleagues. As important, new classrooms and teaching laboratories have enriched the teaching environment; and, based on comparisons with the old laboratories, new research laboratories have created safer working environments, enhanced productivity, and renewed faculty optimism about their research. Faculty members tend to be very satisfied with the Complex. Further, both faculty and students almost unanimously agree that the ISC projects a favorable image of Holy Cross.



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