Education Trends and Learning Environments
Publisher’s Message

A Global Perspective

In this issue of our Journal, we begin our efforts to aggressively reach out to global markets and educate members about educational facility planning on an international scale. An article on educational facilities in Japan by Prof. Fumihito Miyamoto launches our efforts in this direction.

Our cover story features important research work being done by Heloisa Moura, Dale Fahnstrom and Greg Prygrocki at the Institute of Design in the Illinois Institute of Technology on an interesting topic called Thinkering Spaces. These are interactive environments that seek to encourage school-age children to tinker with things, both physical and virtual, and help us learn about how children reflect on their discoveries.

While the overall theme of this Journal is on education trends and learning environments, we also focus on project-based learning and author Dr. Susan Wolff offers us examples of project-based schools.

Later, we take a close look at job order contracting (JOC). David Carrithers gives us his perspectives on how JOC can foster trust between owners and contractors in the school building industry.

Another interesting article features student centers and how they are adapting to the changing needs of students. Jennifer Cordes provides us a case study of the Tivoli Student Center located at the Auraria Higher Education Center in Denver, Colorado, a prime example of a bustling centerpiece on campus. We also carry key findings of a recent study by Building Educational Success Together (BEST) that analyzed spending on school construction and renovation over a ten-year period (1995-2004).

On a personal note, my term as CEFPI President for 2006-07 has ended. I am gratified that the Council is now an internationally recognized authority on school facilities and I extend my warmest regards and heartfelt thanks to everyone who has helped us attain this stature.

Best Regards,

Roy J. Sprague, AIA, CSI, REFP
President – International Board of Directors
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READER POPULATION
Articles should be written to be appealing and interesting to a diverse population that includes school and college administrators, school board members, school and college faculty members, facility maintenance and operating personnel, architects, engineers, builders and contractors. A straightforward, readable style is encouraged.

FORMAT
Preferred length is 1500-2000 words. All manuscripts and graphics should be submitted electronically. Submit text in MS-Word or rich text format; graphics should be submitted in TIFF format. Files may be sent via email or disk. Please use the Chicago style with appropriate citations to sources referenced in the article.

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Each issue of the PLANNER covers topics of interest to practitioners in the field of educational facility planning. Final selection of articles rests with the editor, the Planner advisory board, and the editorial staff, based on review recommendations. When submitting a manuscript, include a one paragraph abstract, along with the full name, title, address and phone number of the author.

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To access the editorial calendar, please visit:
http://www.cefpi.org/editorial_calendar.html

The EDUCATIONAL FACILITY PLANNER is a quarterly publication of the Council of Educational Facility Planners, International and is written, produced and distributed by CEFPI International Headquarters, 9180 E. Desert Cove Dr. Suite 104, Scottsdale, AZ 85260. Mailed to all members of CEFPI, the Journal is paid for annually as a part of the membership dues. Non-members may subscribe at a rate of: U.S./Domestic, $60 annually for four issues; Canada, $70/Foreign, $85 annually for four issues; $15.00 single issue price.

The EDUCATIONAL FACILITY PLANNER solicits and publishes articles designed to further information about the planning of educational facilities. The opinions expressed in such articles are those of the author and do not necessarily reflect the position of the Council of Educational Facility Planners International, its officers or the membership.

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ThinkeringSpaces: A New Genre of Exploratory Environments for Kids

By Heloisa Moura, Dale Fahnstrom and Greg Prygrocki

This article presents core concepts that ground the development of a new genre of interactive environments, called ThinkeringSpaces. These “places in spaces,” within content rich institutions such as libraries seek to bridge the gap between physical and virtual learning experiences, allowing school-age children to thinker concretely and abstractly, reflect upon what they do and discover, and elaborate their ideas in ways they can share with others, locally or remotely.

New Opportunities for Learning
Multimodal technology is creating new experiential opportunities for exploring, tinkering, learning and interacting in the virtual world. When full sensorial activities in the physical world are combined with a rich interactional space, a new genre of networked learning environments emerges – called ThinkeringSpaces.

ThinkeringSpaces are interactive environments that seek to encourage school-age children to tinker with things, both physical and virtual, reflect upon what they discover, and elaborate their ideas in ways they can share with others. Situated in content rich institutions such as libraries, and remotely accessible, these fully independent, drop-in environments or “places in spaces,” take children through the dialectic experience of physical and virtual, and of concrete and symbolic, generating new integrated knowledge and skills.
The ThinkeringSpaces project, funded by the MacArthur Foundation, is being developed at the Institute of Design, Illinois Institute of Technology. The initial project phase sought to define guidelines for the design of these new kinds of environments; the current research goal is to develop continuous behavioral prototyping environments in two libraries in the Chicago metropolitan area. Early prototypes environments are largely about engaging kids in activities as a way to gain a deeper understanding of their behaviors and enable on-going changes in response to interactions within the spaces.

**Tinkering as a Way of Understanding**

Tinkering seems deeply rooted in shops and factories and other places where individual farmers, craftsmen, engineers and inventors set about playing with and learning about materials and objects in the physical world. Mostly, tinkering is thought to be about understanding situations, diagnosing problems, exploring solution possibilities focused on repairing, adapting, re-purposing and inventing.

Today, our understanding of tinkering and the practice of the tinkerer is evolving, just as in the evolution of the digital landscape. Tinkering now has new meaning: it is not necessarily a solitary activity; it is gender and age agnostic; it can be abstract and conceptual; and importantly, it can take place in both physical and virtual dimensions.

Tinkering for the sake of one’s own discovery promotes more than just learning about the topic of inquiry. According to Stager (2003) “A child comfortable tinkering with familiar items and playing with ideas will gain the confidence and self-awareness required to solve a wide variety of problems.” Tinkering further promotes the development of critical thinking skills that will prepare kids as they encounter future, more-complex scenarios.

Thinking while tinkering inevitably leads to “thinkering.” Educational theorist Eleanor Duckworth (1996) observes that: “Making new connections depends on knowing enough about something in the first place to provide a basis for thinking of other things to do – of other questions to ask – that demand more complex connections in order to make sense.” As one tinkers and begins to make additional and more complex connections, building on one’s current knowledge base, the original query is likely to be replaced by more advanced initiatives that are more meaningful to the tinkerer or “thinkerer.”

**Connecting Heads and Hands**

ThinkeringSpace, resulting from the semantic conjunction of the words “thinkering” and “space,” is used here both literally and figuratively. These interactive environments define unique activity areas in libraries where school-age kids independently explore, experiment, author and mentor others. These remotely accessible spaces make use of multimodal technologies in combination with sensorial activities, helping kids to bridge concrete experience and abstract understanding. Through this dynamic, newly integrated knowledge and skills are generated, allowing cycles of engagement and reflection to be accompanied by couplings and de-couplings of technology (Anastopoulou, 2004). ThinkeringSpaces acknowledges the value of connecting head and hands in the discovery process.

**Interactive Image Table**

Web map images are projected onto an air-table where readable artifacts are used to explore interaction with the image. Simulates a playing surface for collaborative strategies.

**Creating Creatures Prototype**

Unique creatures are created from different animal segments. Characteristics and behaviors combine to build survival narratives in alternate biomes. The prototype models a digital version created subsequently.

**An Open Platform Model**

ThinkeringSpaces are freestanding, independent, scalable platform-based installations that are: linked to collections and resources; adaptable to activities that promote productive inquiry; fluid in the interplay of physical and virtual experiences; reconfigurable, independent of building architecture; easily monitored and maintained; and self-contained with their own infrastructure. These interactive spaces combine smart multimodal technologies, sensorial objects and symbolic cues to support different modes of interaction as well as learning preferences. Other core characteristics include: encouraging community building through membership networks; providing anywhere, anytime access; and delivering evolving content.

**Activity Nodes**

Activity nodes are core planning elements in ThinkeringSpaces. Nodes are the spatial sections where kids actually work with materials, objects and images and where they interact with digital tools and other digital media devices as well as with each other. The activities that kids choose to engage in must be supported within the environmental setting regardless of the overall design systems approach. Support means providing access to selected resources and tools, as well providing an internet link, enabling kids to work in situ or online, individually or collaboratively.

**Interplay of the Physical and Virtual Worlds**

ThinkeringSpaces integrate physical and virtual interaction, instead of encouraging one dimension at the expense of the other. Properties, such as tangibility, are best explored through action in the physical world; other properties, such as reproducibility, are more easily explored through action in the virtual world. For example, geometric blocks can be manually explored and combined to build a bridge structure, allowing kids to master physical properties such as the gravity force. Once digitized, these blocks can easily be scaled, multiplied, manipulated and receive different surface characteristics. The interplay of physical and
virtual and of concrete and symbolic creates opportunities for new integrated knowledge and skills.

**Spaces, Technologies, Objects, Cues & Activities**

In order to support kids’ interactions in both physical and virtual worlds, ThinkeringSpaces combine smart spaces, multimodal technologies, sensorial objects and symbolic cues, in a variety of open-ended activities with evolving content.

**Smart spaces** or intelligent environments are envisioned as systems equipped with visual and audio sensing technology, pervasive devices, sensors, and networks that can perceive and react to people, sense ongoing human activities and respond to them (Singh, Bhargava & Kain, 2006).

**New technologies** provide interactants with multiple modes of interfacing with a system beyond the traditional keyboard or mouse input and output. Multimodality is important because it deals with all the means human beings have for making sense of everyday experiences, representing information and conveying meanings (Kress, 2004). Each modality, based on its affordances (Gibson, 1986; Gaver, 1992), creates different possibilities and limitations for interaction and communication, and, therefore, forces individuals into making commitments about meaning, whether intended or not. In this way, multimodal technologies open the doors for new ways of expression, interaction and communication in the virtual world, supporting individual preferences, differences in context and desired output. Overall, they create new experiential opportunities for exploring, tinkering, learning and interacting in the virtual world.

**Sensorial objects** allow individuals to be more fully immersed in the learning experience. According to Ackerman (1990), people utilize their sensorial channels to meaningfully relate to their environment. The five basic senses – touch, taste, hearing, sight and smell – once stimulated in an integrated fashion, causes human cognition to be more fully engaged. In this sense, the overall sensory integration results in a more meaningful, emotional and personal experience (McDonagh, Hekkert, Van Erp & Gyi, 2004).

**Symbolic cues** prime interaction and incite exploration by providing hints for action. They subtly suggest what the possibilities are, what can be acted upon, without giving a definite direction or path to follow. They make the options apparent, or perceptible, and propose how they can be approached or explored. They provide a foundation for learners to tinker with the possibilities and set a track of action. Together with open-ended activities, which are fed by evolving content, they structure the interaction without defining routes. Consequently, individuals are free to set their own goals for exploration and to evolve their goals iteratively as they move on.

**Exploratory Environments Network**

With over 115,000 libraries nationwide, and over 9,200 of these public (American Libraries Association, 2005), libraries present a unique opportunity to integrate ThinkeringSpace installations into the broader community. ThinkeringSpaces, however, can be much more than that. The idea of interactive environments situated within libraries where kids can explore, experiment, reflect on and share their own interests and “wonderful ideas” (Duckworth, 1996) rapidly leads to the idea of a networked space supported by a physical and virtual community of experts of all ages.

ThinkeringSpaces are structured to provide ways for kids’ to author, to make their creations and ideas visible, and to share them with others locally and remotely, adapting to different individual interests and communication styles. Additionally, the network dimension of ThinkeringSpaces is designed to encourage community building where kids and adult experts can support thinkerers in doing what they really like to do or finding out more about, either through face-to-face mentoring at the library space or online.

Therefore, beyond the local experience within the ThinkeringSpace environment, thinkerers can provide or get immediate feedback from other thinkerers around the world. And as the networked community expands and more platforms become available for remote access, a collective history is built, and creative portfolios are stored, feeding ideas and supporting future thinkerers. The new opportunities for knowledge construction and sharing will potentially bring changes to the way kids collaborate and experience the physical environment.

**Initial Research**

Earlier research has enabled framing of important issues for ThinkeringSpaces. The fuzzy idea about kids tinkering in libraries...
has evolved into a series of frameworks and principles for designing conceptual models that leverage the benefits of existing library infrastructure provide planning flexibility and draw on manufactured product systems as a basis for building and scaling these environments. Conceptual prototypes helped to develop early ideas, behavioral prototypes to understand kids’ behaviors and structural prototypes to explore spatial dimensions of environments.

**Systems Thinking**

A system strategy is adopted for the design and development of environmental structures, based on open platform models. Unlike typical museum or trade show exhibits built as one-off’s, ThinkeringSpaces will be built from manufactured components, produced from production tooling, materials and integrated processes. Because installations will widely vary in use and situation over time, kit-of-parts solutions will enable flexible layouts that adapt to available space and meet an individual library’s program intent.

**Current Research**

Because ThinkeringSpaces will be closely integrated into library settings, understanding the particular library culture, observing how librarians and staff do their work, knowing how facilities operate and how libraries relate to and serve their respective communities is requisite. A library assessment study of a small number of local libraries is underway currently. The results of this study will guide prototype environment design and implementation criteria for a continuous, iterative prototyping environment.

**What’s Next**

The current grant focus is to use prototyping as a learning tool to inform and guide the design of the actual, implementable design system behind ThinkeringSpaces. Placing kids in a real context with real content doing exploratory activities will enable a deeper understanding of their behaviors and reveal opportunities for engaging them. As stated earlier, observation will be continuous, modifications periodic and evaluations summative. And finally, a user manual will describe how libraries who choose to participate can engage with the program and get value from ThinkeringSpaces.

**Summary**

This article presents core concepts that ground the development of a new genre of interactive environments, called ThinkeringSpaces. These “places in spaces”, within content rich institutions such as libraries, seek to bridge the gap between physical and virtual learning experiences, allowing school-age children to thinker concretely and abstractly, reflect upon what they do and discover, and elaborate their ideas in ways they can share with others, locally or remotely. By combining smart spaces, multimodal technologies, sensorial objects, symbolic cues, open-ended activities and evolving content, new opportunities for knowledge construction and sharing are created. With community participation, ThinkeringSpaces become part of a larger network where kids collaborate face-to-face or at a distance, doing what they really love to do — tinker.

More information can be found at: www.thinkeringspace.org

**Acknowledgements**

The ThinkeringSpace concept development and research work is being supported by John D. and Catherine T. MacArthur Foundation, through its Digital Media and Learning initiative, launched in 2006, to better understand how digital technologies are changing the way young people learn, play, socialize and participate in civic life. Additionally, Heloisa Moura’s Ph.D. scholarship is funded by CNPq, an entity from the Brazilian Government that aims at scientific and technological development.
**About the Authors:**

**Heloisa Moura, PhD Candidate, IIT Institute of Design,** has an interdisciplinary academic background. She holds a Masters of Science Degree in Education and four expertise diplomas, graduate level: Computer Graphics; Internet, Interface & Multimedia; Distance Education; and Psycho-pedagogy. Her B.S. is in Mathematics.

Heloisa is currently pursuing a PhD degree in Human-Centered Communication Design at the Institute of Design, Illinois Institute of Technology, funded by the Brazilian National Council for Scientific and Technological Development, CNPq. Her research focuses on understanding multimodal interaction and learning within Virtual Learning Environments, with attention to technological innovation.

**Dale Fahnstrom, Professor, IIT Institute of Design,** is former director of the Institute of Design, where he has been on faculty since 1966. As a member of the interdisciplinary faculty team that leads the graduate demonstration class, he works individually with students on human-centered product development theses. Professor Fahnstrom assists the Director on facilities planning and coordination.

Professor Fahnstrom has designed products for such diverse corporate clients as Knoll International, Philips Electronics, Steelcase, and NEC. His work in packaging design is featured in the permanent collection of the Cooper-Hewitt Museum; his “Bulldog” chair, designed with Michael McCoy and introduced in 1990 by Knoll, was the largest-selling seating product in the manufacturer’s line. He is a partner in the consulting firm of Fahnstrom/White and holds a B.F.A. and M.F.A. from the University of Illinois at Urbana-Champaign.

**Greg Prygrocki, Associate Professor, IIT Institute of Design,** has served as the Institute’s Associate Director and currently leads the Communication Design track. Professor Prygrocki teaches courses ranging from the Foundation series (required of all incoming students with no design background), to the Research and Demonstration Project class, the "thesis project" of the Master of Design degree.

His professional experience has included work in the areas of identity, signage, publication and book design. His own work and examples of his students’ projects have appeared in various national and international publications. He holds a B.I.D. from the University of Manitoba, Canada, and an M.V.A., University of Alberta, Canada.
According to the research conducted by the Partnership for 21st Century Skills organization, high school graduates need to have high levels of learning and thinking, information and communication, literacy, and life skills (2006). In 2004, the RAND report, The 21st Century at Work: Forces Shaping the Future Workforce and Workplace in the United States, described the skills needed by knowledge workers in every industry. These skills include high-level cognitive skills for managing, interpreting, validating, transforming, communicating and acting on information. Analytical skills that are necessary are abstract reasoning, problem-solving, communication, and collaboration. This research closely reflects earlier studies done by the U. S. Department of Labor’s Secretary’s Commission on Achieving Necessary Skills (SCANS) in 1991 and the 1996 publication by the National Skills Standards Board (NSSB).

Thomas L. Friedman, author of The World is Flat (2005) was quoted in the New York Times as saying, “There is a certain American confidence that whatever we lack in preparing our kids with strong fundamentals in math and science, we make up for by encouraging our best students to be
independent, creating thinkers.” He goes on to say that “the Chinese recognize that they are good at making new things and copying the next new thing, but not imagining the next new thing.” China is now focusing on how to transform classrooms so students become more innovative.

**Project-Based Learning**

According to Kirk (2000), learners are increasingly less willing and able to learn in a lecture format and want teaching and learning to be more active and process-oriented while learning content. Dede (1993) described learning processes to prepare learners for the workplace and society as changing from “the more traditional classroom-based, discipline-focused, learning-by-listening approaches to” just-in-time, life- and work-focused, and learning-while-doing approaches linked to everyday situations (p. 3).

Active learning processes such as project-based learning provide a wide variety of activities and assessment for the necessary skill acquisition for all learners, workers, and community members to be successful in the rapidly evolving era of the 21st century. Project-based learning is an inquiry based method of teaching and learning that begins with a driving question determined by the students and planning by the teachers. Together they create the theme for the project. Projects are student led and encourage the building of relationships, communication skills, and the use of higher order thinking skills, such as critical thinking to define and solve problems.

Other ways to describe project-based learning includes using and manipulating technology; promoting creativity, meaningful learning, and connecting new learning to past performance or learning; incorporating authentic self and outside reflection and assessment; and instilling lifelong learning patterns (Eckert, Goldman, & Wenger, 1997; Kraft, 1999; Wankat & Oreovicz, 2000).

Assessment of project-based learning involves outside experts who have knowledge and practical experience with the topic of the project, stakeholders who will use or take ownership of the outcomes and products, teachers and staff, and peers. “Students involved in project-based learning repeatedly demonstrate confidence in their knowledge and skills, and are excited when talking about their own work,” according to Bobbie May as a member of an early 1990s Washington State education reform committee (Edutopia, 2003).

**Physical Environment that Supports 21st Century Learning**

The Partnership for 21st Century Skills’ report, Results that Matter: 21st Century Skills and High School Reform (2006), strongly states that “we should not design another high school until we’ve agreed on the knowledge, skills, and attributes that matter today: 21st century skills should become the design specs for every American high school. Often, the physical learning environment is a barrier to project-based learning by limiting the ability to form teams and create a sense of community, integrate curriculum, and actively engage in the activities of authentic project-based learning (Kraft, 1999; Lindblad, 1995).

In today’s world, learning is not confined to a classroom, school, or college, and is an essential part of everyday lives and continues throughout life. New technologies have created additional avenues and enhancements for learning. Creating environments that embrace communities, celebrate cultural differences, nurture and hone practical and advanced skills, and encourage innovation and collaboration is the implicit challenge in designing 21st century learning facilities (Wolff, Troyer, & Pang, 2003, p. 5). The authors go on to say that creating environments that embrace communities, celebrate cultural differences, nurture and hone practical and advanced skills, and encourage innovation and collaboration is the implicit challenge in designing 21st century education facilities.

According to Wolff (2001), the six areas of consideration in designing physical learning environments to support and enhance project-based learning are: 1) spaces to support a variety of size of groups; 2) spaces, services, and functions to support psychological and physiological well-being of learners and teachers; 3) spaces that are furnished with moveable, flexible furniture, storage, display areas, and task lighting; 4) spaces that are physically and programmatically adjacent to provide visibility, connection, and sharing of resources and tools; 5) spaces that support functionality such as lectures/seminars, laboratories, production, practice, presentations, and demonstration; and 6) spaces that are flexible, adaptable, have core and fixed-elements, and have a visible infrastructure so the building becomes a learning tool.

**Project-Based Schools**

The following high schools use project-based learning as a primary means to provide multiple opportunities for students to achieve high academic and 21st century skill acquisition:

**School of Environmental Studies – Zoo School**

The School of Environmental Studies (SES) was designed and funded in partnership with the Independent School District (ISD) 196, the Minnesota Zoological Gardens, and the City of Apple Valley, Minnesota. It opened in 1995 and is located next to the Zoological (Zoo) Gardens. The SES is a focus or magnet school for ISD 196 high school juniors and seniors using environmental studies as the theme for learning. The learning process at SES integrates language arts, social studies, and sciences using an environmental theme in a collaborative, project-based approach. The projects are developed around real local, state, regional, or global issues that need to be addressed and solved. A student quoted in Edutopia, *It’s All Happening at the Zoo School*, by Diane Curtis (2002) states, “I feel like I’m not learning in a box of fluorescent lights like I was in my first years in high school. I’m learning in a classroom and I’m learning outside by a pond. I’m learning in a local park. I’m learning at the zoo, working with people who are doing stuff in the field…We do a lot of stuff that has a significant impact on the community.”

**Lake Washington School District**

In 2001, the state Board of Education in the State of Washington voted to require a culminating student project as a part of their graduation requirements. The first requirements went into effect
in 2004 and will be demonstrated by students graduating in 2008. Students choose their own project as a means to demonstrate mastery in reading, writing, and communication; knowing and applying the core concepts of math, the social, physical, and life sciences, civics and history, geography, the arts, and health and fitness; thinking analytically and creatively and integrating experience and knowledge to form reasoned judgments and to solve problems; and understanding the importance of work. The Lake Washington School District stresses the need for and supports using technology in this project.

**The Minnesota New Country School – MNCS**

“It’s not being smart but self-motivated that gets you some place in this school.” — Chelsey

“MNCS gives you a safe place to stand on your own—and fail. Success here is trial and error. You might try one project and it doesn’t work. You try another, and it does. It’s like life. You learn from your mistakes. But here you get to learn with a safety net.” — Tim

The above quotes are from the Website of the Minnesota New Country School. The school is located in rural Henderson, Minnesota and mixes the intimacy of a one-room school house with 21st century technology. The school combines freedom with responsibility, structure with flexibility, and book learning with practical experiences like working at the corner drugstore. In helping students negotiate these dualities and gain the skills they need, MNCS overturns many conventions of teaching and learning. The young woman pictured below created her own business doing the logo embroidery for the regional Emergency Services agencies.

**The East Valley Institute of Technology – EVIT**

The East Valley Institute of Technology (EVIT) is one of the best resources Arizona’s students have to guarantee themselves success. Upheld as a model for career and technical education by the U.S. Department of Education, EVIT provides students with the advanced skills and training needed to thrive in today’s competitive job market. EVIT adds to a student’s academic instruction with hands-on learning provided by experienced professionals and excellent resources. By allowing students to earn elective credit in 35 occupation-specific programs, EVIT enhances the future of every type of student. EVIT is a public school district that serves students from ten East Valley school districts. High school students from Apache Junction, Chandler, Fountain Hills, Gilbert, Mesa, Queen Creek, Scottsdale, Tempe, Higley and J.O. Combs.

**Canby High School – The Applied Technology Center**

The Canby Applied Technology Center (ATC) opened in mid school year 2002. The facility completion represents the initial phase of transformation from an Industrial Arts Program into an integrated academic and technical learning using rigorous project-based curriculum. The physical environment provides a strong framework for the educational program with its industrial feel and exposed infrastructure that serves as a learning tool with its mechanical, electrical, and structural systems exposed and labeled.
## References

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## About the Author:

**Dr. Susan J. Wolff** is the Chief Academic Officer for Columbia Gorge Community College and the Director of Wolff Designs. Susan leads development of academic or learning plans that address necessary knowledge, skills, and abilities needed by learners; advises on master facility plans; and guides the design of the physical learning environment for all educational levels. She possesses specific expertise in community involvement; collaborative, project-based learning; and career and technical education.

Dr. Wolff has worked with clients from all levels of education and architecture firms across the country and internationally. She has presented at state, regional, and international CEFPI conferences, the California Coalition for Adequate School Housing (CASH), the Society of College and University Planners international conference, and Design Share’s World Forum in Barcelona in addition to presentations at many educational conferences. She has served on award juries and teams for the AIA, CEFPI, CASH, and Design Share and has several publications related to the topic of educational and facilities design and education.
Researchers have shown that the all too adversarial atmosphere enveloping today’s construction industry can be attributed to traditional contracting methods, forcing conflict versus performance and results.

In part, the situation stems from the very nature of contracting itself. Little room for communications, interaction and collaboration are allowed. For any long term commercial relationship to work, an element of trust is required. But trust, it seems, is the element that is absent so often today in the relationship between facility manager and construction contractor. Why is it so scarce?

The real reason stems from the fact that facility owners and construction firms routinely find themselves straight-jacketed by low-bid contracts, surrounded by a wall of non-interaction and limited communications.

With only this limited type of contract in place, facility owners cannot hope to change their minds or direction about a project, once it is awarded, without suffering repeated financial penalties in the form of change orders, while contractors cannot hope to deliver a project and earn a profit without cutting corners. The lack of joint scoping, collaborative development, creativity in solutions impacts the results and performance of the facilities construction projects.
Predictable Performance
A JOC isn’t awarded for a specific project. Instead, it awards a construction “program” based on a potential maximum amount of work over a year or a number of years. (For example, it may award an annual maximum of $5 million over 3 to 5 years, with average individual projects of $150,000 to $350,000, but without obligation on the owner’s part to do any work at all.)

The contractor—without guarantee of specific revenue from the JOC program—has every motive to deliver a high-quality project with each job order issued. (As one owner said, every job order is an “audition” for the next one.)

Rapid Response
Rapid response to owners’ timelines and occasional emergencies may be the most noteworthy advantage of JOC.

Not only is the initial time spent to procure construction services with JOC about 75 percent less than that devoted to procurement with the design-bid-build method, but the time required later to award specific projects under a JOC program is typically just a matter of days, not months.

Rapid response is of critical interest to owners such as municipal and school facility managers, who typically have small windows of opportunity to complete construction projects.

Speedy, safe project delivery is standard with JOC, because the contractor providing construction services under a Job Order Contract has a vested interest in building and maintaining its relationship with the owner.

Local Benefit
Lastly, JOC allows owners to invest their construction funds in the local business community. Owners see more building funds “stick” close to home because the contractors retained under Job Order Contracts manage nearly all the construction work by using local subcontractors. In fact, up to 95 percent of the work under a Job Order Contract will be executed by local companies, including small, minority and disadvantaged businesses.

Owners Speak
While the advantages of JOC have been touted for years by pioneers and advocates, only recently have owners been polled about their degree of satisfaction with this innovative purchasing method.

In 2006, a research team, led by Greg Ohrn, P.E., an assistant professor at Northern Arizona University, interviewed owners and facility managers who use JOC. The conclusions—statistically accurate—are telling:

- **JOC is convenient.** Far and away, owners value JOC for its ease-of-use. Seventy-one percent say that JOC is easier to use than other procurement methods.
• JOC is more satisfying. Sixty percent of owners say JOC provides greater overall satisfaction than other procurement methods. Sixty-nine percent say it’s more satisfying, in particular, than design-bid-build.

• JOC is favored for time-critical projects. Forty-three percent say the primary reason for adopting JOC is to meet demands to complete work in a timely manner.

• JOC requires less startup time. Seventy-five percent of owners say projects take less time to start with JOC than they do with other procurement methods.

• JOC requires less design time. Fifty-seven percent of owners say that projects require less design time with JOC.

• JOC requires less close-out time. Sixty-three percent say projects take less time to close out with JOC.

JOC also scores well with owners when it comes to costs. A majority of owners say projects cost the same or less when completed under a Job Order Contract.

Owners of publicly funded facilities everywhere are operating under extreme pressure due to time constraints and a lack of dependable resources. So it’s crucial they embrace the right construction management tools. JOC is one of those tools. It opens doors to teamwork, innovation and new thinking about desired outcomes.

### JOC in Action in School Construction

After one of its major school construction projects ran into problems under a design-bid-build contract, Santa Fe Public Schools committed an additional $1 million in funding to fix and finish the work – this time under a Job Order Contract. The Albuquerque office of Virginia-based Centennial Contractors Enterprises was awarded the JOC.

A forensic architect was engaged to help determine the problems with existing building systems, and to lead a “strategic encoding” programming process. This process prioritized the school’s needs within the available budget, and required consensus from all school community members about which goals were most important. Centennial’s active participation in this process was an important way to rebuild trust and learn about the community’s concerns.

The scope of work included a major HVAC repair, providing hot water and drinking water to all classrooms, exterior “hardscape” and landscape, major IT reworking, and various small, miscellaneous improvements that the school community identified.

The JOC procurement system made a believer out of Deputy Superintendent of Operations of Santa Fe Public Schools Bobbie Gutierrez. “Often times we have emergencies and it’s great to have a company we can call on to do the work on short notice and not have to put orders out to bid,” she said.

Another school renovation project started under the design-bid-build procurement method and reissued as a Job Order Contract was the renovation of an old gymnasium at a Gulf Coast college campus in Texas – part of The Cooperative Purchasing Network, (TCPN), established to help manage renovation and remodeling projects in Houston area schools.

This project was issued to KBR, a Houston-based global engineering, construction and services company in early July 2004 after work had been halted a year earlier due to lack of funds. With the new school semester rapidly approaching, the college had little time to complete this facility.

KBR worked with college facility managers to expedite the selection and delivery of materials to meet their needs including resurfacing the pool deck and installing sports flooring in some areas. KBR made arrangements for the main gym area to be available for registration as work continued. With area prioritization, scheduling, and close coordination with the college, gym activity areas were available as they became needed to accommodate classes and other activities. Work was completed in six weeks.

The flexibility of JOC allowed for expedited selection, changes and pricing of finishes as work progressed. Additionally, the owner & KBR were obligated to a published price book for easy price negotiation.

### Satisfying Every Day Needs

Often times, JOC’s best application is for the completion of smaller, less clearly defined projects that need to be completed quickly and dependably.
In Loudoun County, Va.—one of the fastest growing counties in the United States—JOC projects take a variety of forms. Recently completed JOC projects include re-stabilizing and repaving the county’s 10-acre school bus storage and maintenance facility; replacing several school roofs; and replacing windows at many older schools. Smaller projects have included installing access ramps at school loading docks and installing recessed fire extinguisher cabinets (they had previously been hung exposed on the wall) to make them comply with ADA standards.

According to William Koltser, Director of Facilities Services for Loudoun County Public Schools, JOC allowed the projects to be completed faster. “The smaller projects were completed through JOC before we could even have gotten a design and received bids under normal contracting procedures,” he said.

The JOC format also allowed the County to work cooperatively with the contractor to develop a scope for the projects, eliminating any misunderstanding of what the completed work would entail. “This is probably the biggest benefit,” added Kolster, “because the contractor is not overwhelming the owner with change orders for flaws in the plans and specifications that you routinely find in design-bid-build projects.”

JOC also allowed for consistent results on several projects that would traditionally have been bid out separately. “In the case of the roof installations, working with our JOC contractor ensured that we had the same subcontractor installing all of our roofs to provide a consistent level of performance,” said Kolster.

“The profit for a JOC contractor is a direct result of performing multiple projects over a long period of time,” he explained. This creates the need for a contractor to develop a relationship with the owner that is non-adversarial. In a design-bid-build situation the contractor may never be back so they do not go out of their way to develop a partnership with the owner.”

Additional information on Job Order Contracting can be found at www.JOCexcellence.org

About the Author:

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The New Student Center

By Jennifer Cordes, AIA, LEED AP

Student centers are now an integral part of the community and campus life. Successful student centers must be strategically designed to appeal and to provide for the diverse student population and members of the surrounding community. With an eye on retention and recruitment, student centers have risen to a new level as part of the overall marketing efforts for campuses.

Student centers have long been the hub of social and academic activity on a college campus. Today, with an increasingly competitive recruiting environment, the new student center must charm prospective students – appealing to a generation of discriminating, technology-savvy, active young adults. At the same time, the student center is playing a more active role in towns across America where interaction and activities for students and residents is planned for and encouraged. They are quickly evolving into multi-use facilities that address the wants and needs of various user groups. If carefully executed, they can serve as places where interaction and collaboration is encouraged, relationships are fostered, and a spirited sense of community is promoted within a diverse spectrum of students and residents.

Centralization

Students have voiced their opinions loud and clear in favor of a ‘one-stop shop.’ Centralization is clearly a growing movement. The ideal scenario, for many campuses, is a centrally located building that integrates social activity with a variety of amenities. With a union that is the focal point of the campus, the propensity for students to come, stay and gather together to learn and engage, increases.

The vitality of a student center hinges on the proper combination of resources. These may include dining; mail service; career counseling, tutoring or testing services; travel and banking services; bookstore; auditorium, theater or other social gathering spaces.
These areas may also offer social or recreational activities such as open mic night, bowling, or other after hours activities. The addition of late-night areas located within student unions is a growing trend that requires well-integrated security controls both inside and outside the union.

Centralized food service is essential from both a socialization and operational perspective. Choice and convenience are also key ingredients in the recipe for a successful food service program.

Chicago’s DePaul University provides a prime example. The school touts its tailored food program on the campus website. “Greetings from DePaul Dining Services: Our dining program is specifically designed for you. Whether you are on the go, an early riser, or a casual diner, we are sure to have what you want. By constantly adapting to keep up with the ever-changing trends in campus dining, we are able to offer a terrific mix of vegetarian, vegan, home-style cooked dishes as well as many ethnic options. We also offer nationally branded products such as Au Bon Pain soups, Ben & Jerry’s ice cream and frozen yogurt.”

Other dining trends include: dietary kiosks that provide students with nutritional information, such as calorie intake of the meals they are selecting; organic foods and dining halls designed to look like restaurants with a variety of choices in preparation including grills, woks and sandwich bars.

**Technology**

Keeping pace with the latest technology is a critical component to the design of new facilities or renovations. Creating spaces for students to easily access or utilize technology to enhance their learning experience is more important than ever before.

A report recently published by educause.edu, unveils a unique approach by Northwestern University. “[The] University’s Information Commons, or InfoCommons, is a new type of learning space that exemplifies technology and space design working to encourage and enhance research and collaboration. The library already supports spaces for teaching and learning. The InfoCommons does not replace these spaces; instead, it provides modular furniture, a group project room, staffing support, and a new sense of purpose for students. As a joint venture between the library and Northwestern University Information Technology (NUIT), it promotes cross-departmental cooperation.

During the design phase, groups providing input considered factors such as the ability for different sizes of groups to work and feel comfortable; the flexibility of the space; and the relationship of the InfoCommons to already established departments within the library and Academic Technologies (a division of NUIT). The 5,100-square-foot InfoCommons offers a variety of configurations: individual workstations, group presentation areas, booths for group study, and a small-group project room, permitting students to choose different level of interactions with their peers in a technologically rich yet informal environment.”

The implementation of high-tech areas such as these, which directly address the needs and desires of students and residents of the community, are the future of thriving campuses.

**Going Green**

Sustainable design and green building practices is a must-have in today’s academic environment with LEED certification becoming a growing trend. Harvard began its campus-wide Green initiative in 2000 to make the University “a living laboratory and learning organization for the pursuit of campus sustainability.” As of June 2007, the school has 20 LEED registered building projects both new construction and renovation projects. Likewise, the University of Colorado began its Blueprint for a Green Campus plan in 2000 with the end goal of making CU-Boulder a national leader in sustainable environmental practices.

From the east coast to the west, campuses are incorporating environmentally-friendly practices into their auxiliary facilities. There are countless design techniques that can contribute to the pursuit of campus sustainability. A number of core components of a sustainable building are provided with examples of how to address the issues:

- Daylighting and lighting design – clerestory, high-performance and or double glazed windows; solar tubes that supplement natural light into interior spaces.

- High-performance building systems and materials selection - building envelope, additional glazing and insulation for increased R value, specification of LOW VOC materials and the installation of rooftop gardens.

- Water conscious landscaping – a highly-efficient irrigation system with soil moisture sensors, xeriscaping, decorative hardscape elements and mature trees that provide shading.

- Storm water design and control

**Case Study**

The Tivoli Student Union located at the Auraria Higher Education Center in Denver, Colorado, is a prime example of a bustling centerpiece on campus. The Tivoli may well be one of Denver’s most recognizable historic icons. Images of the City often include a snapshot of this majestic building, with its highly visible smokestack, nestled between the downtown skyline and the Rocky Mountains. Originally built in 1870 as a brewery, today the 16-building complex plays host to 37,000 students on three college campuses known as the Tivoli Student Union. It is used seven days a week not only by students, faculty and staff; but is a sought after place for community activities and special events.

The project mission statement was “to create a vital student center that enriches student life and community involvement in the educational experience of the Auraria Campus.” As a commuter campus, the student-owned Tivoli is the central destination place for students. It was critical the building remain open and accessible throughout construction.
The principal design challenge for the Tivoli was restoring the building, after years of deterioration, while keeping the facility fully operational and occupied by students, facility, businesses and the community throughout the duration of the two-year construction project. This undertaking meant a 24-hour a day, seven day a week schedule for crews. The $22 million project began with a master plan followed by exterior façade repair, window replacement and repair, exterior building lighting, roof replacement, code violation remediation and safety upgrades, as well as mechanical and electrical system placement and upgrades. Meeting the needs of the various user groups was a primary objective. Therefore, the planning process involved students and the campus community. Students voted for a facilities bond fee referendum to fund revitalization, adding $18.50 per student, per semester. The student governing board was also involved in the design team selection process. Participating in design meetings, the student body was involved in the project, meeting regularly with the director of Tivoli.

Upon completion, the Tivoli offers spaces for students, faculty, staff and community members including computer labs, tutoring centers, lecture halls and areas for large events. The food court, lounges and bookstore act as central gathering places. A movie theatre hosts educational and entertainment venues. Prior to revitalization, the tavern served as offices and a restaurant. It has become the new building entry, oriented to the campus, including a lounge. The campus bookstore serves all three schools. The new “Concept Store” created individual stores within the space, providing a separate identity for each school. The vision was realized in a building that provides both a distinctive setting and centralizes services, amenities and community activities into an integrated facility.

Today, student centers are much more than just another building on campus. They are an integral part of the community and campus life. Successful unions must be strategically designed to appeal to and provide for the diverse student population and members of the surrounding community. With an eye on retention and recruitment, the student center has risen to a new level as part of the overall marketing efforts for universities. These facilities can create an instantaneous appeal when amenities and conveniences are centralized into a highly visible focal point on campus and carefully integrated into the surrounding community.

Facility Centers

Jennifer Cordes joined SLATERPAULL Architects nearly ten years ago with a commitment to creating schools that facilitate the learning process. She believes a quality school environment nurtures our children, our communities and our environment and strives to incorporate high performance design elements into all her school designs. Although Jennifer’s experience spans numerous markets, she has focused mainly on her passion, school buildings throughout her career. Jennifer was made an Associate of SLATERPAULL after only a few short years and recently was promoted to Senior Associate. She is a licensed architect and a LEED Accredited Professional who holds a Master of Architecture from the University of Colorado at Denver and a Bachelor of Arts in Economics from the University of Colorado at Boulder. Several of her school projects include award-winning projects such as Centennial Alternative High School that received the "Monarch Award," CEFPI Southwest Region, in 2006.

About the Author:
Flexibility in Elementary Schools in Japan

By Fumihito Miyamoto

The first in a series of global educational facility planning articles that we will be offering in our upcoming issues, the author here gives a brief outline of educational facilities in Japan. The author also highlights flexibility in building schools in Japan and provides an update on research being done in this area.

Brief Outline of Educational Facilities in Japan

Compulsory education in Japan consists of six years, from six years to 11 of elementary school and three years from 12 to 15 of lower secondary schools. Recently, the six-year secondary school system was increased and a nine-year system combining elementary and lower secondary schools began as a new trial.

There are approximately 24,000 elementary schools and 11,000 lower secondary schools in Japan. Japan has a national curriculum and the Ministry of Education, Culture, Sports, and Technology has a subsidy system for construction of school buildings, including the introduction of open space. Local governments are responsible for the management, design and construction of school buildings in Japan.

The education ministry determines the maximum number of pupils per classroom as 40, however, the average number is about 30. Each elementary school typically has 6 to 18 classes in urban areas (about 200 to 700 pupils).

There are four kinds of classrooms in elementary schools in Japan. The first are home classrooms to which open space is adjacent. The second, are special classrooms (with preparation room), that is, science room, music room, art and crafts room, house-craft room, audio-visual room, computer room, library, dining hall and etc.

The third kind of rooms are administration rooms, that is, office, teachers’ office, principal’s office, meeting room, health care room, consulting room, etc. The last one is the gymnasium.

The area of a home classroom is about 63m² to 64m² (7m×9m or 8m×8m) and that of a special classroom is twice as large as a home classroom. The ministry determines the minimum total area of buildings per a school, according to the numbers of classes as per a subsidy system.
There are some general rules of planning elementary school buildings though they are not very strict. Here are the main rules:

1. The schools should have several special classrooms (for music, cooking, and gymnasium, etc.). The playground area should be blocked together for easy use for neighborhooding communities and should not disturb schooling.

2. Classrooms of the same grade are lumped together and open spaces are settled for each grade or some grades classrooms. All classrooms should have windows and must face south between southwest to southeast because of the climate in Japan.

3. The third to sixth grade classrooms should be near special classrooms for easy access.

4. The window of a teachers’ office should be facing the playground for security.

5. Students and teachers must have two pairs of shoes: one pair for outdoor use and the other pair for indoor use. They change their shoes in the entrance hall when they enter inside and go out of school buildings.

**Short History of Open Space in Japan**

The first open space school was built in Japan in 1972. Since then, several schools of a similar type have been built and in 1983, the education ministry finalized a subsidy system for open space. The real history of open space started when western countries began to try the different types from open space schools. The information on closure movements of open space schools in the United States and other western nations has not percolated into Japanese school planning and design. A semi-open plan school system prevails in Japan.

In the Japanese semi-open system, there is a rectangular open space adjacent to the traditional classroom without wall in many cases. The classroom has a main space of classes and learning and the open space is considered sub-space. Teachers do not have to change their teaching styles suddenly and can have time to devise how to use the open space for learning activities. The influence of an open plan on school buildings was stronger than that of open education in Japan.

Today, these open spaces support several kinds of learning from the point of view of flexibility in spite of noise and visibility problems. I think they should be termed flexible spaces instead of open spaces.

**Examples of Classroom and Open Space Units**

Below are four examples of classroom and open space units. These were designed by renowned architects in Japan and are not ordinary schools. This gives a glimpse of the Japanese way of planning and here the classrooms are main learning spaces and the open space is a subset.

1. Example 1 *(See Photo 1)*: Ueno elementary school was built in 1991 in the high density areas of Tokyo Metropolitan.

2. Example 2 *(See Photo 2)*: Shiki elementary school was built in 2003. This school is in Saitama Prefecture, close to Tokyo.

3. Example 3 *(See Photo 3)*: Takiro elementary school was built in 2006 and is in Gifu Prefecture near Nagoya city. In this school, the author supported the architect in the basic planning and advised to set the glass doors between classrooms and open space for protecting noise and for connecting two spaces easily.
Below are 4 photos of children’s learning activities in open space. These provide an understanding of the function of sub space for classes and learnings.

1. The first 4 photos (above) show children’s learning activities sitting on the floor in open space.

2. The second 4 photos (above) show children’s learning activities sitting at desks or tables in open space.

Flexibility of Classroom and Open Space Units

Figure 1 (below) reflects my thoughts about flexibility of classroom and open space units in Japan.

In most cases, architects and teachers have no relation during the planning and designing process. Architects try to design new good space. But in many cases it is not easy for architects to predict that this new space is suitable for real learning activities. On the other hand, it is also not easy that teachers provide their exact views about the new space. We do not have much knowledge about real learning situations. My research hopes to provide the materials with which architects and teachers can understand each other. And these will possibly lead to more flexibility use of physical space.

Below are three recent studies conducted with my graduate students on the current use of flexible spaces:

1. **Physical Plan Analysis**
   Composition Analysis of classrooms and open space units

2. **Furniture Arrangements Analysis**
   The arrangement of furniture in open space

3. **Learning Activities Analysis**
   The arrangements of school furniture for learning activities

**Physical Plan Analysis:** Composition Analysis of classrooms and open space units (Based on research work with graduate student Satoru OHTAKI in 2006)

In other words, I can call this the two dimensional space analysis of classroom and open space unit plans. The purpose of this analysis is to sort the classroom unit plans and to grasp the tendency of planning done during the past 30 years. We researched several plans of school buildings from architectural journals, and books. At first, we abstracted the classroom and open space units, considering the position of lavatory, staircase, and corridor in these unit from all the floor plans (See Figure 2).

![Figure 2: Way of abstracting classroom and open space units](image)

Home classrooms are the main learning spaces in Japan. So we thought we could get the typology from noticing the mutual relationships of classroom positions in units. As I always think that the scientific methods are important, we introduced the notions of operations to decide the classrooms positions in units though I cannot show it here. But it was not so easy to do. We repeated the process of trial and error and came to get convincing several typologies to understand the composition of units.
Figure 3: Operation for Typology of Classrooms and Open Space Units

Figure 3 shows the relationship between the operations and the several typologies of classrooms and open space units. Considering this figure and number of samples together, linear types are many. I can say that this type is basic and consists of a combination of traditional classrooms and adjacent linear rectangular open space. As this plan type is a compact shape, it is adequate to narrow school site and its construction cost is relatively low. We can easily make all the classrooms towards south because of the climate in Japan.

On the other hand, we got other types except the linear type. Architects, planners and school boards always seek something new. They devise the arrangements of classrooms and open space units to create interesting design and effective plans in function.

In the next step, we explored the positions of lavatory, staircase, and corridor in various types of classroom and open space units. Children frequently come and go through open space between their classroom and the lavatory, staircase, and corridor. These children’s moving lines sometimes disturb learning activities. So the positions of lavatory, stair and corridor are very important.

As these typologies show us the whole tendency of planning, we can easily understand the characteristics of unit plan types and also it is convenient to create a new type of plan by avoiding the existing types.

Furniture Arrangements Analysis: The arrangements of furniture in open space (Based on research with graduate student Hajime OKADA in 2005)

The purpose of this analysis is to find the kinds of furniture and grasp some rules of teachers’ way of furniture arrangements in open spaces. We collected the data on the furniture arrangements and made drawings in about 20 schools two or three times for three years.

We grasped 14 kinds of furniture in open space. But all kinds are not set. The amount and kinds of furniture are different at each school and depend on each construction cost. Sometimes, there is almost no furniture. We think teachers move and rearrange furniture for their classes in a different way from architects’ and planners’ thoughts in planning. At first, we compared the real situations with the planning situations about furniture arrangements in open space. The latter were furniture arrangements planned by architects or planners and from books and the architectural journals. Though we collected only several samples about the latter situations, the gap from real situations were clear (See Figure 4). In many cases teachers cannot select the furniture. Architects, planners and school boards decide the furniture. They decide on more furniture than the teachers’ needs. And also teachers’ need vacant space in open space. Vacant space is very flexible for learning activities use.

At the next step we aggregated the number for each kind of furniture. From this, we found the following four types of furniture were set in open space of many schools and thought these were the typical kinds of furniture, that is, 1) Children’s bag cabinet or shelf, 2) Book shelf, 3) Teachers’ cabinet or shelf, and 4) Table or desk. The bag cabinets of 40 children and several tables or desks occupied relatively large areas including their surrounding areas for use.

We think furniture positions in open space are important because they are related with the teachers’ way of use. We tried to put the position as a coordinate in the 2 dim-space of open space. But there are uncountable points in 2 dim-space and we think we need not strictly scrutinize furniture positions for design or planning. So we decided to divide the open space into 5×3 areas (horizontal 5 × vertical 3) facing one home classroom and overlapped the positions for each typical kind of furniture to grasp the characteristics of furniture positions lay by teachers (See Figure 5).

Figure 6 shows the overlapping of furniture position in the central zone of open space vertical to home classroom. Roughly I can understand 4 type of teachers’ layout of furniture as follows.
I can guess the daily furniture arrangements in the part of open space facing a classroom from these figures in some degree. I would like to try to abstract some kind of rules of them in the near future.

Learning Activities Analysis: The arrangements of school furniture for learning activities (Based on research work with graduate student Chiharu KOBAYASHI in 2003)

The purpose here is to grasp the relationship between children’s learning activities and furniture arrangements in classroom and open space units. Based on research, we sorted out about more than 20 kinds of learning activities in open space. We found various kinds of desks or tables for learning activities the areas of which top are from about 0.1m² to more than 3m² (See Photo 6). But there is no manual and no training system for teachers’ using various kinds of desks or tables for learning activities in their classes. Teachers devise how to use, but they do not have a sharing system about their individual devises and knowledge.

Figure 8 shows the relationships among three factors that is, learning activities, furniture arrangements, the combination use of classrooms and open space. Especially as for discussion and presentation, we found teachers devise the layout of desks and tables and the combination use of classroom and open space.

For better understanding, I will show you 5 real examples of using classroom and open space at the same time by moving and set
1. **Learning activity: Explanation, orientation, and summary**
   Teachers and children move tables to the wall and make vacant space in the center of open space. Children gather sitting on the floor there and listen to teachers.

2. **Learning activity: Print exercises**
   Teachers set a desk and a table in the center of the open space and set the tables for picking up print materials on the border between open space and classrooms. Each child does exercise with print material alone in his classroom.

3. **Learning activity: Craft works**
   Children move and set desks in their classrooms and tables in open space. They can use the larger top areas of desks and tables for craft works.

4. **Learning activity: Inquiry learning**
   Children move and set desks in their classrooms. Some children use desks near bookshelves. Some children use PC on the carrels along the wall. And then some children move and set PC with carrels in classrooms and open space. Each child makes inquiry learning alone.

5. **Learning activity: Presentation**
   Children set presentation desks for not specified members in one classroom and for group members in other classroom. Children can make and experience different presentations in each classroom.

Figure 10 shows example of using a classroom and open space at the same time without moving desks and tables.

Teachers always set several tables in open space near classrooms. Children use desks in their classroom and two or three tables set near their classroom at the same time. They do not use the tables set facing the other classroom because of noise and visibility problems.

Though I cannot refer to the learning activity on sitting situation on the floor, children's sitting situations are very flexible in learning contents, children's number, sitting configuration, and so on. I think they are suitable for flexible open spaces.

**Conclusion**

My research work about flexibility is not complete and is now on the way. Our research work can provide some materials for good cooperation and mutual understanding among architects, planners, school boards, teachers, and people interested in school buildings. ■
### References


### About the Author:

**Fumihito Miyamoto** is the Associate Professor, Research Center for Educational Facilities and School of Architecture, Tokyo Institute of Technology. He specializes in Planning of School Buildings (Kindergarten, Elementary school, Lower middle school, Upper middle school, university, library, and educational related facilities) and Environmental Psychology (Environmental Perception, Cognition, and Evaluation). He has been the delegate from Japan, as Associate Member of Program on Educational Buildings (PEB), OECD since 1996.
School Construction and Renovation Spending: Who’s Benefiting?

By Jeff Vincent and Mary Filardo

According to a recent study by Building Educational Success Together (BEST), what was true in 1995 appears to still be true today in school district capital spending: a school with large minority enrollment, in a district with a high percentage of students from low-income families, is still most likely to be in the worst physical condition. The BEST study titled Growth & Disparity: A Decade of U.S. Public School Construction, analyzed the scope and distribution of the construction and renovation spending of the country’s public school districts over a ten-year period, 1995-2004, and found disparities in which students and communities have benefited from this major – and increasing – public investment.

Spending on public school construction and renovation has been on a steady rise for the last few years. Local school districts across the country are spending millions of dollars to maintain, upgrade, and renovate existing schools and build entirely new schools. Many districts are doing both. These capital expenses are enormous and important undertakings by school districts have a variety of impacts on school quality and the vitality of local neighborhoods. The research on school building conditions and student outcomes finds a consistent relationship between poor facilities and poor performance by students and teachers (Schneider 2002; Earthman 2004; Buckley et al. 2004). Research also suggests that overall school quality and school facilities affect communities and their economic strength, including property values, local community revitalization, and job creation (Salveson and Renski 2002; Local Government Commission 2002; Center for Economics Education and Research 2003; Kane et al. 2003; Weiss 2004).

A recent study by Building Educational Success Together (BEST) has analyzed the scope and distribution of the construction and renovation spending of the country’s public school districts over the ten-year period, 1995-2004, and finds disparities in which students and communities have benefited from this major – and increasing – public investment. The study, Growth & Disparity: A Decade of U.S. Public School Construction, was conducted to assess school facilities spending nationally in the decade since the General Accounting Office (GAO) reports in the mid-1990s documented the physical conditions of the nation’s public school facilities, finding that one-third of all public school buildings in the country – about 25,000, serving nearly 14 million children – were in a serious state of disrepair, requiring an estimated $112 billion dollars to alleviate.
The Data
To assess the last decade of school capital spending since the GAO findings, BEST sought a reliable alternative source of data, because there is no comprehensive public national database on public school facility conditions or school construction spending. While the federal government does report aggregate school construction spending within states in the U.S. Census of Governments and the National Center for Education Statistics (NCES) Common Core Data (CCD), these data do not enable analysis of how and where the money was spent. The private sector however, as the primary provider of the labor, materials, and management for school construction, has had a strong interest in school construction spending. BEST obtained detailed project-level data on every building project valued at more than $100,000 undertaken by the nation’s school districts between 1995 and 2004, collected by McGraw Hill Construction, a segment of McGraw Hill Companies. These “construction start” data reflect the contract value of each project and represent the construction “hard costs:” the basic labor and material expenses of the project. The additional “soft costs” – such as site acquisition, architectural, engineering, project management and other fees – are not collected by McGraw-Hill. Hard costs typically account for about 70 percent of a project’s total cost. These 146,559 projects were linked to NCES CCD and U.S. Census data by school information and zip code for analysis.

How Much School Construction Spending has Occurred?
Spending on public school construction has seen tremendous growth since 1995. Of the nation’s more than 17,000 school districts, nearly three-quarters of them had school construction projects during the decade. Not since the post-WWII Baby Boom has the nation seen such investment in K-12 school buildings.

The report finds that public school districts spent more than $304 billion (2005 dollars) on bricks and mortar hard costs for public school construction over the decade. Spending on school construction nearly doubled from 1995 to 2004. Spending rose particularly sharply between 1998 and 2002, made possible in part by a strong economy in the late 1990s.

The average enrollment of public school students in the U.S. between 1995 and 2004 was about 46.6 million. This translates into a 10-year national average school construction expenditure of $6,519 per student – or $652 of school construction expenditures per student, per year.

What was the Money Spent On?
Many school districts and states are planning, designing, building, and renovating public school buildings of exceptional quality and at the same time, working hard to bring existing schools up to code and into good repair. Over the decade, school districts funded more than 12,000 new schools and more than 130,000 improvements. Of the $304 billion spent, nearly half funded new schools.

Figure 2: Nearly Half of Construction Spending Goes for New Schools

How do the States Compare?
Spending within states varied significantly over the decade. To compare states, the total spent within the state was divided by the state’s average 10-year enrollment. The national average per student of $6,519 was more than three times higher than Montana, the lowest-spending state, which spent $2,004 per student, and slightly less than half the spending of Alaska, the highest-spending state, which spent $12,842 per student.

Why Has Spending Increased So Much?
Public school construction spending nationally has increased for two main reasons: enrollment growth and needed maintenance issues associated with age and condition of buildings. In many parts of the country, enrollment growth fueled new school construction and additions to existing schools. Between 1995 and
Poor conditions, new codes and practices spurred spending on renovations. The vast majority of school construction spending was for improvements and additions to existing schools. Years of deferred maintenance and normal wear-and-tear put the nation’s aging school infrastructure in need of massive investment, as documented by the GAO reports. Existing schools also need upgrades to meet new building codes and practices such as energy conservation and more advanced heating, ventilation, and air conditioning systems. Older schools also need electrical and technological upgrades to support new technologies that support changing curriculum needs.

Who Has Benefited?

Ten years ago, the GAO study found that one-third of the nation’s school buildings were in a serious state of disrepair. What was disturbing then was the great disparity in who attended the country’s most dilapidated school buildings. What is disturbing now is that after the biggest school building boom—undertaken during strong economic times, with low inflation and increasing spending in public education—the BEST analysis suggests that there is no sign that the disparity documented by the GAO in 1995 has been alleviated. Based on the analysis of school district capital spending, what was true in 1995 appears to still be true today: a school with large minority enrollment, in a district with a high percentage of students from low-income families, is still most likely to be in the worst physical condition. The analysis finds that the higher the percentage of low-income students in a district, the less money was spent on school facilities. Over the last decade, the most disadvantaged students received about half the funding for their school buildings as their wealthier peers.

To understand the distribution of capital spending over the decade, the BEST research team analyzed the per student spending by: 1) the family income level in public school districts; 2) the median household income of neighborhoods; and 3) the racial and ethnic composition of school districts.

In 1996, the GAO reported that schools with the greatest numbers of students qualifying for free or reduced-priced lunch also reported the most inadequate buildings. Schools with 70 percent or more of their students qualifying for free or reduced-priced lunch reported that 41 percent of their buildings were inadequate. Schools with fewer than 20 percent of their students qualifying for free or reduced-price lunch reported only 25.1 percent of their buildings as inadequate.

School Districts by Students’ Family Income

To analyze how school construction spending was distributed by family income, school districts were classified into five categories (quintiles) based on the percentage of a district’s students that qualify for free or reduced-priced lunch. For the 2006-2007 school year, children who are eligible for free or reduced-price school lunches must come from families with an income of less than $37,000 for a family of four.

The school district quintiles are as follows:

- Very Low Income: More than 75 percent of students qualify for lunch subsidies
- Low Income: 40 to 75 percent of students qualify for lunch subsidies
- Moderate Income: 25 to 40 percent of students qualify for lunch subsidies
- Middle Income: 10 to 25 percent of students qualify for lunch subsidies
- High Income: Less than 10 percent of students qualify for lunch subsidies

The lighter grey columns in Figure 4 display the distribution of students within school districts characterized by the quintiles. Just over 18 million students attend public schools in school districts where 40 to 75 percent of students qualify for school lunch subsidies, but the majority of students attend public school in districts where less than 40 percent of students qualify for lunch subsidies.

As evident in Figure 4, school districts with 75 percent or more of their students qualifying for free or reduced-price lunch received the least facility expenditures per student—an average of $4,800 per student. The school districts with the fewest students qualifying for free or reduced-price lunch, less than 10 percent, spent the most money per student—an average of $9,361. Overall, the higher the percentage of low-income students in a district, the less money was spent on school facilities.

School District Spending by Community Household Income

Because school districts can cover hundreds of square miles and include many types of communities, an analysis of school construction spending at the school district level can mask important variations in spending, particularly in states with county school districts such as Florida and Georgia. To try to understand what is happening in local neighborhoods, the project data was analyzed with Census 2000 median household income data at the zip code level.
Zip code areas were divided into five categories (quintiles) according to their median household income:

- Very Low Income: Less than $20,000
- Low Income: $20,000 to $34,999
- Moderate Income: $35,000 to $59,999
- Middle Income: $60,000 to $99,999
- High Income: $100,000 and more

The lighter grey bars in Figure 5 show the distribution of students in the different types of neighborhoods. In 2003, about half of all public school students in the country lived in moderate-income communities with median household incomes between $35,000 and less than $60,000. Only 1 percent of students live in high-income communities with median household incomes of $100,000 or more, and more than 30 percent of students live in low- or very-low-income neighborhoods with median household incomes of less than $35,000.

The lowest investment ($4,140 per student) was made in the poorest communities, while the highest investment ($11,500 per student) was made in high-income communities. Overall, the more affluent a community, the more funds were spent per student on school construction.

School District Spending by Race and Ethnicity

The minority enrollment in public schools is changing. In 2003, Hispanic students became the largest minority in public schools. The 2003-2004 distribution of students by race was: 58 percent White, 20 percent Hispanic, 17 percent Black, 4 percent Asian, and 1 percent American Indian.

In 1996, the GAO reported that individual schools with higher proportions of minority students were most likely to report inadequate building conditions: 42 percent of the schools where more than half of the students were minorities were reported as being inadequate. Conversely, only 28 percent of schools that had very few minority students were reported as inadequate.

School districts were divided into four groups (quartiles) based on the racial composition of their students:

- Predominantly minority: population is less than 10 percent non-Hispanic white
- Majority minority: population is 10 to 50 percent non-Hispanic white
- Majority White: population is 50 to 90 percent non-Hispanic white
- Predominantly White: population is more than 90 percent non-Hispanic white

Nineteen percent of the nation’s 48 million public school students attend schools in districts that are more than 90 percent White. Although 60 percent of the nation’s public school students still attend public school districts that are majority white, 40 percent attend public school districts that have majority-minority populations.

As shown in Figure 6, spending on school construction between 1995 and 2004 ranged from an average of $5,172 per student in the districts with the highest concentration of minority students to $7,102 per student in districts with the highest concentration of white students. The higher average expenditures occurred in schools that were predominantly white. Schools with high percentages of minorities received the lowest average expenditures per student.

Conclusion

The analysis of school construction spending reveals tremendous growth, yet significant disparities, in who has benefited from the last decade of public school construction spending across the country. The study finds that the disparity in spending by community income was greater than both the disparity by race and the disparity by students’ family income. This suggests that a substantial number of minority children are affluent enough or attend school districts with enough affluent children to benefit from a higher level of investment than would be likely in more economically isolated and poor districts. It also suggests that disparity between schools within a school district is likely masked in a district level analysis.

The BEST report concludes with a set of recommendations to address spending and conditional disparities to ensure that public school buildings are healthy, safe and educationally adequate for all students, teachers, and families. The report recommends a shift in federal and state policy, funding, and accountability to better
support high quality school facilities. Fundamentally, states need systems to better measure and assess school facility conditions.

The report was released by Building Educational Success Together (BEST), a national collaborative of organizations working in education reform and community development, and is available online: http://www.21csf.org/csfs-home/publications/BEST-Growth-Disparity-2006.pdf.

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**About the Authors:**

**Jeff Vincent,** Deputy Director, Center for Cities & Schools, University of California-Berkeley, co-founded the Center for Cities & Schools (http://citiesandschools.berkeley.edu) at the University of California-Berkeley to position high-quality education as a critical component for broader city and metropolitan policy-making, believing that invigorating public education and revitalizing neighborhoods are goals that can, and should, be accomplished in tandem. Jeff has a Ph.D. in City and Regional Planning from UC Berkeley and his research looks at the intersection of land use planning, school facility planning, and community development. CC&S is a member of the Building Educational Success Together (BEST) collaborative, a research, constituency building and communications collaborative to improve urban school facilities. Jeff serves as a researcher for BEST, currently analyzing school construction policy, spending, and outcomes. He can be reached at: jvincent@berkeley.edu

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