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# Pedagogical Reform Drives Phased Addition-Renovation at Grinnell College

*Schematic Planning Facilitates Teaching Methods of Today and Tomorrow*

Providing an educational environment that encourages students to study science at Grinnell College is part of an entrepreneurial vision that began in 1988 with comprehensive plans to upgrade the Robert N. Noyce ’49 Science Center. The addition-renovation project, which was completed in two phases, was driven by changes in teaching pedagogy and a need to provide additional space to accommodate a growing number of programs, students, and faculty members. The private liberal arts college in Iowa is home to 1,600 students with a faculty of 165.

The original science center, constructed in the early 1950s with an addition in 1964, was a two-story building that consisted of three wings to house the biology, chemistry, and physics programs, as well as a modest science library. In 1987, a fourth wing was added for computer science, mathematics, and psychology in an attempt to bring all of the science disciplines together in one complex.

“The 1964 wing was not a prime example of wonderful architecture on the campus,” says Jim Swartz, professor of chemistry who previously served as dean and vice president of academic affairs at the College. “It was built with almost no windows and gave the appearance that entering the science building meant walking through a black hole into an abyss. That’s not the message we want to send to our students.”

Although students are not required to take science courses in order to graduate, the College places great importance on the value of all science disciplines. More than 30 percent of the students attending Grinnell major in science and nearly all of the students take at least two science courses before graduating. The desire to encourage students to study science was a significant influence on the decision to modernize the Noyce Science Center.

“The buildings from the 1950s and 1960s did not anticipate modern scientific instrumentation and, as we acquired instruments and new technology, it tended to go into closets and places that did not have the utilities to support it,” notes Swartz. “The original wings also did not have the kind of spaces that supported and celebrated student-faculty research. The tiered classrooms with tablet-arm chairs did not facilitate or encourage students to actively engage in science. These were the type of problems we wanted to resolve with the phased project.”

## Project Goals

The College had undergone significant curricular and pedagogical reform in the years leading up to the renovation of the science center. The reform was motivated by a desire to more actively engage students in the learning process and to encourage them to think and work like scientists. The classrooms in the original building were not amenable to this type of teaching.

"We had introduced a workshop format where the class and laboratory were merged together and much of the learning occurred in an active environment, in a space without much lecture, but we didn't have spaces to support this kind of teaching," explains Swartz. "Research projects became a central feature of this active learning environment, and our laboratory spaces could not accommodate these projects. In the summer, we typically have about 70 students working in collaboration with faculty members on research. We had to squeeze them into a variety of different spaces, most of which were not designed for student-faculty research."

It became clear in 1988 that a comprehensive upgrade of the science facilities was necessary to keep pace with the new teaching methods that feature more active learning in introductory science and mathematics courses, a workshop format, and more student-faculty research projects.

The goals for the renovation were to create a facility that attracts students to the study of science; create comfortable spaces that facilitate active engagement in the study of science; promote working like a scientist from the very first courses through the senior year; and create a community of active learners.

It quickly became evident that building the type of science complex to achieve all of the project goals would be a costly venture. In fact, when planning started two decades ago, the College's needs far exceeded the available funding and, therefore, a decision was made to break the project in two phases.

"We weren't thrilled about doing the project in two phases, but in hindsight, it was a very good idea because we learned a bunch of wonderful things in the first phase that we were able to improve upon in the second phase," says Swartz.

The first phase involved the renovation of the two older wings of the Noyce Science Center and the construction of a modest addition to these wings. The second phase included the demolition of a third older wing, the renovation of the fourth wing that was originally built in the mid-1980s, and the construction of a large addition. Ultimately, the additions have wrapped around the original wings, unifying them into a rational complex.

Planning for both phases meant taking into account the constraints of the building site, which is located near a major roadway, a railroad track, and the central chilling plant for the campus. The planning also had to ensure that the first phase renovations could function independently of whatever was planned for the second phase since it was not known when the funding would be available to complete the second part of the improvements.

**Phase One Renovation**

The first phase of the capital project, completed in 1997 at a cost of $15.3 million, included improvements relevant to the biology, chemistry, and physics departments, as well as the science library. Specifically, it included a 45,000-gsf addition that wrapped around the south and west sides of the existing structure and the renovation of 60,000 gsf of the science center, most of which was converted to laboratory space.

The laboratories were housed in the renovated space, while the classrooms and offices were placed in the new addition. Although the lack of swing space and the 12-foot floor-to-floor height created design challenges, the completed project effectively fulfilled the project goals. Special attention was paid to creating community building spaces both within the confines of particular rooms and in open spaces. Tiered classrooms with two tables per tier and movable chairs support group work and can accommodate between 50 and 90 students. A courtyard, clerestories, and plenty of natural light provide an inviting, comfortable setting for students, faculty members, and visitors.

“We tried to create laboratory spaces that bring light in and encourage students to interact with one another,” says Swartz. “Two students can work together at the eight-foot fume hoods. We have tables and chairs in the labs to encourage them to work like scientists, and to be engaged.”

A glass-walled connector between the classrooms is also an ideal area for interaction. The flexible space includes tables, chairs, blackboards, and areas where students can display their projects or hold social functions. The connector has attracted students who would not otherwise visit the science center and the College has noticed an increase in enrollment, particularly among women and students of color, groups which have been under-represented in the sciences.

The interior courtyard also facilitates interaction and supports educational and social functions. The clerestory brings natural light into all areas of the building and the addition of windows, where there were previously none in the 1964 wing, gives the center a feeling of openness and offers a view inside the laboratories.

Students and faculty were pleased with the first phase improvements, which resulted in students working together at all hours. The laboratories worked well from both a technical and a pedagogical standpoint, and the classrooms achieved the results the College had intended.

However, there were lessons learned from the initial improvements that the College was able to use when it began the second phase of construction. For instance, some of the laboratories were more noisy and harder to teach in than anticipated; changes in class size made large classrooms less valuable; changes in newer technology created the need for more improvements; and changes in faculty over the past decade resulted in different facility needs. All of these lessons and concerns were addressed in the second phase, which was completed in 2008.

**Learning from Phase One**

During the $45.3-million second phase, a large three-story addition replaced one of the older wings. Spaces to support chemistry, biology, and physics were added contiguous to those created in the first phase, while renovated or new spaces were constructed for computer science, mathematics, and psychology programs. The second phase included more than 100,000 gsf of new construction and 53,000 gsf of renovated space.

Departmental spaces were interwoven to create a science center that supports interdisciplinary learning. The classrooms added in this phase are smaller, geared toward 20 to 36 students, and they have movable tables and chairs to accommodate multiple, ever-changing pedagogies. Many of the classrooms are situated next to teaching laboratories to further embrace the workshop-style teaching, where there is no formal distinction between lecture and laboratory. In the introductory biology classrooms, the acoustics are better and fewer visual obstructions in the lab permit students to interact to a higher degree.

A central feature of the addition is the new science library, designed to be adaptable to the changes in collection growth and electronic usage.

“One of the challenges we faced is that we didn’t have a crystal ball to show us what a science library will be like in the next 35 years,” says Swartz. “Therefore, we used a scenario planning approach based on the expected rate of growth of the periodical collection.”

In order to accommodate future needs of the library, a flexible design was used. The floor loading capacity is designed to allow for additional compact shelving if the collection growth requires it. The design also anticipates the installation of necessary wiring for additional workstations, which may be needed if the collection growth turns sharply to electronic media.

While trying to include flexibility into the second phase, planners also paid close attention to sustainability. For example, a heat recovery system is now used to decrease energy costs, native plants are used in the courtyard to minimize maintenance, and drainage water is used for the greenhouse. Recycled materials were also used, whenever possible, in the construction and renovation.

“We constantly reminded ourselves that we were constructing something for the future and we were always thinking about what the College’s needs might be in 25 years,” says Swartz. “With that in mind, we designed a science center that is flexible, adaptable, and sustainable. During the process, some faculty members retired and were replaced by others with different teaching and research requirements that we needed to accommodate. What is most impressive, however, is that essentially all faculty members, both old and new, have become enthusiastic reformers really transforming the educational experiences for our students.”

**Biography**: **Jim E. Swartz** is a professor of chemistry at Grinnell College, where he served as dean and vice president for academic affairs from 1998 through June 2008. As a faculty member, he worked to develop division-wide science efforts to improve introductory courses and to substantially increase the number of participants involved in student-faculty research occurring both during the academic year and during the summer at Grinnell. He directed both phases of the renovation and expansion of the Robert N. Noyce ’49 Science Center, as well as an earlier renovation to the chemistry research areas. Swartz has served as a consultant to approximately 36 colleges and universities in the planning of science facilities and curriculum development; has been a coordinator and presenter at several Project Kaleidoscope facilities workshops; and has co-authored a book on planning undergraduate science facilities. He is the project coordinator for the NSF-funded Project Kaleidoscope Pedagogies of Engagement project and he is the chair of the Iowa Energy Center Advisory Council, as well as a member of the Team Chair Corps of Consultant-Evaluators and the Accreditation Review Council for the Commission on Institutions of Higher Education for the North Central Association of Colleges and Schools. He graduated from Stanislaus State College in California and received his doctorate in chemistry from the University of California at Santa Cruz. After two years of post-doctoral work, he joined the faculty at Grinnell College.

This report is based on a presentation given by Swartz in October at the Tradeline *College & University Science Facilities 2008* conference.

**For more information**

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**Project Team**

Architect: Holabird & Root, Chicago
Construction General Contractor: The Weitz Corp., Des Moines, Iowa
Laboratory Design: Research Facilities Design, San Diego
Library Interior Design: Landon, Bone, Baker, Chicago

**Sustainable Design**: The new addition-renovation at Grinnell College features sustainable design elements. A heat recovery system is used to decrease energy costs, native plants were used in the courtyard to minimize maintenance, and drainage water is used for the greenhouse. (*Photo courtesy of Jim Swartz, Grinnell College*.)

**Workshop Format**: Laboratory spaces include tables and chairs to encourage students to work like scientists, to work together, and to be engaged. (*Photo courtesy Grinnell College, Robert Canfield photographer*.)