Design Features Of the Physical Learning Environment For Collaborative, Project-Based Learning at The Community College Level

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ABSTRACT

The purpose of the study was to (a) determine the design features of the physical learning environment that support collaborative, project-based learning, and (b) to gain an understanding of the rationale for the selection of the features. The literature review indicated a need for changing learning expectations to prepare learners for rapidly changing roles and responsibilities for the 21st century. Collaborative, project-based learning was identified as a pedagogy that prepares learners for these new learning expectations. Data were collected in three phases using a phenomenological approach. Collection methods included site visits, observations, reflection, text, interviews, and designs. Architects and educators participated in the study. Thirty-two design features were identified and placed into six categories. Upon further reflection and analysis, it appears the essence of the findings is the interrelationship among spaces and people.

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FOCI AND SIGNIFICANCE OF THE STUDY

The study began determining learning processes that support 21st-century learning expectations to prepare learners for new roles and responsibilities. The study next moved to the physical learning environment that best supports and enhances the attainment of necessary knowledge and skills to meet those roles and responsibilities. Why should we be concerned about the physical learning environment?

The majority of the current community college facilities were built beginning in the 1960s at a rate of one new college per week (American Institute of Architects, 1999; O'Banion, 1997). During this heightened building phase that continued through the 1970s, facilities were produced as box-like, minimalist structures using concrete-load bearing and exterior walls, low ceilings, and few windows (Brubaker, 1998). According to Lindblad (1995), the design features described by Brubaker limited the sense of community among learners, reduced the ability for learner-to-learner and learner-to-teacher interaction, and inhibited the ability to create a variety of learning environments that support active learning processes. "Colleges that thrive and prosper in the 21st century will be those that are able to anticipate change, redefine themselves, and align their facilities to support their institution's mission and academic plan" (Reeve & Smith, 1995, p. 1).

Community college presidents, boards of trustees, and legislators in the United States are faced with the dilemma of having learning facilities that are reaching the end of their useful and safe life spans at the same time resources for new capital construction or renovation are limited. Examples of the need for new or improved facilities are the following:

1. Three-fourths of the 2001–2003 biennial capital budget request to the Legislature by the State Board for Community and Technical Colleges (2000) in the state of Washington was to (a) repair aging buildings, (b) modify facilities to use today's technology and serve today's students, and (c) increase capacity to serve the baby-boom echo and adults seeking retraining.

2. On the general election ballot in November 2000, five Oregon community colleges requested approval of a total of $244 million dollars for the improvement of their facilities.

3. The state of North Carolina passed a statewide bond in 2000 for $3.1 billion dollars for new construction and renovation of facilities for community colleges and universities. For example, one of its colleges, Guilford Technical Community College, earlier in the year had passed a local bond for an additional $25 million, and still received $33 million dollars of this allocation. Out of the $33 million, the college allocated $5 million for repairs and renovations, with the remainder going for new construction at their five sites. Of the earlier $25 million, they set aside $3 million for technology.

4. The North Harris Montgomery Community College District in Houston, TX, passed a $186 million bond in 2000 for new construction for the ensuing three years—$90 million will go to build the new Cy-Fair Community College, $15 million will be allocated to each of the other five colleges in the district, and the remainder will go the district office.

Donald (1997) stated that college policy makers have paid comparatively little attention to identifying the appropriate learning context and process for achieving stated learning outcomes, and even less to the design of the physical learning environment that supports the learning process. Supporting this, Lawton (1999) and Mayer (1999) discussed the abundance of research studies and published articles on various forms of learning processes and the linking of these processes to learning outcomes relevant to the changing context of work, family, and community life. However, there is very little research or literature on college campus and facility planning that is supportive of the needed learning processes.

Foci of the Study

The study had two areas of focus. The first was to identify and describe the desired features of the physical environment that support and enhance collaborative, project-based learning in community college settings. The characteristics of the physical environment investigated in the study included scale, location, functionality, relationships, and patterns. The second area of focus was to understand the thinking behind, or rationale for, the desired characteristics being recommended, and included the following aspects:

1. What factors are important to consider?
2. What is the sequence of consideration among the factors?
3. How are the factors related to one another?
4. How are the recommendations derived?
5. What is still puzzling about the process?
6. What theories are applied in making the recommendations?

Significance of the Study

The significance of the study was based on the following newly defined societal and educational expectations that resulted from the transition from the industrial era to the knowledge era: (a) changing roles and responsibilities of work, family, and community life; (b) learning outcomes needed to meet the changing roles and responsibilities; (c) learning processes that supported the achievement of the learning expectations; and (d) features of the physical environment that enhanced a selected learning process—that being collaborative, project-based learning.

Changing Roles and Responsibilities of Work, Family, and Community

In addressing the changing roles and responsibilities of work, family, and community life, Walsh (1999) stated the following five, broad contemporary challenges facing today's learners and faculty: (a) globalization, created by the speed with which ideas, people, capital, and cultures move with the aid of technology, and which erases space and borders; (b) changing nature of

work from an industrial age to a knowledge age, requiring new and rapidly changing desired skills and competencies; (c) changing demographics, creating a diverse and multi-cultural living and working environment; (d) changing societal norms due to fast-paced, fragmented, and changed structures that challenge traditional values and truth claims; and (e) accelerating rate of change that requires the ability to learn new things, use initiative, and take charge of one's own learning.

More specifically, a National Institute for Literacy (NIFL) study, written in 2000, identified common activities used in work, family, and community roles and responsibilities in today's society. Activities include the ability to (a) gather, analyze, and use information, (b) manage resources, (c) work within the larger picture, (d) work together, (e) provide leadership, (f) guide and support others, (g) seek guidance and support from others, (h) develop and express sense of self, (i) respect others and value diversity, (j) exercise rights and responsibilities, (k) create and pursue vision and goals, (l) use technology and other tools to accomplish goals, and (m) keep pace with change.

In summary, work, family, and community life roles and responsibilities were impacted by globalization, entrance to the knowledge age through the availability and use of technology, changing demographics in population, and the accelerated rate of change. These changes, in turn, created new learning expectations. Several initiatives were established to encourage and support attention to changing learning processes that addressed the newly defined learning expectations.

Changing Learning Expectations and Related Educational Initiatives

To assist in defining learning expectations needed for the 21st century, the U.S. Department of Labor Secretary's Commission on Achieving Necessary Skills (SCANS; 1991) recommended a set of skills needed by workers of the new century. Among the skills were the ability to (a) reason; (b) think creatively; (c) make decisions; (d) solve problems; (e) work in teams; (f) work well with people of other cultures; (g) understand, monitor, correct, design, and improve systems; (h) select appropriate technology and apply it to specific tasks; and (i) direct their own personal and professional growth through lifelong learning.

In 1996, the National Skills Standards Board (NSSB) was formed to determine national industry standards, against which learners' and employees' competency in skill areas could be assessed. One part of the vision of the NSSB was to encourage educational institutions to implement processes to ease the recording and acceptance of completed credits and assessments from one institution to another. A second part of the vision was to encourage educational institutions and business/industry partners to establish common competencies and common assessment tools. Another federal initiative, sponsored by the U.S. Department of Labor to address the changing needs of work, family, and community, was The Workforce Investment Act of 1998. The Act recognized the need to provide necessary family and social service support systems for people while they developed their workforce skills. At the same time, other state and federal initiatives were established for identifying learning outcomes or expectations, for establishing new methods for assessment, and increasing accountability to legislators and taxpayers. According to the League for Innovation for Community Colleges (1998, 1999, 2000), the outcomes identified for 21st-century learners included achievement of strong (a)

communication skills; (b) computation skills that included the capabilities of reasoning, analyzing, and using numerical data; (c) community skills of citizenship, diversity, and pluralism; (c) local, global, and environmental awareness; (d) critical thinking and problem solving skills; (e) information management skills; (f) interpersonal skills including teamwork, relationship management, conflict resolution, and workplace skills; and (g) personal skills that included management of change, learning to learn, and personal responsibility.

In summary, the impact of moving from the industrial age through the technology age to the knowledge age spanned the boundaries of work, family, and community. Skills needed to effectively fulfill roles and responsibilities in the three areas were far different than those needed for the industrial age. The last two decades of the 20th century saw youths and adults (a) working and living within systems of different cultures; (b) actively participating in a global economy; (c) contributing new thinking to work, family, and community by engaging in team work, creating new products, and solving problems; and (d) managing their own lifelong learning. To fulfill the roles and responsibilities, youths and adults sought more active, relevant opportunities to learn the skills required to actively participate and make contributions to their work, to their families, and to their communities. The new roles, responsibilities, and expectations of the learners indicated a need for changing learning processes.

Changing Learning Processes

Dede (1993) described learning processes to prepare learners for the workplace and in 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). In addition to the previously mentioned initiatives sponsored by the League for Innovation in the Community College, the W.K. Kellogg Foundation (2000) and The Pew Charitable Trusts (2000) also funded projects for community colleges to identify necessary skills for learners to contribute in their work, family, and community roles and responsibilities. Subsequently, they identified learning processes that best address the necessary skills.

The need for more active learning processes included pedagogical strategies such as (a) collaborative learning, (b) cooperative learning, (c) learning communities, (d) inter-disciplinary seminars, (e) integrated learning, (f) project-based learning, (g) work-based learning, and (h) community-based learning (Bruffee, 1995; Cooper, Robinson, & McKinney, 1994; Fosnot, 1993; Goodsell, Maher, Tinto, Smith, & MacGregor, 1992; Oakey, 1995). According to Skolnikoff (1994), educational institutions need to provide programs in which learners learn to think and become participants in the larger world.

For this study, collaborative, project-based learning was chosen as the active learning process to address the learning expectations necessary to meet and direct the challenges of work, family, and community roles characterized in the previous sections. As described by Gokhale (1995), collaborative learning is an active learning process that groups and pairs learners at various performance levels for the purpose of working together in achieving an academic goal. More specific to this study, Bruffee (1995) stated that collaborative learning is designed for the older learner and provides learning expectations not only for content, but also for critical thinking,

problem solving, teamwork, negotiating, reaching consensus, social and academic development, and developing a sense of community.

The literature described project-based learning as being oriented to the "real" world and having value and meaning beyond the teacher and learner (Bruner, 1990; Dewey, 1939; Rogers, 1969). It encourages the building of relationships, communication skills, and the use of higher order thinking skills, such as critical thinking to define and solve problems. 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 & Oregovicz, 2000).

In summary, with the changing roles and responsibilities for work, family, and community, changing learning expectations have emerged to prepare learners to meet the shifts in roles and responsibilities. In turn, pedagogies needed to address the changing learning expectations with more emphasis on active, learner-centered learning processes. Collaborative, project-based learning was identified as a pedagogy that prepares learners for the new learning expectations. To support and enhance collaborative, project-based learning, how do community colleges design physical learning environments in which learners successfully gain the understanding and skills to meet the challenges in their futures?

Features of the Physical Learning Environment that Support and Enhance Collaborative, Project-Based Learning

According to Kirk (2000), learners are increasingly less willing and less able to learn in a lecture format, and want teaching and learning to be more active and process-oriented, while learning content. Many factors contribute to learner achievement, and through what little research has been done, advocates state that educational facilities are an essential part of improving education—especially as educators move toward using active learning processes (Lawton, 1999). Relatively little attention has been paid in the literature to physical environments in relation to various active learning processes, and in particular to collaborative, project-based learning.

Halpern (1994) edited a book on changing college classrooms by focusing on new teaching and learning strategies for the increasingly complex world, but there was no mention of the physical environment in which these new strategies were used. Another example of the lack of information about the physical learning environment and how it impacts the learning process was a book written by Johnson, Johnson, and Smith (1991) about active learning in the college classroom where only one paragraph was written describing the importance of the room arrangement.

How should the physical learning environment be configured for more active learning processes? Often, the physical learning environment is a barrier to collaborative, 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). To remove those barriers, Brubaker (1998) advocated the need for (a) flexibility

of space that allows for a variety of learning methods, (b) specialized facilities that respond to specific curricula and delivery modes, (c) community space for citizens of all ages, and (d) space for a variety of on-site social services to address the emerging learning expectations of the 21st century.

Designing Physical Learning Environments

Prior to the 1990s, most of the existing learning facilities were designed to sustain a model of education characterized by large-group, teacher-centered instruction occurring in isolated classrooms (National Clearinghouse for Educational Facilities, 1998). In a recent design session for a new high school, the superintendent described why the thinking about and designing of school facilities remains locked in the early 20th century. He stated that "it is our collective and idealized memories of the learning setting that could be the greatest barrier for designing facilities that will help learners achieve success today and in the future." Reflecting on my experience as a community college administrator confirmed that the design of the majority of community college learning settings was also based on the historical thinking and practice described by the superintendent. Combining the concerns of dated learning processes and physical learning settings, Perelman (1992) stated that the early pattern of students being passive recipients of knowledge, while being seated in traditionally designed classrooms, had been indelibly stamped on each successive generation.

This study focused on the community college level; however, there are references to public school settings primarily in the first phase of the research. This is due to the nature of the first phase being exploratory, and my need as a researcher to create new knowledge. Additionally, research showed that those at the K–12 educational level recognized the need for changing learning expectations, processes, and learning facilities to a greater degree than did those at postsecondary educational institutions. When addressing life roles and responsibilities, both the NIFL study and SCANS included secondary and postsecondary levels of learning. Thus, the identified learning expectations and processes are as pertinent and adaptable to both secondary and postsecondary learning as are the design features of the physical learning environment that emerged from the study.

The design of educational facilities gained increased attention from both educators and architects by the late 1990s. The American Institute of Architects (1999) sponsored a conference on renovating schools built in the early- and middle-20th century. One session of the conference covered three current trends in educational programming, which required a redefinition of classroom space and the need for flexibility in the design. The three trends listed were: (a) no more teacher as lecturer, (b) focus on project-based learning, and (c) cooperative work, which is fundamental to society and work.

In 1998, the American Institute of Architects, the U.S. Department of Education, and the White House Millennium Council (U.S. Department of Education, 1998) held a symposium on designing schools for the 21st century. Suggestions by symposium participants for building new schools were to:

1. Enhance teaching and learning, and accommodate the needs of all learners by designing physical environments that support hands-on, project-based, and interdisciplinary learning.

2. Serve as centers of the community through the creative configuration of the physical environment to accommodate learning for all age levels, to support learning during days, evenings, weekends, and summers.

3. Involve all stakeholders in the design process and provide adequate time and resources for the design process.

4. Provide healthy, safe, and secure physical environments.

5. Make effective use of all available resources by creating flexible spaces that serve small and large groups, and in which office and maintenance areas are designed to serve both educational and operational functions.

6. Maximize the use of technological resources.

7. Allow for flexibility and adaptability to changing needs, and remain open to possible changes in the community's aspirations for the physical environment.

In September 2000, the National Alliance of Business, the U.S. Chamber of Commerce, and the U.S. Department of Education (U.S. Department of Education, 2000) held a Satellite Town Hall Meeting on modernizing schools. During the Town Hall Meeting, then-Secretary of Education Richard W. Riley challenged the audience to "re-imagine our school buildings and classrooms to (a) support the teaching and learning styles of the 21st century, (b) serve multiple uses, and (c) become centers of communities for people of all ages." Secretary Riley stated that the building and what happens inside were inseparable. Often community colleges rent their available facilities, hold classes in public school and community buildings, and are beginning to plan and build shared facilities as a means of conserving resources.

In summary, the related literature and the various national initiatives indicated a need for more active learning processes to prepare learners for the changing roles and responsibilities of work, family, and community. The majority of community college facilities were built at a time when the learning process was content-driven and delivered through lecture. As the literature pointed out, for learners to gain competency in the knowledge and skills needed for new roles and responsibilities, learning processes need to be more active, and facilities need to be designed to support various styles of learning and teaching.

What was missing from the literature relating to the foci of this study was adequate research to describe the desired features of the physical environment that support collaborative, project-based learning—especially at the community college level. Yet, colleges across the country continue to spend billions of dollars building new facilities or renovating existing facilities. Will those facilities resemble the learning factories of the early-20th century, or will the facilities be

designed to be an integral component of a more active learning process, and be flexible enough to accommodate the rapid changes in the contexts of work, family, and community life?

DESIGN OF THE STUDY

The study was designed to seek meaning through engagement with participants using an emergent process as the study progressed. Because of the nature of the foci of the study, I chose to do a qualitative study from a phenomenological perspective and write the study using first-person vernacular that is in keeping with phenomenology. To gain the rich description, reflection, interpretation, and appropriation that Langan (1984) described for phenomenological studies, the design of the data collection and analysis processes included three phases. The phases served to: (a) move the research from an introductory and exploratory stage in which I was becoming aware of the need for the study and to clarify the foci of the study; (b) reinforce the significance of the study to advocate the benefits of active learning processes in preparing learners for the rapidly changing roles and responsibilities in work, family, and community life; and (c) narrow the scope of the study to collaborative, project-based learning at the community college level. Table 1 summarizes the three phases of the research.

Design of Phase I

Phase I served as an introduction to, exploration of, and clarification of the two foci of the study. As stated previously, Phase I included both secondary and postsecondary sites. The first phase was made up of two main events. The first was comprised of site visits to two schools in the Twin Cities area of Minnesota—the School for Environmental Studies and the Interdistrict Downtown School. The second event was an internship required by the Community College Leadership doctoral program at Oregon State University, and included: (a) working with an architectural firm in developing a master plan for a community college, and planning the pre-design for a new community college facility to be located on a university campus; and (b) concurrently working with another architectural firm in renovating an existing community college building.

Because this was a phenomenological study, Phase I occurred in actual educational settings to gain a preliminary understanding of design features of physical learning environments and of the thinking behind, or rationale for, selection of features. Sources of data for Phase I included observations and notes from site visits; research and writing I did for the internship and used in the master planning process, and in the pre-design and renovation projects; participation in facilities design processes; and reflection.

Design of Phase II

The second phase of the research began to narrow the scope of the study to collaborative, project-based learning at the community college level and the design of the physical learning environment that supports and enhances the selected learning process. However, some of the educational sites visited in Phase II were PreK–12 level because that is the level of education where collaborative, project-based learning is most often used and where sites can be found.

Table 1
Three Phases of Study Design

	Phase I	**Phase II**	**Phase III**
Purpose	Gained awareness of and explored general topic areas of study. Began to move focus to community college level. Clarified focus of study.	Gathered data specific to collaborative, project-based learning and the design of the physical learning environment.	Gained a deeper understanding of the design features of the physical environment that support and enhance collaborative, project-based learning and the rationale for the selection of the desired features.
Events	Visited educational sites. Completed internship with an architectural firm focusing on community college facilities.	Attended a conference workshop on project-based learning. Attended a conference on innovative learning environments.	Conducted a 2-day design studio in which architects and educators designed physical environments that supported and enhanced collaborative, project-based learning at the community college level.
Nature of Data	Studied physical learning environments in general and design processes for physical learning environments.	Explored the desired features that support and enhance collaborative, project-based learning.	Researched in-depth the features that support and enhance collaborative, project-based learning and the thinking behind the selection of the features.
Data Collection	Recorded notes from observations, participation in, and reflection on design processes.	Participated in two workshops, recorded notes, toured educational facilities, and conducted informal and formal interviews.	Conducted interviews, recorded notes from observations, reflections, participants' journals, audiotapes and videotapes, and participants' design work.
Data Analysis	◄———	Theme analysis	———►

Phase II also had two main events. The first event was participating in a project-based learning workshop session at the National Council for Occupational Education annual conference held October 26–28, 2000, and conducting follow-up, informal interviews with two of the presenters of the session who are community college employees. The second main event of Phase II was the opportunity to attend an international conference, Innovative Alternatives in Learning Environments, sponsored by the American Institute of Architects' Committee for Education, Hogeschool van Amsterdam, and the National Clearinghouse for Educational Facilities. The conference was held in Amsterdam, The Netherlands, November 6–11, 2000, and included the following sub-events: (a) attending a pre-conference workshop, (b) touring educational facilities, (c) hearing presentations and case studies, and (d) participating in a learning-space design workshop.

In a phenomenological research study (Denzin & Lincoln, 1998; van Manen, 1990) the researcher enters into close relationships with the research participants in order to gain an understanding of their everyday "lived" experiences. The conference provided the opportunity to create relationships with several of the participants on a person-to-person basis and in open-ended e-mail interviews after the conference concluded. Sources of data for Phase II of the research included observations from sites visits, notes that I took at the conference sessions, reflection, and audio-taped and e-mail interview transcriptions.

Design of Phase III

The third and most intense phase of the research was a 2-day design studio that I conducted March 26–27, 2001, in Portland, OR. The term "design studio" comes from combining the definitions of "design" and "studio." According to Merriam-Webster (1993), design means: to create, to fashion, to sketch; to draw, lay out, or prepare a design; to execute or to construct according to a plan. The definition of a studio is a working place that supports the creation of things—typically art, photography, architecture, or radio and television programming, or creative acts such as, dancing, acting, or singing. Senge, et al. (2000) described an architectural design studio as an educational tool to incorporate multiple modes of learning such as drawing, reading, writing, model-making, conversation, and team and individual projects (p. 180).

The design studio provided a venue to gain a deeper understanding of the design process—not only for myself, but also for the participants, and to produce designs of physical learning environments that supported and enhanced collaborative, project-based learning. The activities of the design studio included creative and active engagement in determining the features of the physical environment and in understanding the thinking behind the selection of the design features for physical environments that supported and enhanced collaborative, project-based learning at the community college level. For Phase III of the study, data was gathered from the following sources: (a) notes from observing the participants; (b) individual audiotaped interviews with the participants; (c) audiotaped recordings of selected group discussions; (d) journals that each participant kept of her/his thoughts, insights, and questions; (e) tangible products produced by the teams in the form of diagrams, conceptual designs, and charting on large sheets of paper; and (f) a videotape of the designs' final presentations.

Research Participants

Phase I Participants. The research participants in phase one of the study were K–12, community college, and university administrators, faculty, and staff; architects; educational facilities directors; educational planners; site administrators, staff, and students; community members; and government officials. These people were involved in the projects in which I participated during my doctoral program internship and also provided the various educational site tours. Because this phase was introductory, I did not conduct formal interviews and did not enumerate the number of people involved, although it was well over 200.

Phase II Participants. Participants in Phase II of the study were: (a) a community college faculty member and an administrator who presented a project-based workshop at the National Council for Occupational Education annual conference, October 26–28, 2000; and (b) the architects and educators, representing 16 countries, who attended the Innovative Alternatives in Learning Environments Conference in Amsterdam, November 6–11, 2000. Of the attendees I became acquainted with during the week, eight participated in e-mail interviews, bringing an international perspective to the study and increasing the number of participants.

Phase III Participants. For Phase III of the study, which was the design studio, five architects and five educators were selected as participants. For a phenomenological study, the building of relationships is critical; therefore, it was important to balance the number of participants in Phase III with the amount of time available to build affinity without taking away process time. Additionally, the number of participants was limited to keep the group size manageable for one facilitator, as well as to manage the quantity of data gathered and analyzed. The participants were not compensated for their time or their travel expenses. Lodging and meals were provided.

Selection criteria for the participants of Phase III was experience in the following activities: (a) collaborative or project-based learning at the community college or university level as an administrator, faculty member, and/or learner; (b) management or involvement in community- or work-based learning projects; (c) design experience for innovative educational facilities; and (d) willingness to participate in a 2-day intensive workshop.

The educators, each from different curriculum areas, were: two community college faculty members, one community college dean, a learner from a public 4-year college emphasizing learning communities and project-based learning, and a director of a science education program at a large metropolitan science and industry museum. The architects were chosen because of their innovative design work at both the K–12 school and community college levels in different parts of the country and around the world. The participants were assigned to one of two teams of five. Participants who worked together in the same organization were placed on separate teams.

Multiple Perspectives. Each of the participants brought a different perspective and set of experiences to the study. The educators' experience in teaching and learning levels ranged from kindergarten through the university level to lifelong learning. Subject matter expertise among the educators included basic education, developmental education, college/university preparatory, college/university, and technical education. The architects in all three phases brought experience and expertise in all aspects of educational facility design, ranging from (a) analyzing facilities for safety, infrastructure code requirements, lifespan, and functionality for specific use; (b)

developing master facilities plans; and (c) designing new educational facilities and renovating existing facilities. For the most part, each participant was involved in only one of the three phases, which allowed for fresh thinking, a variety of responses, and a larger pool of participants. The participants also brought multicultural, national, and international perspectives to the data.

Data Analysis

This study followed the premise of phenomenological research in the following areas: (a) developing deep and meaningful relationships with the participants; (b) using various and progressive data collection methods as the study progressed; (c) adapting the design of the study as the essence of the phenomena being studied continued to evolve through each phase (Tuckman, 1999); (d) attaining a greater understanding of the phenomena as a web of experiences developed, as described by van Manen (1990); and (e) confirming what Miles and Huberman (1994) stated regarding good qualitative research leading to serendipitous findings, new integrations, and possible revision of existing conceptual frameworks. The intent of a phenomenological study is neither to produce generalizable data nor to make specific recommendations from the findings. Rather, the intent is to gain an understanding of the areas of focus from which to create meaning, based upon individual and collective "lived experiences."

Thematic Analysis Procedures

Gall, Gall, and Borg (1999, p. 298) described the steps of interpretational analysis from a phenomenological perspective as follows: (a) create an organizational system (database) of all the data collected, (b) divide the data into meaningful segments, (c) develop categories from which to code the data, (d) code the data, (e) group the categories and codes, and (f) generate themes from the categories. Examples of coding categories described by Bogdan & Biklen (1998, pp. 171-176), were (a) setting/context, (b) definition of the situation, (c) perspectives held by the participants, (d) participants' ways of thinking about people, objects, and situations, (e) process, (f) activities, (g) events, (h) strategies, (i) relationship and social structure, and (j) methods.

To manage the large quantities of data collected from multiple sources, I first organized the data by each phase of the study, and then by event and sub-event. The data were then analyzed in phase and event order to determine the desired features of the physical learning environment that support and enhance collaborative, project-based learning, and to understand the thinking behind, or rationale for, the selection of the features. The analysis of the data is displayed in Table 2, with the Category, Title, and Description columns relating to the first focal point of the study, which was the identification of the desired features of the physical learning environment that support and enhance collaborative, project-based learning. The second area of focus, which was to understand the thinking behind, or rationale for, identified features being recommended, is explained in the Purpose column of the table.

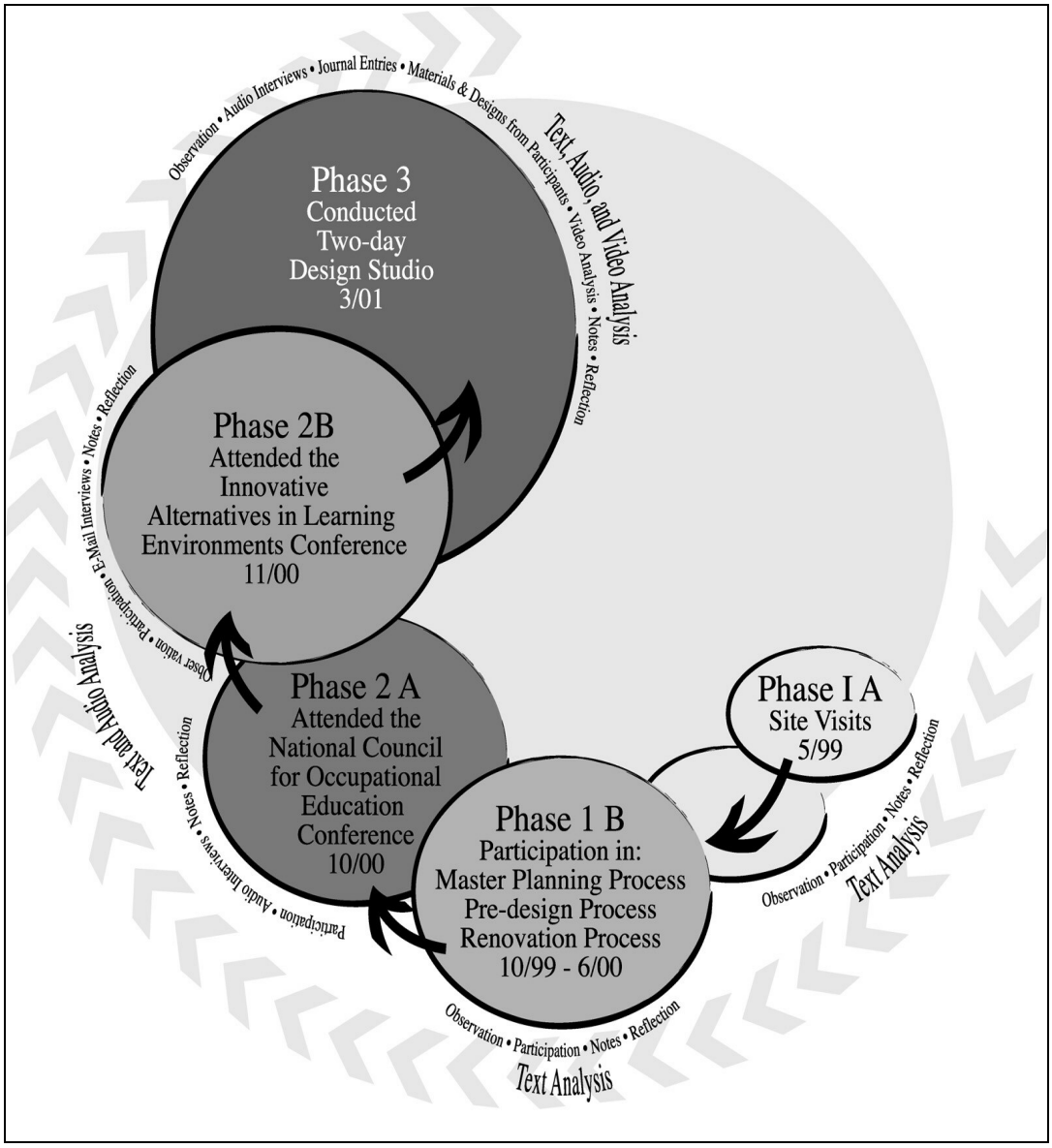

Figure 1. Data gathering and analysis processes.

Data in the study were coded using an alpha-numeric scheme and reported in tabular format for each phase. Using this data, I clustered the identified features into possible categories. At the conclusion of Phase III, I further analyzed the design features identified in all three phases and the preliminary categories to look for: (a) meanings from the data that might have been missed; (b) feature titles, descriptions, or purposes that might need further development; (c) reasons to move features to other categories; and (d) fine-tuning of the categories. Figure 1 shows (a) the phases, events, methods and dates of data collection; (b) the interrelationships between the phases; and (c) the analysis processes used. Secondly, the figure illustrates how observation, participation, and reflection occurred in each phase of the study and informed the design of each subsequent phase.

FINDINGS FROM THE STUDY

Descriptions and findings of the design features of the physical learning environment that support and enhance collaborative, project-based learning and the rationale for the features that were identified in each of the three phases are described and illustrated through the following verbal descriptions and graphical images. Findings from both levels of learning are included, based upon the phasing of the research over a period of 2 years, beginning with gaining initial, broad knowledge from public school and community college settings and narrowing the research to the community college level. This inclusiveness shows the progression of determining the design features and purposes of those features. When thinking of education in a systemic fashion, some of the features and purposes found in the research may be applicable to all levels of learning. My interpretation or clarification of participant quotes appears within brackets.

Phase I of the Study

School of Environmental Studies

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, MN and is located next to the Zoological Gardens (Zoo). 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 interior physical environment for SES is designed for 400 learners who are divided into "houses" of 100 each. Each house has a team of three teachers who guide the theme studies to the same 100 learners all year. The learners work with other teachers in elective classes and with community members who are involved in the theme-studies courses. 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.

Part of what prompted and motivated my interest in the design of the physical learning environment and its connection to quality learning came from observations made and conversations held while on the site visit. Two of the several points of interest were:

1. Use of collaborative, project-based learning processes that tied the learning to local, regional, and global environmental problems.

2. Knowledge (e.g., self-knowledge, content knowledge, and community-to-global knowledge) and skills (e.g., putting knowledge to practice, being skilled communicators, and actively contributing to producing products and services for others) explained and demonstrated by the learners.

The school was intriguing not only because of the innovative design of the physical environment that encourages integration of curriculum and teaching, but also because collaborative, project-based learning processes were used. The learners demonstrated what seemed to be significant learning. The sense of pride and ownership shown by the learners and staff indicated that SES was a unique place for learning.

Design Features of the Physical Environment. The natural setting in which the facility is located includes a pond, stands of trees, and pathways used as learning laboratories. Interior spaces of the physical learning environment include a common area that can seat all 400 learners, four "houses" with 100 learners each, a computer/multimedia laboratory, an art studio, and a zoology laboratory. Each house has the following learning areas: (a) spaces for small and large group work; (b) project space; (c) "pods" (Smith, 1996), each designed for 10 learners; (d) a central common space to gather all 100 learners; (e) science laboratory; (f) seminar space; (g) teaching team space; and (h) storage spaces for supplies and projects. The design features of the "pods" include (a) individual workstations with personal, lockable storage; (b) a display space for each learner to personalize her/his space; and (c) access to computer technology.

The furnishings are easily moveable, collapsible, and stackable. Aquariums, terrariums, and a wall in which plants grow are in the large common area. The south-facing wall has two-story, floor-to-ceiling windows to allow natural light and provide a view overlooking the pond and woods. Other walls showcased pictures of learners actively involved in their pursuits, as well as recognition plaques honoring SES curricular, staffing, and organizational models, and for the design of the built environment.

The Interdistrict Downtown School

The Interdistrict Downtown School (IDDS) is located in downtown Minneapolis, MN. The concept of an IDDS in Minneapolis (Minnesota Public Schools, 1995) was first discussed in 1989 to address the issue of voluntary racial desegregation and to design a focus or magnet school with multiculturalism as one of the themes for learning. The Minneapolis School District and nine neighboring suburban school districts, all having different racial compositions, participated in the visioning and designing processes for the school. The school, envisioned as a neighborhood school in an urban setting, provides a rich learning environment by accessing existing public and private facilities that include public theaters, YMCA, and public library. Access to and use of the public facilities provided the opportunity to design a school facility that did not need its own gymnasium, library, and stage/auditorium. Additionally, the location provides learners with the experience of being in the downtown business and community environment.

A design team selected five comprehensive learning goals that were being advanced by the Minnesota Department of Education as the basis for designing the learning context of the school and learning expectations of the students. The five selected learning goals were (a) purposeful thinkers, (b) effective communicators, (c) self-directed learners, (d) productive group participants, and (e) responsible citizens. Taking the five learning goals, the unique setting of the school, and the multicultural theme, the team established the learning context (Minnesota Public Schools, 1995) for the IDDS that (a) models 21st-century learning and school design, (b) uses the learning richness and possibilities of the downtown, (c) makes use of related experiences and practices from the nine participating districts, and (d) promotes collaboration and integration among grade levels and disciplines.

The learning context established the foundation for the development of the learning expectations and learning processes for the school (p. 11). According to Pease and Rowell in Minnesota Public Schools (1995), the design team then established specific learning products that would give evidence that learners had achieved the above-noted learning expectations. Skills to be developed through working on learning products (Minnesota Public Schools, 1995) included (a) learning research skills by gathering information through the use of surveys, interviews, and focus groups, (b) defining and developing materials, (c) using appropriate technology for research and production, and (d) building trust and resolving conflict. The various settings where learning products could be researched and developed were (a) library/resource center, (b) community areas, (c) businesses, (d) cafeteria, (e) private spaces, (f) outdoors, and (g) learning spaces within the school (pp. 26–29).

Design Features of the Physical Environment. Part of the design process for the IDDS was to envision a 21st-century learning environment and to link this vision with the identified learning outcomes, learning products, learning processes, and learning settings. The design of the IDDS is similar to the SES in that it provides a small-school structure through the use of "houses" of multi-grade-level learners. The building is designed to serve a maximum of 600 students. The houses are designed to support overlapping of grades with the lower floor serving grades K–5, the middle floor serving grades 4–8, and the upper floor serving grades 8–12.

In addition to providing a multicultural theme or focus for the IDDS, a second theme is to incorporate the richness of the downtown area in which the school is located. In keeping with the downtown theme, Stanton (1999) described how the street-level spaces of the school were designed to include a large commons area similar to what might be found in a town square or plaza. Adjacent learning areas are designed to be similar to a variety of shops and spaces found along a downtown street. One space is the resource/media/technology area designed to be similar to what might be found in a downtown bookstore or photocopy store, with access to resources and technology. Two other smaller areas, with wooden floors, are used for presentations, work display, projects, and practice spaces for dance and movement classes. The smaller spaces have glass-paned garage doors that open to the "town square," to provide additional space.

With the learning processes being experiential, each of the upper floors is designed to have a common, shared space with workbenches, hand tools, equipment, storage, and supply areas. The spaces can be closed off with garage doors at each end. It is intended that learning spills out and is not necessarily contained to a specific space or time. The common, shared spaces were defined as the "glue spaces" that link the various learning activities occurring on that level. Floors are sealed concrete, as project learning could be messy.

The infrastructure and mechanical systems of the building are exposed, making the building a learning tool. Environmental quality and sustainability are elements in one of the experiential learning programs offered at the IDDS. In keeping with the concepts of designing a physical learning environment that focuses on learner needs, the windows open for fresh air, and the major learning spaces are on the south side of the building, incorporating natural lighting. A design element incorporated into the building to indicate it is a place for learning is a large, cantilevered, glassed staircase at the street end of the building, which showcases the presence of

learners to the outside community (Pfluger, 1995). The staircase design serves as a visual link to the marquees of the theatre arts facilities on the same street.

Internship Activities

Wanting to focus on physical learning environments at the community college level, my internship with LSW Architects, PC, included (a) the development of a Master Facilities Plan for Clark College, and (b) the pre-design of the Clark Center, a Clark College facility to be built at the Washington State University, Vancouver (WSUV) campus. Concurrently, I worked with HSA Architecture, LLC, Vancouver, WA, on a renovation project to bring the Clark College Applied Arts 4 (AA4) building up to current code standards, and to add a second floor to increase learning space.

Developing a Master Facilities Plan. In fall 1999, Clark College undertook the process of updating the College Master Facilities Plan for the main campus and to address future opportunities and needs in the service district of the college. A planning symposium was held on November 30, 1999, where key shareholders from the community, State Board for Community and Technical Colleges, Higher Education Coordinating Board, and legislators were invited to hear a keynote address by George Copa, Director, New Designs for Learning, Oregon State University. Points made by Copa were: (a) interdisciplinary learning prepares learners for the complexities of work and society; (b) educators need effective partnerships with businesses, community agencies, K–12 and higher education institutions to provide the context for learning, determine the learning outcomes, and give support in terms of staffing, locations for learning, and shared funding; (c) facilities must be designed flexibly for adaptation with less effort and cost to keep pace with the changing demands of work, family, and community life; and (d) borders between educational facilities and the community need to blur and blend to provide for learning at the times and places needed by learners.

After Copa's address, college staff and faculty engaged with other audience members to identify (a) the current and future learning needs of the community, (b) the characteristics of the various learning audiences, and (c) the facilities that would be needed to support the learning activities and the learners in reaching their intended educational goals. A campus team was formed to work with LSW Architects to develop the Master Facilities Plan (LSW, 2001). Through the planning effort, a set of design features for the physical learning environment was developed.

Pre-Design of the Clark Center

The design process for the Clark Center included faculty, administrators, and staff from Clark College and WSUV, in addition to the architectural team from LSW Architects, PC and representatives from various state government agencies. As the Clark Center was located on the WSUV site, the process addressed the master facilities plans of both institutions, and the architectural firms from both institutions needed to stay involved and informed.

When built, the Clark Center will have approximately 63,334 sq ft (LSW, 2000) and house classrooms, science laboratories, nursing and computer-based instructional spaces, offices, study spaces, and a community/business training center. Clark College also plans to offer at this site selected vocational programs that will articulate into current WSUV degree programs. The two

institutions will share plant services and infrastructure, student services, library services, food service, parking, bookstore services, student activities, security services, and child care.

Renovation of the Applied Arts 4 Building

The Applied Arts 4 (AA4) building at Clark College was built in 1958 to serve as the automotive shop for Hudson's Bay High School of the Vancouver School District. The south side of the building was originally constructed with high bay ceilings, and a single story addition had been added on the north side. Throughout the years, modifications to the building included a partial mezzanine for added teaching and storage space and partial wall partitions; also, more permanent walls were added to accommodate some program changes. In 1999, the college was awarded funding by the state to update the infrastructure and meet new code requirements in the AA4 building. The college was facing the need for more general-purpose learning space to meet the needs of a growing population in its service district and subsequently increasing enrollment. The physical assessment of the building determined that, due to its structural soundness and high ceilings on the south side of the building, a second floor could be added to gain learning space.

The design process involved the formation of a campus team, which included the faculty and staff whose programs were located in the AA4 building, the plant facilities director, other campus personnel, and the architectural team from HSA Architects, LCC. The team addressed program space and design needs, took a tour of a career and technical education K–12 program that was noted for its innovation, and designed a facility that supported program integration and shared space.

The desired features of the physical environment that emerged during the design process were (a) providing space to meet learner, community, and industry needs; (b) providing efficient use of the facility through flexibility in the design; (c) providing a better learning environment through integrated learning, shared use of space, and adequate, adjacent supply and storage areas; (d) providing a model student learning center by incorporating new technology and providing for growth and change for future technology, incorporating natural light into the interior spaces on both floors through the use of exterior windows and interior window walls; (e) designing and placing of faculty office space; (f) designing circulation patterns that encouraged and supported the integration of courses and programs; and, (g) locating several small group study and informal gathering/conference spaces on both floors. Regarding the design and placement of faculty office space, some of the faculty were interested in being in office suites that were located close to the learning spaces, while others preferred individual offices located elsewhere. The building's original exterior wall was constructed with concrete columns placed every 20 ft along the perimeter. The construction allowed for the design of an adaptable interior with the use of de-mountable walls between the 20-ft spans. Mechanical systems were also designed with this adaptability in mind.

Summary

The events of Phase I served as an introduction to the field of educational facilities design and how the design supported and enhanced learning processes—specifically, collaborative, project-based learning. The first event of Phase I was K–12-based, and the second event was

designed to explore facilities design at the community college level and gain experience working with architects and educators involved in facility design work.

Findings From Phase I

Twenty-eight design features of the physical learning environment were identified in Phase I of the study. I analyzed the 28 design features for preliminary clustering and emerging categories. Four categories emerged when searching for commonalities. The four categories were (a) spaces to hold different-sized groups of learners, (b) spaces for different types of learning activities, (c) adjacencies among spaces for different-sized groups, different learning activities, and different types of support, and (d) the furnishings of the spaces. Findings included a description of design processes observed in Phase I.

Group Size

Design features relating to group size recommended in Phase I were (a) large, open, or common spaces; (b) all 100 "house" members; (c) small group, team space, and seminar space; (d) large group space; and (e) teaching team space. Specifics for group size were not always given in the descriptions or presentations, but based on observations and professional experience, I chose the groups sizes to range from the individual (1), small group size (3–15), team size (5–10), and large group size (15–35). One description specific to group size was "pods," or team spaces for 10 learners.

Learning Activities

Learning activities mentioned in the study were (a) group instruction to teach concepts or skills to the whole team or group; (b) laboratory learning in which learners have the opportunity to discover, explore, practice, and use specialized equipment to create and produce information, products, and services for their projects; (c) project work; (d) teamwork to choose, develop, and produce a service or product; (e) individual work, study, or reflection; (e) preparation for and presentation of acquired knowledge and skills as a means of assessment; (f) practice space; and (g) informal learning.

Adjacencies

Relationships of spaces to one another showed importance in providing (a) access to the community; (b) galleries, studios, and presentation spaces to show the learning process and final products; (c) linked spaces and circulation patterns to connect learners and learning activities; (d) exterior windows that provided a visual link between the outside and inside of the school/college as well as provided natural light and fresh air; (e) interior windows that provided a visual link between learning activities; (f) access to technology that provided information and links with other sites and people; (g) connections in terms of movement of people and products between learning areas and activities; (h) pods or team spaces in which small groups work together to reach a common goal; (i) informal learning spaces for learners, faculty, and staff to gather for informal conversations and activities; (j) learner access to teachers and vice versa; and (k) adjacent spaces to increase access to resources, supplies, storage, and technology.

Furnishings

Identified furnishings for the physical environment that supported and enhanced the variety of learning activities, team work, and need for flexibility in collaborative, project-based learning included (a) moveable furniture; (b) different sizes of work surfaces such as tables or benches; (c) durability of furnishings; (d) floor space on which to do work; (e) tackboards and whiteboards; (f) task lighting and light tables; (g) casements to store supplies and projects, hand tools, and specialized equipment; (h) technology in the form of computer stations, copiers, facsimile machines, and telephones; and (i) secure, personal storage spaces.

Phase I of the research was introductory and exploratory. Phases II and III of the study were designed to narrow the inquiry to the design features of the physical learning environment to collaborative, project-based learning, to focus on the community college level, and to gain a deeper understanding of the thinking behind, or the rationale of, the selected features.

Phase II of the Study

National Conference Participation. The first event of Phase II of the study was participation in a conference session, "High Performance Student Work Teams Deliver Powerful Training Solutions," held at the 2000 annual conference of the National Council for Occupational Education (NCOE). While providing background information for the session, one of the presenters described a college that was exploring various options of delivering curriculum using multiple learning processes as a way to address increased enrollment. According to the presenter, "This tremendous increase in enrollment caused the college to tear up old ideas and to look at their curriculum and facilities differently." One process being explored was the use of collaborative, project-based learning to provide service learning opportunities for learners, and from which the college gained ways to connect with the growing community. After the session, I conducted informal audiotaped interviews with two of the three presenters to ask about (a) the benefits of collaborative, project-based learning, and (b) the design features of the physical learning environment that supported and enhanced the use of collaborative, project-based learning.

In the conference session, it was explained that in the High Performance class, the learners (a) applied team concepts to real-life situations, (b) integrated interpersonal skills, group dynamics, and leadership activities in the work team, and (c) effectively applied group participation and problem-solving techniques. The learning occurred through collaborative, project-based learning, and incorporated the concept of service learning—both of which provided the opportunity for learners to practice the skills they were learning.

To emulate a real work situation, the learners in the class were given a written description of the following tasks for each project: (a) produce expected deliverables, (b) stay within accurate timelines, and (c) determine appropriate rewards and consequences for finishing or not finishing the project. Prior to starting the project, the learners received training on problem solving, decision making, and communication skills. The learners were given the tangible support they needed (e.g., supplies, space, use of telephone/copier/facsimile machine, and coaching). In addition to learning how to work in teams producing a product, students gained skills in using available technology to enhance the development of the product, as well as to deliver services.

Design Features of the Physical Learning Environment

In interviews with both presenters, I asked them to describe how they would design the physical environment for project-based learning and to identify the features of the environment. Individually, and yet almost identically, they talked about walking into classrooms and seeing tables and chairs pushed up against walls and finding learners working on the floor. Seeing this, both participants stressed the need for furniture that can be easily reconfigured according to the needs of the learners and the activities.

One presenter described the ideal project-based space as "having civilized amenities like what you would find in an office or a work space." The amenities or features of the physical environment included (a) telephones, (b) facsimile machine, (c) copier, (d) ability to plug in laptops at each table, (e) access to the Internet, (f) different-sized tables or work surfaces to accommodate projects, (g) places to sit on the floor, (h) seating for groups, (i) presentation areas, (j) laptop teaching station, and (k) access to food and beverages. The second presenter added the following additional features to a project-based physical learning environment: (a) good lighting, including track or task lighting, and a light table, and (b) an adjacent space to be used as a break-out space and to provide access to technology.

International Conference Participation. The second event of Phase II was participation in an international conference, "Innovative Alternatives in Learning Environments," November 6–11, 2000, in Amsterdam, The Netherlands. The conference provided opportunities for site visits to educational facilities, some of which used collaborative, project-based learning processes. The many conference venues varied in scope from a pre-conference workshop to site tours of educational facilities, conference sessions, and a post-conference site tour. Additionally, I attended a workshop at the conference that brought architects and educators together in an intense time frame to design space for learning. The workshop provided insight of who to have as participants and how to design the design studio—Phase III of this study. Several of the conference attendees became participants.

Site Tours

The conference included site tours during and after the conference to provide visual exposure to the concepts and work of various architects, and stimulated more questions related to this study. I observed educational facilities as stand-alone buildings in urban and suburban areas. Others were located above street-level businesses, or were on the ground floor of housing complexes.

Conference and Site Visits

The conference was held at the Hogeschool van Amsterdam, a non-residential university for professional education at which the primary learning process was project-based learning. According to Tom DeGraff, who led the design planning team for this university site, the focus of the university was based on how to learn, as well as acquiring knowledge. In recognizing that 40% of the students failed their first year and that 80% of those students fell behind within the first 3 months of school, the university took the following steps: (a) organized the teaching staff into teams, (b) organized the learners into teams, (c) designed the learning spaces to keep the faculty close to students and provided shared teacher-student spaces, and (d) used project-based

learning as the primary learning process. The majority of the learning spaces were open working spaces that incorporated small group space, laboratory space, and project space. Support areas included (a) the library/media center, (b) cafeterias, (c) large common spaces, and (d) computer laboratories.

Another postsecondary site I toured was Icthus College in Rotterdam. The design-features of the college relevant to this study were (a) large, open, common spaces, (b) access to food and beverage at all times, (c) access to technology and resources, (d) small group spaces interspersed throughout the building that provided individual and team work stations, and (e) areas of high flexibility in rearranging the learning space quickly to accommodate changing learning activities.

E-Mail Interviews

After returning to the United States, I invited attendees of the conference with whom I had spent considerable time to participate in e-mail interviews. Eight gave consent and participated. Five were from the United States, two were from The Netherlands, and one from Israel. I asked the participants four questions. Questions 1, 2, and 3 were focused more on the challenges of the design process used for educational facilities. Those questions were informational, and only comments specific to the focus areas of the study were included in the findings.

Question 4 was directly linked to the foci of the study, and asked, "What are the key features of space designed for active learning, specifically for collaborative, project-based learning?" Three areas that emerged from their answers included (a) needing flexible and multiple-use spaces, (b) providing a sense of ownership, and (c) recognizing the use of non-classroom spaces for learning.

Flexible Spaces. All the participants mentioned the need for flexible spaces as a key feature for the physical environment for collaborative, project-based learning.

> Flexibility! The environment must be capable of adapting quickly to changes in the learning process. Flexibility can mean many things, but the simplest method is to create places where different activities can occur within the boundaries of the same space.

A participant said that "the project-based model typically requires greater flexibility for technology and furniture arrangements [than for spaces using other learning process]." In describing the desired features of collaborative, project-based learning environments, a participant included flexible, comfortable furniture; computers; Internet connections; and library materials.

> [Generally,] this space will serve both as places where individual and small-group project work can be carried out in close proximity to the faculty, and as meeting places where serendipitous interactions among students and faculty can occur, enhancing the learning process. [Specifically,] a collection of spaces ranged from large, open, high-bay, shop-type space to more traditional lab [laboratory] space to clean room space, to large and small group meeting areas, to "study houses" and "slump" spaces for planned and serendipitous meetings, which often generate synergy and new ideas.

Sense of Ownership. Three of the participants emphasized the need for a sense of ownership by the users in flexible spaces.

> The biggest issue with using a space for multiple types of learning activities is the loss of ownership by the instructor and the students. If it is used by many, no one person feels a need to connect with the space and make it a part of their pedagogy. This is the biggest complaint we hear about flexible, multi-use space. Human beings have a need for identity. Creating places where we are treated anonymously generally creates a feeling of disconnection and a need to "mark" our presence within that space. In schools, this usually expresses itself as vandalism.

> Let the environment pay respect to the student; then the students will be proud of their building. Make a dull environment, and the students will have less motivation, demolish things, etc. The human scale—not the economic or organizational scale—must affect the environment.

Non-Classroom Spaces. Two of the participants mentioned that the key to designing spaces for active learning processes such as collaborative, project-based learning, is to, "look at the spaces in between."

> In other words, find ways that the non-traditional, non-classroom areas can support the learning process. In our own work environments, the most important discussions do not take place at our desks, but in the lunchroom, library, stairs, or lobby. We treat the schools the same way. Wherever possible, we provide opportunities for students to sit in hallways and lobbies with access to daylight and technology (high-tech data/voice/video and low-tech whiteboards).

> Success is not only in the labs or in the classrooms, but also on the "edges," where the interaction takes place. These can be lounges, simple benches, markerboard areas, study areas, etc. Breakout space is needed adjacent to the rooms for smaller groups to work. This needs to be programmable space, as without it, the facility will lack the energy and soul it will require to be successful. Vitality of programs depends upon support the new environment gives to interaction among and between students, faculty, administration, and community.

The described features given by the participants of the e-mail interviews further reinforced the findings of Phase I and the first event of Phase II. For purposes of gathering more data, other activities at the "Innovative Alternatives" conference that provided rich sources of information were (a) conference general sessions, (b) case studies, and (c) a designing space workshop.

Conference General Sessions

In his opening remarks for his keynote address, Herman Hertzberger, an architect and professor from The Netherlands, reminded the audience that the old thinking about learning was that learners were pumped full of knowledge and that truth came from blackboards. The new thinking is that learning is not just about acquiring knowledge and skills, but also about gaining an understanding about attitudes, behavior, and communication by learning in an environment similar to living and working environments.

The environments designed by Hertzberger have no traditional corridors, but are designed like streets with sidewalk cafes—only that these cafes are for learning. The plazas or squares are places to learn and to discover. The design of space organizes and encourages behaviors. Spaces give the messages of *welcome*, *walk here*, *sit here*, and *discover here*. Space designed for expected behaviors reduces the need for creating and posting rules.

Case Studies

The conference provided several case studies of innovative alternatives in learning environments. I have gone into more depth in the case studies that were most pertinent to the foci of this study. The titles of the case studies were those given by the presenters.

Case Study 1—Open and Flexible Learning Spaces (Heinavaara Elementary School). Reino Tapaninen, chief architect of the National Board of Education in Helsinki, Finland, opened his remarks for the case study with a presentation slide showing a line of "identical blockheads" emerging in a straight line from a "block" school building. Recognizing that learning needs to be taking place differently for societal and economical reasons, Finland had changed its educational system to be learner-centered, cooperative, and project-based.

The Heinavaara Elementary School was designed 2 years ago and, according to Tapaninen, learners are involved with projects all day. The learners learn, study, and assess together, and proceed at their own levels. They work in small and large groups, use technology to access information, have panel discussions and assemblies, create displays, and give presentations.

Recognizing that schools also provide a place for social growth, Heinavaara Elementary was designed to be a place that learners bonded with and belonged to, where they met with peers and took part in the learning process and life together. The spaces allow for different-sized groups, have laboratories for experimentation, and have individual workspaces. Teachers learn and experiment with the learners and are located in the middle of the learning spaces. In keeping with the nature of projects, dining was available in small cafes—open all day with no proscribed times to eat.

Design Features of the Physical Environment

According to Tapaninen, flexibility, openness, and visibility of learning at Heinavaara result from designing the facility around a central resource area. Production of information and projects occur in large open spaces, rather than in rooms separated by corridors. Comfortable and versatile furniture, and soft and inviting lighting are important features that support learner-centered, collaborative, project-based learning.

As learners enter the main door, they enter a plaza and pass by a large hearth providing a "warm start" to the day. From the plaza, there are streets with cafes, and net-surfing and media bars; and a large information resource area. The streets lead to workshop spaces. The building is also used a learning tool, in that the night sky is painted on the ceiling and building signage uses several languages.

Case Study 2—Designing a Place for Problem Solving (The Center for Applied Technology and Career Exploration). Daniel Duke, professor of educational leadership and director of the Thomas Jefferson Center for Educational Design at the University of Virginia, described how the community of Rocky Mount, VA, needed to address a high dropout rate, and at the same time needed a new middle school. The new middle school was designed as a Center for Applied Technology and Career Exploration. The per-capita income for the region was less than $16,000; 40% of the adults had less than a high school diploma, and 32% of the students were eligible for free lunches. Preference would have been to build a traditional middle school for 1,000 learners; however, the cost would have been $14 million dollars, and the community had passed a bond for only $7 million dollars.

Duke explained that educators and community members recognized eighth grade as a crucial year—often the time of losing students from the school system. Through a community-based design process, the community created a school focused on career clusters and project-based learning. The aspiration was to keep the learners in school and begin to prepare them for careers.

Because of the funding limitation, it was decided to build a school for 500 learners. Half of the middle school students would attend the school for half of the year. The other 500 learners would remain at the existing school. The groups switch locations mid-year. During the 18-week semester at the Center for Applied Technology and Career Exploration, each learner selects three 6-week career modules. The learner spends each day of the 6-week period in that module. Learning is based on real community issues that need solutions. The learners present their findings to community agencies, local governments, and boards. The modules provide team learning, problem solving, improved oral and written communication skills, clarification of career paths, and the opportunity to develop a work ethic comprised of responsibility, initiative, and dependability.

Design Features of the Physical Environment

Duke explained that the school is designed as a center with no traditional classrooms, laboratories, cafeteria, or gym. There is an electronic library, one computer per two learners, individual workstations rather than desks, a commons that provides food service for a 3-hour time block to better accommodate the problem-based learning process, storage in each workstation, and access to the local YMCA for physical fitness activities.

Case Study 3—Designing for the Unknown. (Alpha High School). Norm Dull, architect with Dull Olson Weeks Architects, described the dilemma of designing learning facilities for a future that is unknown. Educators request facilities that are flexible and adaptable in hopes of gaining a facility that will be as usable in 30 years as it is today. One high school his firm designed is Alpha High School (AHS) in Gresham, OR, in the Portland Metropolitan area. The school is an alternative high school designed around the needs of the learners. Two goals for the learners are: (a) to develop a positive self-image, and (b) to gain skills necessary to be employed upon graduation. The school is also a cornerstone of an urban redevelopment project in Gresham, and used as a community center in the evenings and weekends by local senior centers and Mt. Hood Community College.

During half the day learners are at Alpha High School taking academic courses in order to graduate, and during the other half-day they are at work sites. As much as possible, the curriculum for the academic courses is designed using projects or service learning. The projects range from growing plants for a stream restoration in a national forest to learning about running a small business such as video production or bicycle repair. Over 200 business partners come into the school to provide guidance and school-to-work experiences. The school also has space for small-business incubators in which learners are given the opportunity to observe and participate in the development of a business.

Design Features of the Physical Environment

Dull pointed out the most impressive design feature of AHS is the ability to move all the walls and cabinetry in the learning portions of both floors. Learning spaces can be created for groups as small as 10, and the total area can be opened up to house over 200. The administrative area of the school can be secured to make the school available to other users in the evenings and on weekends. Two other noticeable design features about the AHS that differ from the traditional comprehensive high school are (a) the small size of the school and (b) no large parking lot. AHS is located next to light-rail and bus lines. The size of AHS can be small due to having half of the learner population at the facility at one time, while the other half is at work sites.

The design does not include a traditional library, cafeteria, or gymnasium. Alpha High School partners with the public library, which is located a few blocks from the school. For meal service, it is more appropriate to provide an eating area with microwave ovens and vending machines to accommodate students as they transition from the school to their work site at different times. The majority of the students attending Alpha High School do not choose to be involved in school-based sports activities, thus there is no need for a gymnasium.

Space Workshop

Six design theme workshops held at the conference addressed (a) location, (b) space, (c) time, (d) scale, (e) cost, and (f) context. I participated in the space workshop, and here explain the process of the workshop because it served to guide the design of Phase III. I also describe the features of the physical learning environment that were identified during the workshop that were pertinent to this study. The description of the space workshop read, “The basic building block of a school design has been the classroom, a setting supportive of lecture-style instruction.” The

question given to the workshop participants was, "How should the spaces for learning be designed to accommodate new learning approaches?"

Design Process. The process began with a question to the workshop participants to think back to a successful learning experience, and to make note of the following things: (a) what was the learning experience, (b) what activity was occurring, (c) where were they, and (d) who were they with. The facilitators of the workshop analyzed the answers and determined that 77% of the listed learning experiences took place outside of school-based learning activities and settings.

Workshop participants formed three groups. The group I participated in produced three learning diagrams. Figure 2 illustrates one diagram more closely related to this study, showing an in-depth learning community with streets or pathways. The intersection of the four streets was a basic core learning area with resources, media, computers, and staff. In each of the four directions from the central learning core was one of the following learning spaces: (a) personal spaces for students and the community; (b) project-group spaces; (c) exploratory spaces for science, equipment, and technologies; and (d) social-experience and activities spaces. The diagram showed direct flow in and out of all of the spaces, using wireless and Internet technologies, community providers as teachers, and learning staff going out into the community. The social experience and activities area also provided community support services and a basic commons area for the community, learners, and staff.

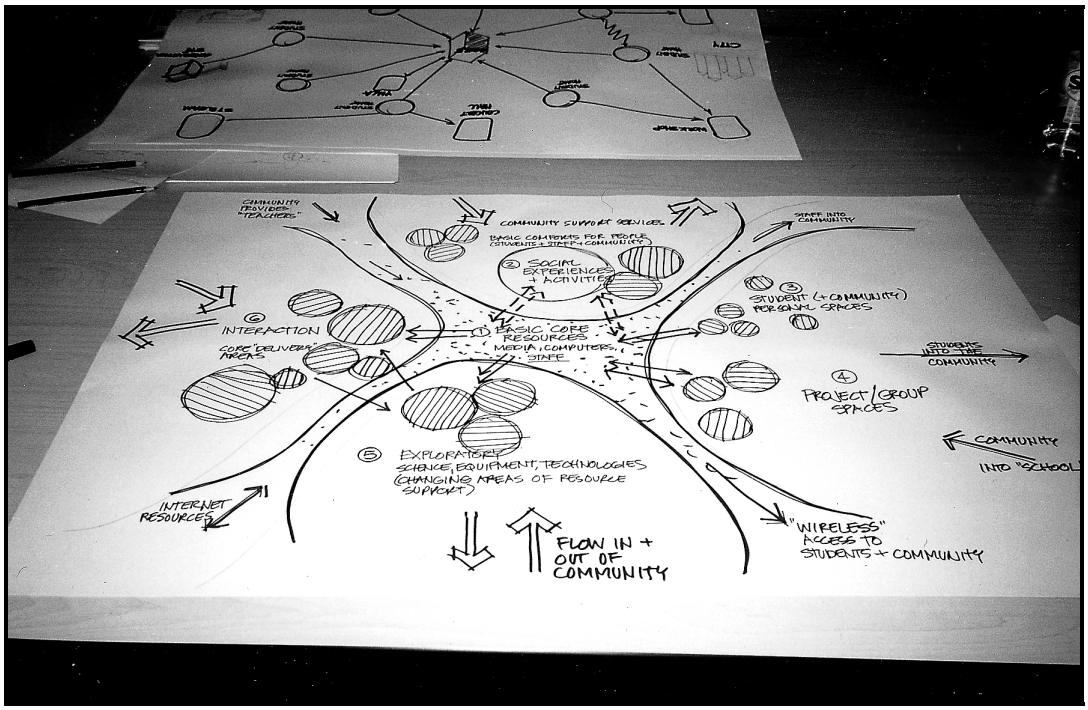

Figure 2. Learning community diagram.

The process used in the space workshop illustrated that in a relatively short time, a small group of people, who basically did not know one another, but all of whom had knowledge and experience in education and/or architecture, were able to (a) produce insightful designs, (b) identify the features of the design, and (c) provide insight into the thinking behind the selection of the features and the design process.

Findings of Phase II

Five new features emerged in Phase II. Those features were (a) access to food and beverage; (b) lighting such as task lighting and light tables; (c) high-bay shop space; (d) technology laboratories; and (e) slump spaces or places to generate synergy, create ideas, think, and relax. Features recommended in Phase I that were not mentioned in Phase II were (a) public display space, (b) lockable personal storage, (c) personal display space, and (d) durability.

Analysis of Phase I included clustering design features into four preliminary categories of group size, learning activities, adjacencies, and furnishings. The five new Phase II features fit into the categories next described. The features (a) building as a learning tool, (b) high-bay shop space, and (c) technology laboratories were added to the learning activities category. Lighting (e.g., general purpose and task-based) was added to the furnishings category as an element to support learning processes. Specialized infrastructure, equipment needed to support specific learning activities, and the infrastructure of the building being used as a learning tool to teach concepts such as sociology, psychology, mathematics, and scientific and environmental principles were identified. These features did not yet fit into a category.

Further analysis of Phase II identified a new category of design features that I labeled as psychological and physiological support—referring to the human functions that need to be addressed during the learning process.

Psychological and Physiological Support

The design features put into this category were access to food and beverages and slump spaces. One could say that all learners need access to food and beverage; however, the participants stated that with collaborative, project-based learning, the activity takes place in longer blocks of time, and to break from learning at appointed times rather than at natural breaking points could be disruptive. The participant who described slump spaces gave them a dual purpose. One was to offer a space similar to a think tank, which is an energizing space for idea creation. The second purpose was a place for a small group of individuals to get away from formal activities for relaxation and reflection.

In the analysis of Phase I, the feature called sense of pride and ownership did not fit into any of the categories that emerged in Phase I; however, from further descriptions and purposes described in Phase II, I placed it into the psychological and physiological support category. This decision was based on the psychological aspects of belonging and not feeling anonymous, and needing a space to own, expressed by personalizing and caring for the area.

Phase III of the Study

Phase III of the study was one event—a 2-day design studio I conducted in March 2001, in which five architects and five educators participated. The design studio was held at the former Kennedy Elementary School, in Portland, OR. The facility is no longer being used as a school, but has been converted into a hotel/conference facility, and remains a community center for the neighborhood. The Kennedy School was chosen because it represented a learning facility, and because of the amenities it provided such as lodging, naturally lit work space, table space, tackboards and chalkboards, relaxation areas, and food and beverage convenient access.

Participants were originally organized into two teams to produce designs of the physical learning environment that support and enhance collaborative, project-based learning. By morning of the 2nd day, one participant requested to produce a third design. The findings of Phase III were organized around the three designs for physical learning environments developed by the participants, and include narrative of the process used by each team. For clarification of participants' quotes or meanings, I have placed my interpretations within brackets.

Findings from Design Studio

Design #1 used the Kennedy School as a model from which to work. Design #2 was based on a composite of individual projects selected by each member of the team. Design #3 illustrated the design process for building physical learning environments using both an historical and a futuristic approach.

Design #1

The team took the Kennedy School as it is now [based on a traditional, double-loaded-corridor elementary school with a middle corridor and classrooms on each side of the corridor], and made it into a 200-student community college facility for the neighborhood. Knowing that community colleges vary in enrollments and in physical size, the design developed by the team served as a model with design features that could be used for a building on a campus, as a portion of a building, or within a shared facility with other agencies or educational institutions. The team named the college facility the Learning Village and felt very strongly that the design and the functionality of the building needed to reflect the community in which it was located.

> We wanted to keep the building in the context of the community. You can't build machine shops here, but we believe that type of learning can be done in the greater community through cooperative education and apprenticeships . . . we are starting to draw partnerships between the communities and business. We talked about the importance of partnerships with the community and where the partners would "camp out" in the facility.
>
> We felt it was important to stay with the history and spirit of the building and the neighborhood because it belongs to the community. This should be a place that has quality aesthetics to help with the pride and ownership felt by both the individuals who work here and the people that use it . . . this should be a place of pride for the community. It needs daylighting, connections between the indoors

> and outdoors, and options for hands-on and interactive [learning], that tie back into [addressing] multiple learning styles.

The team used the concept of zoning in their design to designate areas that ranged from private to public, from learner to staff, and by activity types. The zones, sometimes called "nodes" by the team, were (a) staff node; (b) meeting zone; (c) process gallery or studio zones for messy or creative projects; (d) finished product zones; (e) courtyard zones; (f) support zones for administration, student services, and media; (g) and public zones of auditorium, cafeteria, and gymnasium. In giving a verbal tour of the Learning Village (Figure 3), a participant described the zones and nodes:

> The classroom and lab space is a meeting zone for seminars and projects. It is more like an application lab where our ideas are hatched, and then we migrate to multi-use [studio] spaces where projects are completed, and then to the gallery spaces where they can be viewed by the public and judged for their merit. The classroom, lab spaces, and gallery spaces have lots of storage.

> The studio idea is our strongest idea of using an existing building and making the corridors go away. It increases accessibility of student areas, and integrates them with the public areas, and they are open to the general population of the building. There are not a lot of secrets here. It is very open, and yet has private areas.

In addition to providing space for producing products and for showcasing final products or projects, the studio zones were also seen as a way to stimulate integration of curriculum.

> The studio zones increase the multidisciplinary aspect of the projects. An example is the solar car project, which is next to the class studying the effects of color on the psyche, which is also next to the engineering studio. They all come together to create upholstery for the car.

> Having projects migrate from space to space addressed the desire for "cross-pollination" within the building. There is a tendency to create a studio and its support spaces, and to isolate that work. We used galleries [not only] for the products, [but also] to make production processes visible to students and staff, and to the general public.

The Learning Village was an example of taking an existing structure with the traditional double-loaded-corridor design and providing open, interactive spaces that support collaborative, project-based learning.

> We want to reiterate, to show that all the aging community college facilities out there with the double-loaded-corridor plans can be adaptably reused to create group communication, small group, [and] large group [spaces]. We tore out the middle, the guts, and created a more open, flexible space. The cost would average around $70/sq ft, compared to $130/sq ft for a new building. The utility comes

from using what is there and convert[ing] it to a collaborative, project-based space.

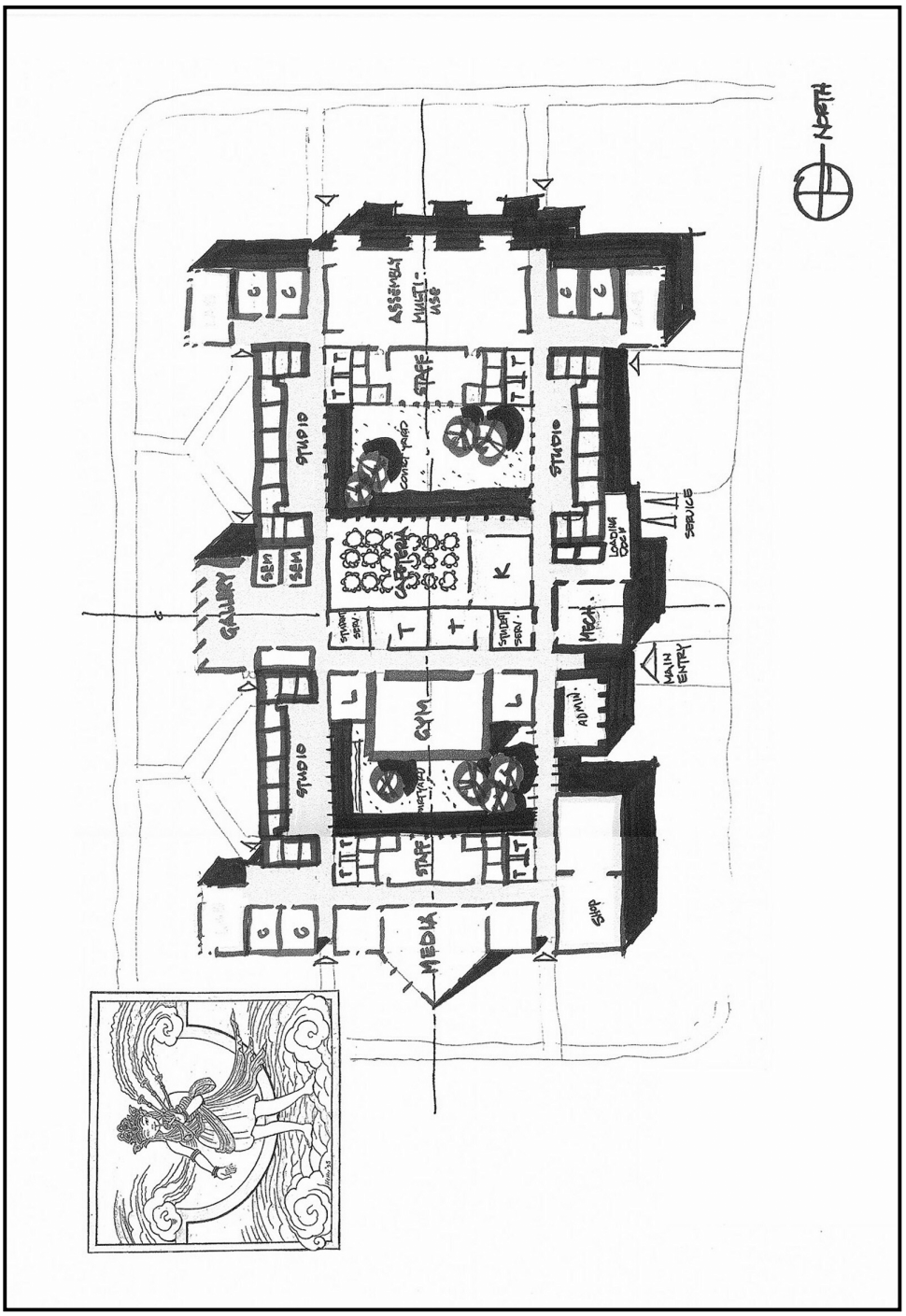

Figure 3. Design #1.

Design # 2

To approach the task, the second team began by creating a composite of the community and identifying groups of people the design would serve. Their team process included (a) developing a list of characteristics of the population to be served; (b) determining the content, skills, and services needed by the population to be served; (c) identifying all the places that the learning could occur such as community centers, local high schools, business and industry, and on campus; and (d) identifying the features of the physical learning environment that would support the learning activities and the needs of the learners.

In the next planning step, each member chose a specific collaborative, project-based learning activity. "Our team took a collaborative approach to the design process. We started with the communities, and tested our ideas for appropriateness for project-based learning. We each chose a [collaborative learning] project [and] then looked for common environmental characteristics across the five projects."

> I needed a cost-effective spatial system that is flexible and has access to technology, space for communication storage, accommodates presentations, and has flexible furnishings. I need a home base, space for small groups, caves [individual spaces used to work, study, reflection, or rest], and a production space. A design where you can move in, occupy, and leave, and not impact the next group using the space, nor needing 2 hours to change [the space].
>
> I want a home base, and a classroom where you begin the learning process. I want accessibility to computer labs, to the commons, to caves, and to the outside. I want storage for equipment and I want windows. They have to be realistic spaces.
>
> I need lots of windows that open because rooms with lots of computers generate heat, and it is nice to bring fresh air into the room while keeping the room cool. I need computer spaces with good chairs because the students will be sitting in those chairs for a long time. I need science and art areas right next door. It could be a messy room right next to the digital technical area. The art area needs to have moveable furniture—especially portable tables. It is the notion of specialized spaces or studios for "dirty" (fabrication) projects, and specialized spaces for technical projects. I would also like to see access to the outdoors where there would be a walking trail, a rock garden with stones . . . places for students to get away to think and relax.
>
> A series of spaces for integrated, collaborative learning that solves math and movement problems. I need collaboration space for the "birth of concepts." This birth space needs natural light, moveable surfaces, space for small groups ranging in size from 3 to 6, up to a space for 12 to 15 people, whiteboards and tackwalls to display concepts, access to technology, and access to nourishment. I need a space for design work and another space for fabrication. Movement of process needs to happen between all these spaces.

> I have pods that serve as a home base for each team of four, and then there is a shared living room that can also be a home base for all the teams. The shared home base has places to pin up work to show during discussions and presentations, and this space also serves as a lounge. Each pod contains individual workstations with access to the Internet, a team table, shared secure storage, indirect lighting, and a light table. The five pods and shared living room make up the main studio.

Looking across all five learning projects, the team looked for common spaces and activities among projects. Those activities and spaces were described as (a) bringing people back together, (b) having dirty work space and loud activity areas, (c) accessing information, (d) providing a home-base space, (e) using tools and materials, (f) including caves/quiet spaces, and (g) emphasizing community interaction [bringing the community into the learning environment, and taking the learning out to the community].

Using the information from the projects and from the previous work of determining the needs of the community and those to be served, the team developed a final design. They labeled the spaces within the physical learning environment as: (a) home base, which can also be used as a classroom, (b) collaboration incubator, (c) computer lab, (d) caves, (e) staff nodes, and (f) a series of laboratory suites. The desirable features of each of those spaces are listed below:

1. Home Base. For the home base, which served the purposes of group instruction, discussion, tutoring, and checking in, the design features included (a) comfortable seating and moveable desks and chairs, (b) windows, (c) blackboard/whiteboard, (e) storage, (f) freedom of movement, and (g) close proximity to caves and computer lab.

2. Collaboration Incubator. The collaboration incubator was designed for five teams of five learners to work collaboratively and fairly independently on their projects, with the teacher or faculty member being more of a mentor or guide as the format for instruction. The team spaces had individual desks or workspaces for the learners, storage, and a round table. In addition to the team spaces, the incubator had a large, open space to work on projects and to share with community partners who were involved in the project. The incubator was "where there can be a sense of ownership for a period of time. A space of my own, but also a shared space."

3. Computer Lab. The computer lab included (a) computers set up in pods of four [configuration was not specified], (b) work surfaces [tables], (c) storage, (d) printer station, and (e) late-night accessibility.

4. Caves. The caves provided (a) space for individuals for study or reflection, (b) proximity to the home base, and (c) [were located at] various locations and presentations [different space designs].

5. Staff Nodes. The staff nodes, with access to technology, were used for planning and communication among the faculty.

6. Series of Laboratory Suites. A series of laboratory suites accommodated: (a) technology labs that required high technology systems and infrastructure in a clean environment, (b) fabrication labs for wet and messy projects that required specialized equipment and infrastructure, and (c) combined labs with easy access to both technology and fabrication in the same space.

   > The laboratory suites were spaces that supported the students [while they] generated work [the project]. They began in the technology lab with the instructor, and then the students decided when to move from their pods into the larger incubator area.
   >
   > Technology laboratories have a natural integration of projects around a particular purpose, are authentic, and are chosen by students. The separate fabrication laboratories focus on use of high systems and high infrastructure to design projects that are then moved to fabrication areas within the laboratory.

The team designed a physical learning environment that actively encouraged and supported the communities it served by making them active partners in the learning process.

> The design [Figure 4] focused on bringing the community in and out of the projects in a collaborative way through the design of a "main street" that provided freedom of movement and access to all the spaces. The spaces along the main street were a commons area, small group/large group spaces, staff nodes, technical laboratories, fabrication laboratories, presentation auditoriums, caves, a flexible home base, and a collaboration incubator.

In recognizing the need to prepare learners to work in collaborative teams, a participant described the flow of learning activities in collaborative, project-based processes.

> You can't drop a student into a 100% collaborative effort. They start in the home base and set group goals. Once their skill base increases in working collaboratively and they are ready for more complex work, they can then move into the incubator. The incubator has flexible walls, and students define their own spaces.

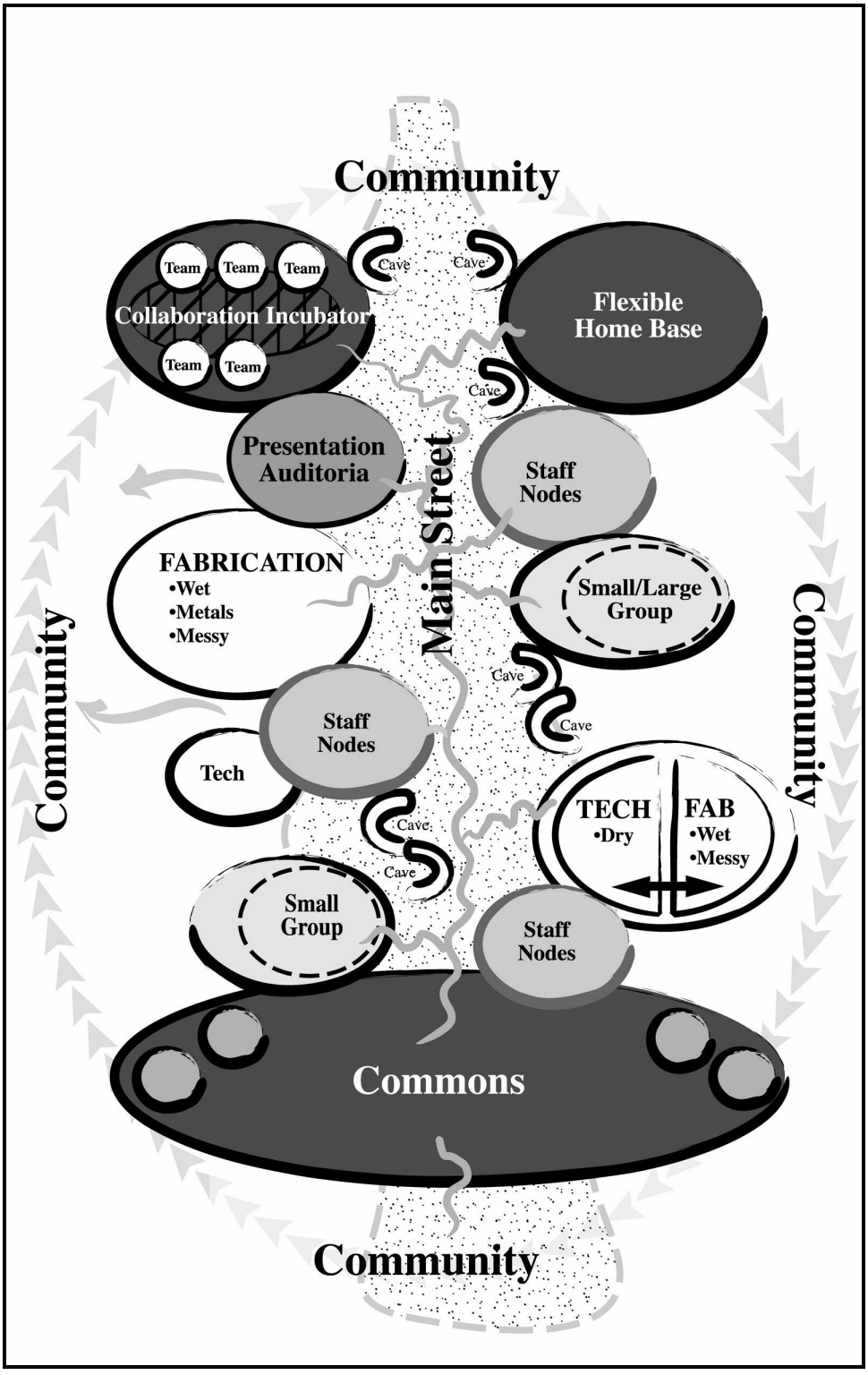

Figure 4. Design # 2.

Design # 3

The third design was presented as a story using words, illustrations, and diagrams focused more on general design principles that could be applied to physical environments that support and enhance collaborative, project-based learning rather than on specific design features. The presentation provided an historical look at how architects, educators, and communities have been designing educational facilities based on societal history, rather than being based on present or future societal needs. The story, as presented by the participant, began with a diagram (see Figure 5) providing guidelines to four layers of what needs to be designed, and not to be designed, for the physical learning environment. One point made was that the layers illustrated the need "to think in terms of the design being done incrementally, and the layers being integral to one another and providing a sense of coherency to the learning."

> I started with colors representing the different points of view. One area [of the design] was the red box that illustrates agreement and enough money to build the bricks and mortar that supports a learning process. Another area that we want to provide for, but don't want to build, was illustrated by the green box. The brown area indicated the area that there was not enough money for but it is important that connections [partnerships] were [made] so that the learners could get to it. And finally, the rest of this, the cross-hatched area, is thought of in terms of creating a learning environment that is to be done [designed] by the learners themselves.

My interpretation of this quote was that when designing a physical learning environment, it is not always necessary to include spaces or features in the school or college that can be accessed through other means such as community partners, as was illustrated in Phase I with the School of Environmental Studies and the Interdistrict Downtown School. The participant also emphasized that learners need to be given more responsibility in designing their own learning and to determine what is needed in terms of features of the physical learning environment that support and enhance that learning. This responsibility can be as simple as moving chairs and desks in a classroom, to having freedom of movement to go to different learning areas, to accessing learning opportunities off-site. The significance of that responsibility was shown in the layers, to illustrate the desire to design what the participant termed as the armature [basic framework or core elements of the physical environment]. The participant described the armature:

> The armature creates a richness or soul of the building, and a creative transformation of the building. The richness comes from what the learner does with the environment. We should allow them to do that more by collecting the insights, desires, and intents [of the learners].

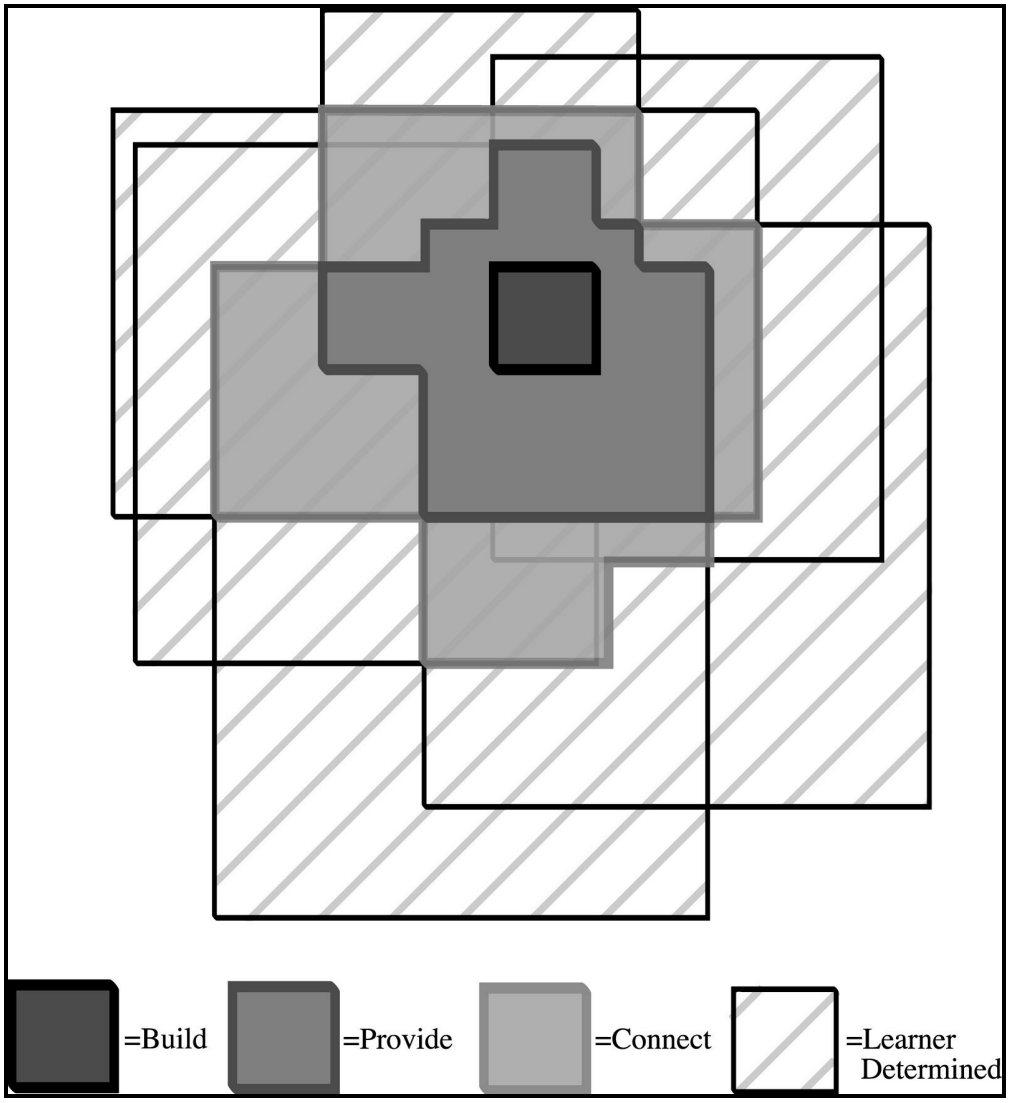

Figure 5. Design #3.

UNDERSTANDINGS, CONSIDERATIONS, AND FUTURE RESEARCH

As a phenomenological study, the purpose was to seek meaning or understanding of the two focal areas of the study by interpreting the accumulated data, and not to produce specific recommendations. Phenomenological questions are "meaning" questions that are not solved (van Manen, 1990, p. 23). The readers of this research has the opportunity to form their own insights from the findings, interpretations, and understandings formed, and consider those for their own situation. This last section presents the understandings I gained from the study, and discusses three areas that emerged warranting further exploration. The study evolved over the course of 2 years, engaged different participants in each phase, and used different methods of data collecting in what became an iterative cycle—each step informing the next step.

Understandings

Initially, the study resulted in 44 features being identified and described as pertinent to supporting and enhancing collaborative, project-based learning. Collaborative, project-based learning was chosen as an active learning process that prepares learners to meet changing learning expectations for new roles and responsibilities of work, family, and community life in the 21st century.

Analyses of the findings from Phases I–III were conducted at two levels. The first level of analysis examined the two foci of the study, and was presented primarily from the data and in participants' voices. The second level of analysis became more complex during the translation of the data into the summary tables, when it became necessary, for clarification, to occasionally add my interpretation to the description and purpose statements. At the end of Phase III, the design feature table was a comprehensive listing of the different titles, descriptions, and purposes for each feature, based on the data and my interpretation. To refine the analysis and move to a synthesis of the findings, I reviewed the design features to look for commonalities of function and design. As a result of the review, the number of design features was reduced from 44 to 32.

At the end of Phase III of the study, I grouped the design features into the following preliminary categories: (a) group size, (b) learning activities/learning spaces, (c) adjacencies, (d) furnishings, (e) psychological and physiological support, and (f) structural aspects. Continuing the analysis and synthesis, I reviewed the features yet another time to determine if the preliminary categories were still appropriate. This last analysis indicated the category of "learning activities/learning spaces" needed to be renamed "functional spaces for learning activities" because features describing different learning activities pointed to the necessity for specialized spaces that support the activity. Table 2 summarizes the remaining 32 design features by title, description, and purpose, as they were placed into the six categories. Considerations of these features and categories for community colleges are addressed at the end of this section.

Table 2
Design Features and Supporting Rationales of the Physical Learning Environment

Category	Title of the Feature	Description of the Feature	Purpose of the Feature
Group Size	Variable-sized spaces	Areas that are easily and quickly changed moment-to-moment, day-to-day, and may support several learning activities within the same space.	Provides for multiple purposes and different-sized groups. Encourages and supports integration of courses and programs through sharing of space and equipment.
	Individual work spaces	Space for an individual to personalize and in which to work and study.	Provides sense of ownership and teaches responsibility for one's own learning.
	Faculty team spaces	Individual or team spaces for faculty that have adjacent material preparation areas and meeting space.	Encourages team teaching, mentoring of other faculty, integrated planning, and informal discussions.
Functional Spaces for Learning Activities	Focus-laboratory spaces	Areas to support learning activities requiring specialized equipment or furnishings (e.g., science, technology, art, music, dance, fabrication, trouble-shooting).	Provides space and infrastructure to develop and practice specialized skills. Brings relevancy, work, family, and community to the learning process.
	Classroom spaces	Area in which to provide direct instruction of concepts, content, and skills. Often is a space that does not require specialized equipment or infrastructure.	Supports the learning process by bringing a group of learners together to focus on specific content and for group discussion.

Table 2
Design Features and Supporting Rationale of the Physical Learning Environment (continued)

Category	Title of the Feature	Description of the Feature	Purpose of the Feature
Functional Spaces for Learning Activities (cont.)	Presentation spaces	Places for individuals or teams to demonstrate and perform.	Gives opportunity to practice, share acquired skills and knowledge with learners, staff, and the public, and receive feedback.
	Practice spaces	Open or specialized areas with or without needed equipment to practice new skills (e.g., theatres, gymnasiums, music rooms, dance floors).	Supports the acquisition of skills by providing space and needed tools or equipment to increase efficiency and self-sufficiency.
	Process galleries, studios, and display spaces	Places and furnishings to display work in-progress or completed projects (e.g., whiteboards, tackboards, display cases, studios).	Supports and shares learning process by showcasing concept development, learning activities, development process, and finished products and services.
	Project space	Space that provides a variety of work surfaces, cabinets for supplies, storage areas for projects in the development stage, access to tools and technology, specialized lighting, and other infrastructure, such as sinks and disposal.	Provides space to produce information, services, or products. Encourages critical thinking, problem solving, and teamwork.
	Home base	Gathering place for learners and faculty.	Provides a common space to start a learning activity, seek assistance and resources, share ideas, and hold group discussions.
	Informal learning spaces	Non-classroom spaces (e.g., hallways, eating areas, study spaces, lounges, outdoor spaces).	Provides spaces for socializing, informal gathering, and serendipitous meetings that often foster creative thought and solutions to problems.

Table 2
Design Features and Supporting Rationale of the Physical Learning Environment (continued)

Category	Title of the Feature	Description of the Feature	Purpose of the Feature
Functional Spaces for Learning Activities (cont.)	Collaboration incubator	Idea generation space, team meeting space, access to technology and other resources, and display space for models and ideas.	Support creativity, idea generation, teamwork, and prototyping of concepts. Encourages involvement of local employers in the development of projects.
Adjacencies	Access to community	Consortia of community agencies, businesses, and learning institutions providing educational opportunities.	Creates a learning system that provides resources in the forms of curriculum, assessment, space, materials, personnel, and funding. Brings relevancy to the learning.
	Adjacent and nested spaces	Related spaces in proximity of one another.	Supports integration of learning, people, and support services.
	Visibility	Exterior windows, interior window walls, and open learning areas.	Invites participation in the learning activities by bringing processes and projects into view.
	Connections among people and spaces	Physical and visual links and movement patterns between interior and exterior spaces and among learners, family, and community. Sometimes referred to as streets or pathways.	Provides connection with others, encourages integration of activities, invites broad participation in the learning process, and movement of learning projects among functional support areas.
	Resource, supply, and storage spaces	Casements and space within or adjacent to the learning activities spaces to provide resources, and store supplies for classroom projects, tools, learning products, and materials.	Provides ready access to needed supplies, tools, and storage for learning projects.

Table 2
Design Features and Supporting Rationale of the Physical Learning Environment (continued)

Category	Title of the Feature	Description of the Feature	Purpose of the Feature
Adjacencies (continued)	Space and furnishings for technology	Desks, tables, and casements for technology (e.g., computers, printers, scanners, copier, telephone, facsimile, video/audio equipment, tools, text resources, research assistance).	Supports research and gathering of information, preparation and delivery of learning materials, and supports skill development in using technology.
Furnishings	Spaces with versatile furnishings	Moveable furniture and casements, folding walls, track lighting, multiple technologies, various sized and shaped work surfaces, and comfortable seating.	Provides flexibility in how space can be used to support a wide variety of learning activities (e.g., development of information, services, or products. Allows users to shape learning environment.
	Display spaces	Whiteboards, blackboards, tack surfaces, and showcases.	Provides places to show ideas, works-in-progress, and finished products.
	Spaces with variable lighting	All-purpose, general, soft and inviting, adjustable, track lighting, task lighting, and light tables.	Provides specific type of lighting needed for different learning activities. Adjusts in intensity, focus, and location.
Psychological/ Physiological Support	Spaces that provide sense of belonging, ownership, and pride	Learning environment that evokes a sense of belonging and identity.	Encourages desire to take responsibility for the use and maintenance of the physical environment. Provokes higher interest in learning.
	Spaces with access to food and beverage	Cafes, coffee and snack carts, cafeterias, or dining rooms.	Supports different learning time frames and informal learning activities by providing something to eat and drink when it is convenient to the learner.

Table 2
Design Features and Supporting Rationale of the Physical Learning Environment (continued)

Category	Title of the Feature	Description of the Feature	Purpose of the Feature
Psychological/ Physiological Support (continued)	"Get-away" spaces	Lounge areas, small study rooms, and outdoor seating to get away from formal learning activities.	Supports need for rest, relaxation, and reflection.
	Zoned spaces	Attributes of the physical environment that encourage behavior and use of space (e.g., private or public).	Gives users and visitors cues for expected activities and services.
	Caves	Quiet spaces for individuals.	Provides quiet place for work, study, reflection, or rest.
	Natural light	Daylighting provided by exterior and interior windows.	Increases learning performance through improved psychological and physiological functioning.
	Spaces for transportation support	Bicycle parking, bus shelters, loading areas, and parking.	Supports movement of learners and projects.
Structural Aspects	Flexible spaces	Areas that easily and quickly change learning spaces moment-to-moment, day-to-day, or support several learning activities within the same space at the same time.	Provides for multiple purposes and different-sized groups. Encourages and supports integration of courses and programs through the sharing of space and equipment.
	Spaces with visible infrastructure	Exposed building infrastructure (e.g., ceiling beams, plumbing, disposal, heating/air conditioning systems).	Involves the building structure as a learning tool.

Table 2
Design Features and Supporting Rationale of the Physical Learning Environment (continued)

Category	**Title of the Feature**	**Description of the Feature**	**Purpose of the Feature**
Structural Aspects (continued)	Adaptable spaces	Alteration or change in form or structure of areas to fit new use. Larger infrastructure and space changes that take more effort and time than flexible places. Concept of looking to future change, and designing the structure for alteration to meet new uses.	Enables renovation of structure and infrastructure with less cost and time.
	Layered spaces	Determination of what should be built and provided for in the built environment. Areas incrementally developed as uses are identified.	Creates options and guidelines for what and when to build. Allows for users to define and design spaces suited to their needs and the activities occurring.
	Spaces with durable building materials and finishes	Composition of and finishes for flooring, work surfaces, and furnishings that withstand active and frequent use.	Allows spaces to be used for planned activities with less concern about damage to them, and prolonging the life of space or features.
	Spaces with core or fixed-elements	Framework and basic elements of the physical learning environment (e.g., walls, floors, stairs, elevators, windows, plumbing, disposal, electrical).	Provides basic structure and infrastructure for learning that can be “finished” by the user according to activities and needs.

Future Research

The following three areas emerged for future investigation:

1. What are the systems of relationships among people and spaces that support and enhance collaborative, project-based learning?

2. What are the core or "fixed" elements of the design of the physical learning environment, and how can the design process be thought of in terms of layers, as illustrated in Figure 5?

3. How can community colleges implement collaborative, project-based learning approaches?

System of Relationships

What appeared to make the physical learning environment unique for collaborative, project-based learning was the need to create a system of relationships among people and learning spaces. The three designs created by the participants in Phase III visually illustrated the relationship of spaces to support the learning process. Other data from the same participants gave verbal descriptions of the relationships among the people involved in the learning activities. Reviewing the data collected in Phases I and II also indicated strong provision of systems of relationships.

Using definitions from the Merriam Webster's Dictionary (1993) and the Oxford English Dictionary (1989) and understanding derived from the study, the term "relationships" refers to a state of being interrelated or belonging, establishing kinship and affinity, and being mutually connected by circumstances. These relationships come to be when connections are present in the framework of the physical environment to join or unite people and learning processes. Relationships are established through feelings of being connected and familiarity. Building and maintaining relationships (Hendrick & Hendrick, 2000) requires skills in interpersonal communication and problem solving that result from sharing tasks, enhancing assurance, and creating social networks. Design of the built environment can enhance relationships by providing space and structural connections, or can hinder relationships by being spatially incongruent and disconnected. Rapoport (1982) described the physical environment as a series or system of relationships among things and people that provide structure, pattern, and visible cues for expected behaviors.

Strange and Banning (2001) stated that physical features of a campus environment can hinder or promote learning (p. 31), and settings allow participants to take full advantage of the possibilities of the setting (p. 20). The physical environment, through the use of semi-fixed elements (e.g., signs, materials, colors, forms, sizes, furnishings, landscapes) communicates context and desirable behaviors (Rapoport, 1982, pp. 56–57, 89). One example, as described by Strange & Banning (2001), was when a learner walked into a classroom and saw the teaching podium 20 feet in front of the first rows of desks or chairs. The learner expected the upcoming learning experience to be formal and one that did not encourage participation and involvement, or the formation of relationships (p. 21).

To better understand the meaning of systems that support relationships, I turned to Capra (1996), who described two approaches—the first being the pattern of organization of the system, and the second being the structure of the system. The pattern is the configuration of relationships among the system's components that determines the system's essential characteristics. The structure of a system is the physical components of the pattern of organization (pp. 158–159). Figure 6 uses the six categories of design features described in the study, and illustrates a system of relationships in collaborative, project-based learning. Alexander (1979) explained the importance of relationships of spaces—

> Evidently, then, a large part of the structure of a building consists of patterns of relationships…the fact is the elements themselves are patterns of relationships and when the elements dissolve and leave a fabric of relationships behind, that is the stuff that actually repeats itself and gives structure to a building (p. 89).

Alexander's words reflect the findings of the study and the need for systems of relationships among people and spaces to support and enhance collaborative, project-based learning at the community college level.

Core or "Fixed" Elements

The second concept to explore further is determination of the core or fixed design features, and thinking of the design process using the concept of layers. The essence of the third design created in Phase III was pushing at this concept. The participant who prepared and described the design spoke of the "armature" of the physical learning environment or, as described by Rapaport (1982, 1990), the core or fixed elements.

Another feature described in the third design was layers, or phases, of the planning and design process. Figure 5 illustrated the layers and framework decisions to be made while creating a physical learning environment. At the center of Figure 5 was the core of what everyone involved in the design process of a physical learning environment agreed should be built, and includes the core or fixed elements. The remaining layers indicated how the rest of the learning needs would be taken care of through partnerships with community agencies, businesses, and other learning providers, and would not necessarily be offered at the central site. A larger remaining layer indicated the need for the users to "finish" the design or space according to their needs and to determine the "semi-fixed" elements. Providing the opportunity to personalize the space gives the learners a sense of identity and ownership. Figure 6 also illustrates the concept of layering, or overlapping, of the categories of design features.

Implementation of Collaborative, Project-Based Learning at the Community College Level

The third area of needed research that emerged from my own community college administrative experience, practice of working with architects and educators, and the data was how to implement and support collaborative, project-based learning at the community college level. Research shows that collaborative, project-based learning prepares learners for the 21st century in terms of gaining knowledge and skills for life and work roles and responsibilities. According to Duke (2000), one of six design principles for building learning facilities is that the quality of the learning experience dictates the physical learning environment, and not vice versa. Due to increased pressure from accreditation agencies, community colleges are addressing

college-wide abilities or learning expectations, but not all are addressing the learning processes that would best support achieving expectations.

Additionally, community colleges and other levels of educational institutions must answer to state and federal mandates for performance, and to funding sources to account for efficiencies. However, performance and efficiencies are based upon time honored and worn practices and policies that focus on numbers of learners, specific square-footage allowed per learner, 50-minute time blocks, and individual silos of curricula. According to one of the participants of the study, the overriding question is always, "What is the cost per square foot, and how many FTES (full-time student equivalencies) will it generate," rather than basing decisions on defined learning expectations and processes that will support those expectations. These questions and concerns cannot be taken lightly because allocation of resources is most often based on state-established service levels or enrollment in programs or departments, or at the institution level.

Requesting funds for renovation or capital construction, either through state agencies or from local taxpayers, is based on demonstrating a positive cost-benefit ratio. This ratio is based upon the numbers of students to be served in the space, rather than designing facilities to support learning processes that assist students in achieving learning expectations. Learning facilities at other levels of education are being designed in ways that support active learning processes and result in a greater cost-efficiency index per-square-foot and per-student. Additional research is needed to assist community colleges in their planning and designing processes.

Considerations

The findings of this study are useful for community college planners and architects when renovating or building new learning facilities. The context in which each college operates differs; however, the 32 design features and the purpose for each can serve as guidelines. For the most part, community college learners are non-residents, are transient, and range in age from 16, up. A participant emphasized the unique needs of these students: "For community college students, it is important to create connections and linkages. It is easy to lose the magic of belonging." Collaborative, project-based learning focuses on learners working together in teams—with both one another and faculty. Examples of design features that support young and older adult learners, individuals, and teams are (a) formal and informal learning spaces, (b) variable-sized spaces, (c) on-campus and community places to gain knowledge and skills, and (d) flexible and comfortable furniture. Paying attention to these design features, as well as those providing psychological and physiological support, is one of the most visible means of creating a sense of belonging for the community college learner.

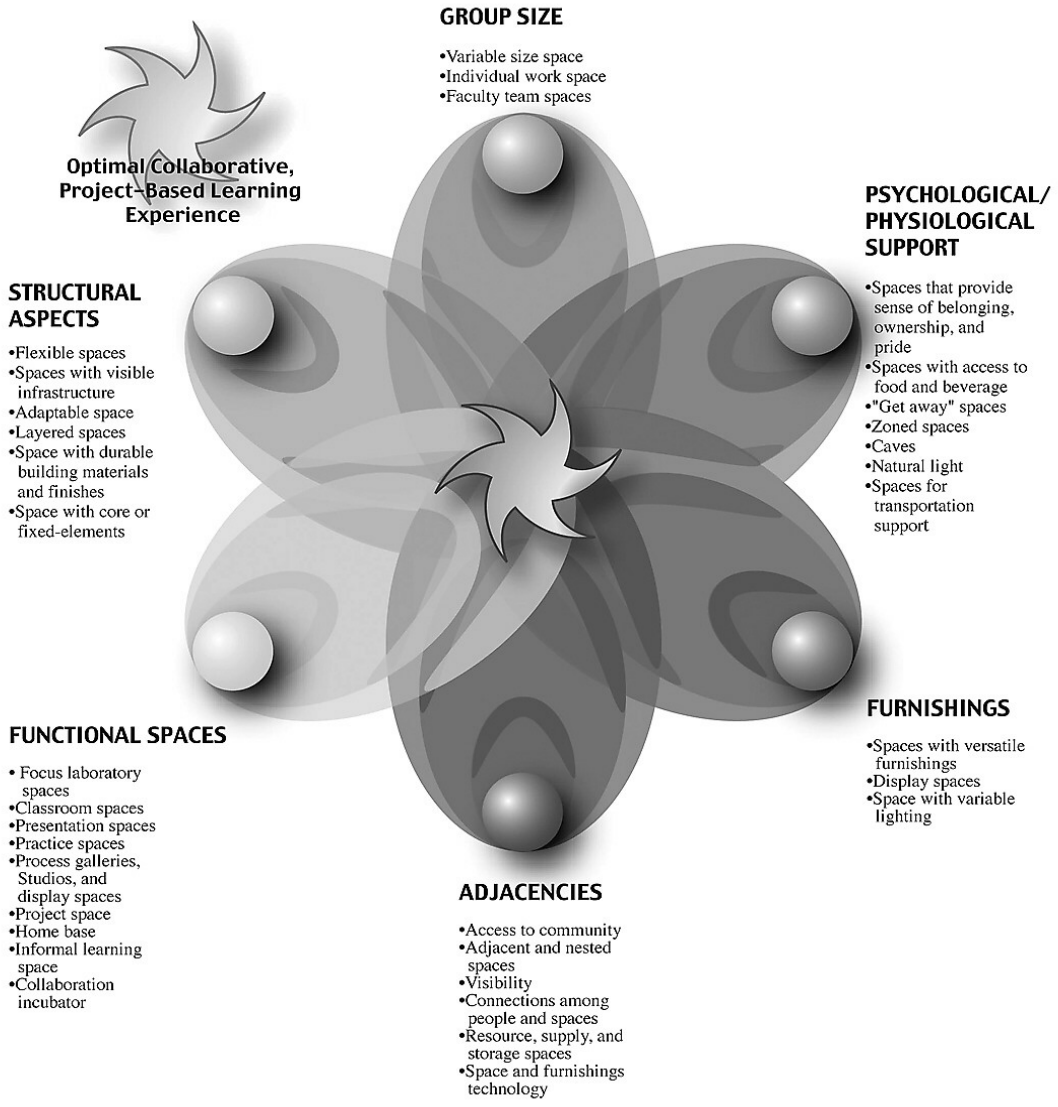

Figure 6. Design features of the physical learning environment for collaborative, project-based learning.

The category "structure" is especially pertinent when understanding that learning facilities are built to be useful for 50 to 100 years. The question becomes: "Will this space and/or building still be as vibrant and supportive of needed learning activities 10, 20, or even 50 years from the time the building opens?" A participant [a community college administrator] in Phase III of the study expressed frustration: "We don't abandon our failures. Once a space is designed for a particular function, we cannot turn the space into something else, even though it may not be

providing solutions or educational opportunities as originally envisioned." Another participant in Phase III stated: "Once you build, you are passing on teaching/learning models for another 60 to 70 years. Models of today are based on visions of the past, and even the ideal model is based on the best of the past. We are stuck there." Another consideration from the study is to ask if some of the learning can take place in facilities off-campus, as described in the data and findings, thus reducing duplication of facilities, efforts, and dollars.

From my practice in working with architects and educators in designing physical learning environments, it has been difficult to look beyond present uses to the future. There seems to be an overwhelming need to "over design" the spaces, and think in terms of "finality," rather than encouraging flexibility and adaptability. Considerations include determining which of the core or fixed elements can be more easily adapted with minor cost and a little time, and which elements will remain fixed over a long period of time. One example is the renovation of the AA4 building at Clark College, in which the design of the heating, ventilation, and air conditioning (HVAC) systems has the ability to stay balanced even when de-mountable walls are moved to increase or decrease size of spaces.

Cy-Fair College in Houston, TX, that is scheduled to open fall 2003, also exemplifies several study considerations. The college president sought extensive input from the surrounding communities, and determined that "collaboration" would be the signature of the college. The footprint of the buildings and programs to be offered were in place when I arrived to assist with the design. Using concepts and design features from this study, the architects redesigned several learning spaces, adding areas that support teams and projects and are co-located among more traditional spaces. The thinking is that those spaces are easily used for a variety of needs, and can be reconfigured by the users. Another space that had earlier been designated as a traditional, tiered teaching theatre was redesigned to remain a large, open, flexible space that can house large groups, teams and small groups, and individual learning areas. The planning team viewed this space as similar to the "collaboration incubator" described in Design #2 of the study. This decision saved money because static, tiered rooms are costly to build, can only be used for one purpose, and are often empty. By keeping the space open and flexible, it is another example of a space that can be reconfigured by the users to support different learning activities.

As community college administrators and planners work with architects to renovate existing facilities or design new buildings and spaces, these design features and categories can serve as a guide to design physical learning environments to support learning that prepares learners for their new roles and responsibilities in the 21st century. Another important consideration: Figure 6 can be used to understand the overlapping of the categories and features, in order to provide an optimal learning experience and create a system of relationships that support that learning. This research is being used by several architects and planners, and will continue to evolve through implementation of some or all of the design features and subsequent reviews of results. With each project, more considerations and questions appear that will guide future research.

REFERENCES

Alexander, C. (1979). *The timeless way of building*. New York: Oxford University Press.

American Institute of Architects. (1999). *Renovating Early- and Middle-20th Century Schools Conference*. St. Louis, MO.

American Institute of Architects, Committee for Education, Hogeschool van Amsterdam, and National Clearinghouse for Education Facilities. (2000). Innovative Alternatives in Learning Environments Conference. Amsterdam, The Netherlands. Retrieved May 4, 2003, from www.aia.org/pai/cae/amsterdam_report_ed

Bogdan, R. C. & Biklen, S. K. (1998). *Qualitative research for education: An introduction to theory and methods*. (3rd ed.) Boston, MA: Allyn and Bacon.

Brubaker, C. W. (1998). *Planning and designing schools*. New York: McGraw-Hill.

Bruffee, K. A. (1995). Sharing our toys: Cooperative learning versus collaborative learning. *Change, 27*(1), 12–18.

Bruner, J. (1990). *Acts of meaning*. Cambridge, MA: Harvard University Press.

Capra, F. (1996). *The web of life: A new scientific understanding of living systems*. New York: Doubleday.

Cooper, J. L., Robinson, P., & McKinney, M. (1994). Cooperative learning in the classroom. In Diane F. Halpern and Associates (Eds.), *Changing college classrooms* (pp.74–92). San Francisco: Jossey-Bass.

Dede, C. (1993, August). *Beyond distributed multimedia: A virtual forum for learning* (Unpublished paper). Fairfax, VA: Center for Interactive Educational Technology.

Denzin, N. K., & Lincoln, Y. S. (1998). *The landscape of qualitative research: Theories and issues*. Thousand Oaks, CA: Sage.

Dewey, J. (1939). *Experience and education*. New York: Macmillan.

Donald, J. (1997). *Improving the environment for learning: Academic leaders talk about what works*. San Francisco: Jossey-Bass.

Duke, D. (2000). *Designing a place for problem solving: The center of applied technology and career exploration*. Paper presented at the Innovative Alternatives in Learning Environments Conference, Amsterdam, The Netherlands.

Eckert, P., Goldman, S., & Wenger, E. (1997). *The school as a community of engaged learners*. Menlo Park, CA: Institute for Research on Learning.

Fosnot, C. T. (1993) Preface. *In search of understanding: The case for constructivist classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development.

Gall, J. P., Gall, M. D., & Borg, W. R. (1999). *Applying educational research: A practical guide*. New York: Addison Wesley Longman.

Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. Journal of Technology Education. *7*(1).

Goodsell, A., Maher, M., Tinto, V., Smith, B. L., & MacGregor, J. (1992). *Collaborative learning: A sourcebook for higher education*. University Park, PA: National Center on Postsecondary Teaching, Learning, & Assessment.

Halpern, D. F. (1994) *Changing college classrooms: New teaching and learning strategies for an increasingly complex world*. San Francisco: Jossey-Bass.

Hendrick, C., & Hendrick, S. S. (2000). *Close relationships: A sourcebook*. Thousand Oaks, CA: Sage.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1991). *Active learning: Cooperation in the classroom*. Edina, MN: Interaction Book.

W.K. Kellogg Foundation (2000). *Leadership recommendations: Engaging higher education in societal change*. Battle Creek, MI.

Kirk, C. (2000a). Campus as place. *Planning for Higher Education, 28*(1). Retrieved May 4, 2003, from www. scup.org/nexus1.htm

Kirk, C. (2000b). Challenges and opportunities of student multiplicity. *Planning for Higher Education, 28*(2) 32–41.

Kraft, N. (1999). *Criteria for authentic project-based learning*. Denver, CO: RMC Research Corporation. Retrieved May 4, 2003 from http://www.rmcdenver.com/useguide/pbl.htm.

Langan, T. (1984). Phenomenology and appropriation. *Phenomenology + Pedagogy, 2*(2) 101–111.

Lawton, M. (1999). School design can say a lot about teaching and learning. *Harvard Education Letter, 15*(1) 4–7.

League for Innovation in the Community College (1998, 1999, 2000). League connections and leadership abstracts. Retrieved May 4, 2003, from www.league.org

Lindblad, J. L. H. (1995). Restructuring the learning environment: A cross-case study of three collaborative learning communities in American undergraduate education (Doctoral Dissertation, The Pennsylvania University, 1995). *Dissertation Abstracts International*.

LSW Architects, PC (2000), *Predesign study for the Clark Center*. Vancouver, WA: LSW Architects.

LSW Architects, PC (2001). *Facilities master plan for Clark College*. Vancouver, WA: LSW Architects.

Mack, L. (1999, September 5). Downtown school designed with creativity in mind. *Metro/State Star Tribune,* pp. B1, B2.

Mayer, F. W. (1999). A review of a campus and facility planning bibliography: An essential reference tool. *Planning for Higher Education 27*(4), 39–40.

Merriam Webster's Dictionary (1993). *Third new international dictionary, unabridged*. Springfield, MA: Merriam-Webster.

Miles, M. B., & Huberman, A. M. (1994). *An expanded sourcebook: Qualitative data analysis*. Thousand Oaks, CA: Sage.

Minnesota Public Schools. (1995). *The downtown school: A report of the K–12 interdistrict team for the West Metro Education Program*. Minneapolis, MN: Minneapolis Public Schools.

National Clearinghouse for Educational Facilities, (1998). *Design principles for planning schools as centers of community*. Washington, DC: National Institute of Building Sciences. Retrieved updated publication, May 4, 2003 from http://edfacilities.org

National Council for Occupational Education. (2000). *Strategic Alliances for the Future*. National conference. Westminster, CO.

National Skills Standards Board. (1996). Retrieved May 4, 2003, from www.nssb.org from Skills Standards and Initiatives page.

Oakey, J. H. (1995). Foreword to *Learning about project-based learning* by Rudie Tretten and Peter Zachariou. San Rafael, CA: The Autodesk Foundation.

O'Banion, T. (1997). *A learning college for the 21st century*. Mission Viejo, CA: League for Innovation.

Oxford English Dictionary (1989). (2nd Ed.) Oxford, England: Clarendon.

Perelman, L. J. (1992). *School is out: A radical new formula for revitalization of America's educational system*. New York: Avon.

The Pew Charitable Trusts (2000). *Learning outcomes for the 21st century: Report of a community college study*. Philadelphia, PA.

Pfluger, J. (1995). *The downtown school: A project of the West Metro Education Program.* Minneapolis, MN: Cuningham Group.

Rapoport, A. (1982, 1990). *The meaning of the built environment: A nonverbal communication approach*. Beverly Hills, CA: Sage.

Reeve, J. R., & Smith, M. B. (1995). *Planning for master planning*. Alexandria, VA: The Association of Higher Education Facilities Officers.

Rogers, C. R. (1969). *Freedom to learn for the eighties*. Columbus, OH: Charles E. Merrill.

Senge, P., Cambron-McCabe, N., Lucas, T., Smith, B., Dutton, J., & Kleiner, A. (2000). *Schools that learn: A fifth discipline fieldbook for educators, parents, and everyone who cares about education*. New York: Doubleday/Currency.

Skolnikoff, E. B. (1994). Knowledge without borders? Internalization of the research universities. In J. R. Cole, E. G. Barber, & S. R. Graubard (Eds.), *The research university in a time of discontent* (pp. 333–360). Baltimore: The Johns Hopkins University Press.

Smith, M. M. (1996). This school is a zoo! *Electronic Learning, 15*(5) 26–28.

Stanton, K. (personal communication, June 10, 1999). *Cuningham group designs "storefront" multicultural, experiential school on bustling Hennepin Avenue in heart of downtown Minneapolis*. Minneapolis, MN: Cuningham Group.

Stein, S.: National Institute for Literacy. (2000). *Equipped for the future content standards: What adults need to know and be able to do in the 21st century*. Washington, DC.

Strange, C. C., & Banning, J. H. (2001). *Educating by design*. San Francisco: Jossey-Bass.

Tuckman, B. W. (1999). *Conducting educational research*. Orlando, FL: Harcourt Brace.

U.S. Department of Education, National Alliance of Business, and U.S. Chamber of Commerce. (2000). [Satellite Town Hall Meeting #72]. *Modernizing Schools: Technology and Buildings for a New Century*. Washington, DC: U.S. Department of Education.

U. S. Department of Labor. (1991). *The Secretary's Commission on Achieving Necessary Skills*. Washington, D.C. Retrieved May 4, 2003, from www.academicinnovations.com/report.html

U.S. Department of Labor. (1998). *Workforce Investment Act*. Washington, D.C.

van Manen, M. (1990). *Researching lived experience: Human science for an action sensitive pedagogy*. New York: State University of New York Press.

Walsh, D. C. (1999) The academic challenge: Creating spaces for spirit. *Change 31*(4), 18–23.

Wankat, P., & Oregovicz, F. (2000). Making projects successful. ASEE *Prism* (33).

White House Millennium Council, and American Institute of Architects. (1998). *Designing schools for the 21st century: National symposium to offer ideas and models for new learning environments*. Washington, DC: U.S. Department of Education Conference.