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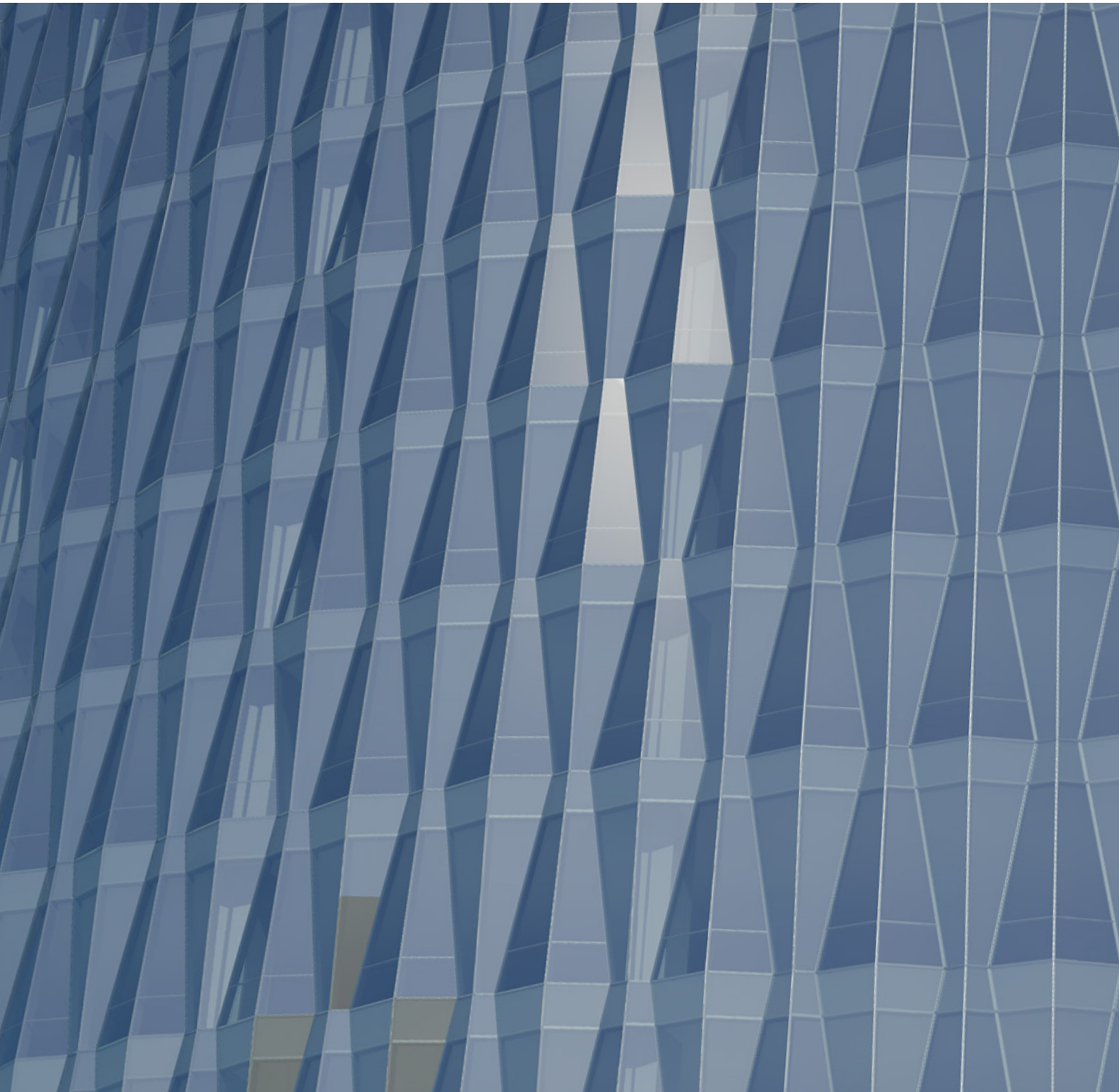

03.
STUDENTS OF TODAY AND TOMORROW:
Discovering How and Where They Learn Best

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ABSTRACT
This article explores various educational theories, research and factors that can be correlated to or have an impact on the physical spaces in which learning takes place. As school design and planning becomes more in tune with the influences that affect education, the connection between physical space and the learning process becomes more relevant. Drawing from sources such as recognized research on student learning habits and styles as well as our own research regarding student social behavior and engagement we can begin to propose concepts and design solutions that may help achieve the goals of education and most importantly, the goals of the student.

KEYWORDS: engagement, relevancy, involvement, technology, transferable

1.0 INTRODUCTION
"Schools cling more and more stubbornly to their mistaken idea that education and teaching are industrial processes, to be designed and planned from above… and then imposed on passive teachers and their even more passive students."

John Holt[1].

Holt's statement above summarizes the educational delivery model for American schools over the past fifty years. Education was distributed and measured in the same manner of our industrial economy in the post World War II era. Educational theory and practice has since evolved and there are numerous approaches to student learning that were not part of the educational discussion fifty years ago. Is it possible to make correlations between the new educational models and the spaces in which learning is taking place? For architects and school designers, it is important to make this correlation. By highlighting a select number of educational principles and examining the goals of these principles, we can begin to propose designs that are responsive and informed by the educational process.

Holt commented on relationships between education and architectural spaces, "*When we better understand the ways, conditions and spirit in which children do their best learning and are able to make school into a place where they can use and improve the style of thinking and learning natural to them, we may be able to prevent much of the failure… that takes place in school*"[1].

This article discusses a comparative analysis of learning styles and learning spaces. Perkins and Will embarked upon a survey-based research project entitled "The High School Project", which was intended to gather feedback and comments from high school students across the country. It was decided that a focused study of student life would potentially provide evidence about how schools function and how students function within them. One of the primary goals of the High School Project is to determine, through various survey questions, which environments students find most engaging and why. The preliminary results of this survey have proven to be very valuable. The content of the student responses reflected many or our predictions about how the physical environment affects the student experience and provided insight into the specifics of how students are using technology in today's learning environment. This research project sought to measure student engagement, which is one of the most important aspects in education. Many of the questions sought to reveal something definitive about physical spaces that foster engagement. How can we, as architects, take this information and plan our new schools around these engaging spaces?

2.0 MULTIPLE INTELLIGENCES: AN OVERVIEW
There are libraries filled with books and studies on child psychology, educational trends and other topics related to education and learning. Each author or group of re-

searchers have their own perspective on the issues and propose a solution to a problem, an analysis or a new concept. Among all of these publications, there exists a shared fundamental idea that children are naturally very good learners. Whether it is children's limitless curiosity, innate resilience or inexhaustible resourcefulness, children's natural ability to learn and learn in many ways should be the dominant factor in education.

As described in the previous section, the schools and educational concepts during the 1950's and 1960's were designed, built and functioned in ways that ran counter to the notion that children learn naturally and each in their different ways. A school comprised of floors of identical corridors that lead to blocks of identical classrooms does not foster or support the varied learning styles of children.

The ways in which children learn has been well documented and serves as a critical component to the school design and planning process. A fresh idea in educational theory appeared in the mid 1980's with Gardner's publication of his book, *Frames of Mind*[2]. In this book Gardner identified eight multiple intelligences that unlike traditional educational theory, places a value on the numerous ways in which students learn. Each student sees the world in a different way and educational methods must respond to these various intelligences if they are to be successful. "The capacity to think intelligently is very different from knowing lots of information. ... And here at last is where our multiple intelligences can make their contribution ... Instead we can learn about it in many different ways using our multiple intelligences and that concept or topic is much more likely to remain with us … and to be usable in flexible and innovative ways"[2]. This book and the core ideas behind Multiple Intelligence (MI) theory began the movement towards student-centered education.

A common misconception about MI theory is that certain people only possess some of the intelligences and not others or that every person has a dominant intelligence. Gardner is clear to point out that this is not the case. Most people often display some level of aptitude in all of the intelligences and a strong aptitude in a single intelligence type may never develop.

The list of Gardner's multiple intelligences is as follows:

1. Linguistic
2. Logical-Mathematical
3. Spatial
4. Intrapersonal
5. Interpersonal
6. Bodily-Kinesthetic
7. Musical
8. Naturalistic (added in the mid-1990's).

2.1 Learning Styles: Ways and Means of Interacting

Gardner's multiple intelligences have also been defined as learning styles, referring to the way someone acquires knowledge. It is not focused solely on what is learned, but how something is learned. Learning styles are as much about interacting with the world as they are the content of the interaction. Although we may be capable of using all of the learning styles, most of us rely on only one or two. As a result, we develop a specific approach to learning based on our preferred learning styles. The list is as follows:

1. *Linguistic Learners* have a unique relationship to language, either in written or spoken form. Their ideal vehicle for learning is reading, storytelling, abstract thinking, etc.
2. *Logical-Mathematical Learners* perform best when logic and reason are used to interact with the educational process. Making observations, analysis, hypothesizing and making judgments based on information is their strength.
3. *Spatial Learners* prefer visual clues and imagery to handle information. Painting, drawing and sculpture are various means of acquiring knowledge and providing an expression for the spatial learner.
4. *Intrapersonal Learners* thrive in situations and conditions where they are required to self-reflect. Well developed reasoning skills and a heightened awareness of emotions are the strength of this learning style.
5. *Interpersonal Learners* are the opposite of the intrapersonal. These learners thrive in groups and when communicating with others. They have a well defined sense of others' feelings and perspectives and therefore thrive in the open group environment.
6. *Bodily-Kinesthetic Learners* find learning through physical movement as the most natural way to acquire knowledge. The movement of the body and exercise allows these learners to understand situations and their responses are most clearly expressed through their own movement.
7. *Musical Learners* have the inherit ability to recognize rhythm and tone, patterns in speech, music and other acoustic sources. Their preference is to interact and respond in music, sound and tone.

8. *Naturalistic Learners* use their surroundings, namely the environment and nature to learn best. Their connection to nature allows them to best recognize, categorize and deal with information.

2.2 Multiple Intelligences: Putting the Theory to the Test

Once MI theory became a widely distributed idea, hundreds of teachers and educators began to implement the theory in practice in various ways. There are countless examples of schools that applied the thinking to their educational approach, but the one school that stands out is the Key Learning Community in Indianapolis, Indiana. The Key Learning Community began in 1987 with their mission statement reading "research and develop innovative practices in teaching to celebrate diversity in our population and our communities and to personalize education by building upon each student's strengths in the following intellectual areas: Linguistic, Musical, Logical-Mathematical, Spatial, Bodily-Kinesthetic, Naturalistic, Interpersonal and Intrapersonal"[3]. The school establishes MI theory for the basis of their educational approach and the schedule is organized so that each day each student is able to study all of the intelligences. At this time there is no specific research on the educational performance of students at the Key Learning Community.

There have, however, been many research articles written on the impact of MI theory on education with two studies of importance in particular. Project Spectrum conducted a study from 1984 to 1993 that focused on effects of MI-based curriculum on academically at-risk first graders. A report released in 1993 by Chen stated the following, "At-risk students although they perform poorly in traditional academic areas, are not necessarily low performers in all areas of learning"[4]. The author continues to point out that identifying and nurturing the strengths at an early age led to increases in student motivation, productive social behavior and overall engagement.

The second study [(Project on Schools Using Multiple Intelligences (SUMIT)] was a national survey conducted from 1997 to 2000 that consisted of 41 schools that applied MI theory to its educational approach. A report on this study indicated some promising statistics as follows[5]:

- 81 percent of schools reported improved student discipline.
- 78 percent of schools reported improved academic performance by students with learning difficulties.
- 78 percent of schools reported improved standardized test scores.

2.3 Principles of Learning

Reinforcing the importance of the learning styles identified above, educators and school planners have begun to emphasize student-centered learning versus teacher-centered educational models. This trend focuses on connecting events and learning in the school to real life situations that students can easily relate to and identify with. One of the goals of student-centered learning is to be adaptive to various learning styles and, in doing so, focus on comprehension and thinking versus memorization and drills. Student-centered learning has significant implications regarding the design of the physical environment. In a student-centered classroom, the teacher is no longer the focus of the room, but based on the content of the curriculum, the students arrange themselves accordingly. This translates into countless learning environments that promote numerous learning styles.

Student-centered learning relies on some key principles. The International Academy of Education has established a list of twelve Principles of Learning that are widely referenced on the topic[6]. The principles are intended to work in concert with one another, each supportive of the next. They are as follows:

1. *Active Involvement*
   Learning requires the active, constructive involvement of the learner.
2. *Social Participation*
   Learning is primarily a social activity and participation in the social life of the school is central for learning to occur.
3. *Meaningful Activities*
   People learn best when they participate in activities that are perceived to be useful in real life and culturally relevant.
4. *Relate New Information to Prior Knowledge*
   New knowledge is constructed on the basis of what is already understood and believed
5. *Being Strategic*
   People learn by employing effective and flexible strategies that help them to understand, reason, memorize and solve problems.
6. *Engaging in Self-Regulation and Being Reflective*
   Learners must know how to plan and monitor

their learning, how to set their own learning goals and how to correct errors.

7. *Restructuring Prior Knowledge*
   Sometimes prior knowledge can stand in the way of learning something new. Students must learn how to solve internal inconsistencies and restructure existing conceptions when necessary.
8. *Aiming Towards Understanding Rather Than Memorization*
   Learning is better when material is organized around general principles and explanations, rather than when it is based on the memorizations of isolated facts and procedures.
9. *Helping Students Learn to Transfer*
   Learning becomes more meaningful when the lessons are applied to real-life situations.
10. *Taking Time to Practice*
    Learning is a complex cognitive activity that cannot be rushed. It requires considerable time and periods of practice to start building expertise in an area.
11. *Developmental and Individual Differences*
    Children learn best when their individual differences are taken into consideration.
12. *Creating Motivated Learners*
    Learning is critically influenced by learner motivation. Teachers can help students become more motivated learners by their behavior and the statements they make.

The principles of learning described above are based on a culmination of theories, observations and research. The intent of the research was to gain a greater understanding of student learning. As architects responsible for the design of learning environments, we looked to expand this type of research and begin exploring connections between learning styles and learning spaces.

3.0 THE HIGH SCHOOL PROJECT: STUDENT-CENTERED SCHOOLS: SURVEY AND EVIDENCE-BASED DESIGN

We began the High School Project by first meeting with a focus group of high school students. In our discussion, we addressed the issues and topics that we intended to cover with the survey. At that time it was unclear how the research and survey would be administered, whether it would be conducted school-by-school or district wide. The students in the focus group quickly identified the means to reach the broadest audience would be by establishing a web-based survey and creating a presence on a social networking site such as Facebook. The clear advantage to this method of distributing the survey was the organic manner in which news about the survey could be spread. This allowed the survey to take on a life of its own beyond the students and schools we had access to. The next phase of the research was to determine what questions the survey would include placing a priority on student engagement and physical space and the role of technology in the students' school life.

There is precedent for this research, however, the focus of the existing research is on teaching techniques and methodology. The most well published research is what is known as HSSE, High School Survey on Student Engagement, which was developed at Indiana University's College of Education[7]. One of the taglines for this research is "Charting the Path from Engagement to Achievement".

HSSE is a student research study that, as of 2005, had surveyed 90,000 high school students in 26 states. The findings of the survey indicate that the primary issue with students and education today is engagement. A 2005 USA Today article on HSSE had the following information to report:

- 56 percent of students surveyed said they put a great deal of effort into schoolwork.
- 55 percent of students surveyed devote no more than 3 hours a week to class participation, but 65 percent of these students report getting A's or B's in their classes.
- 37 percent of college bound students reported spending more than 7 hours a week on schoolwork.
- 18 percent of college bound students did not take a math course their senior year.

Another precedent of note is the 2002 21st Century School Fund's Building Educational Success Together collaborative work, which commissioned the research of the affect of school facilities on educational achievement. The research, in cooperation with the Council on Educational Facility Planners International, sought to review facility design and conditions with teacher and student feedback. The report was issued in October 2009. The schools represented are from public school districts all across the United States and share the common theme of better designed and better functioning facilities have a positive impact on educational success in many different forms.

Table 1: Examples of research highlights.

Data set	Information gathered
Sample: Data Source: Variables: Results:	South Carolina School Principals Facility condition score Significant relationship between building condition and test scores. At least 75 percent of principals indicated that adequacy of school facility impacted teacher attitudes, student behavior and parent and community attitudes and support.
Sample: Data Source: Variables: Results:	National sample of public school principals School Principals Facility condition rating Approximately 1/3 of schools indicated that there was at least one factor that interfered with their ability to deliver instruction to a moderate extent.
Sample: Data Source: Variables: Results:	Rural and Suburban Georgia schools Researcher observation Design Elements (movement/circulation, daylighting, views) Significant effects found between high scores on all three design elements and test score results.

Our High School Project survey developed into thirty five questions. The questions are divided into several categories such as demographic information regarding school size, community type, student academic performance, etc. These questions begin to identify possible similarities and differences between various student populations. The remaining questions are divided among four categories: Engagement, Facilities, Study Habits and Trends.

The breakdown of questions as a percentage of the total survey and sample of each is indicated below.

Demographics 26 percent
What type of community is your school located in:
a. Urban
b. Suburban
c. Rural

Engagement 17 percent
In a typical class do you find that you pay more attention during:
a. AV presentations
b. Lecture/marker board discussion
c. Group work
d. All types are equal

Facilities 43 percent
In a typical class do you prefer to sit:
a. Near the front of the room
b. Near the middle of the room
c. Near the back of the room
d. Near the window

Study Habits 9 percent
In conducting research for school projects how much of the information you gather is via the school's library:
a. 10 percent
b. 25 percent
c. 50 percent
d. 75 percent
e. 100 percent

Trends 6 percent
Do you post content (blog) on the web:
a. Yes
b. No

Because the primary goal of the research is to influence school planning and design, the majority of the survey consists of facilities-based questions. These questions inquire as to how and why students prefer specific spaces within a school versus others, which areas they spend most of their time, which classes do they find most interesting and what about those spaces stands out.

Table 2: Some information from preliminary responses.

States Represented:	**7 GA,FL,TX,MO,WA,MN,OH**	
High Schools Represented:	**32**	
Public 86 percent	44 percent respondents attend school with an enrollment of 500-1000	
Private 6 percent	34 percent respondents attend school with an enrollment of 1000-1500	
Charter 8 percent	12 percent respondents attend school with an enrollment of 1500-2000	
Question 15: What Influences have lead you to your decision about a potential career path?	- A particular inspiring teacher - A particular inspiring class - Exposure to career-based learning at school - A work-study program - An experience outside of school	31 percent of students responded that they have an interest in a career path because of a non-school related activity or organization.
Question 23: The media center/library should be open the entire day and the students should be able to access it during any free period they might have.	- Agree - Disagree	98 percent of students responded that they would use the media center if it were open to students throughout the day.
Question 27: How much of your work in the school's media center/ library is using the library books:	- 10 percent - 25 percent - 50 percent - More than 50 percent	The majority of the students polled (57 percent) responded that only 10 percent of their time in the media center is spent using the books.
Question 29: In a typical class do you find that you are more engaged during:	- AV presentations by teacher - AV presentations by fellow students - Lecture/Marker board discussion by teacher - Group projects/discussion with fellow students - Indepedent work time	40 percent of students responded that they feel most engaged during group projects with fellow students.
Question 30: If the resources of the media center/library were spread out throughout your school in student lounges would you use the books, computers, peridicals:	- More - Less - No change	68 percent of students responded that they would use the media center resources more if they were distributed throughout the school.

4.0 TRANSLATING LEARNING INTO DESIGN: CASE STUDIES

The twelve principles of learning are an excellent road map to designing schools that promote students to engage and interact with their peers, their teachers, their surroundings and foster learning at the highest levels. In many ways each principle acts as a design requirement above and beyond the basic function of a school building. Examining the goals of the principles of learning and designing environments that respond to them is the aim of student-centered design.

Active, social, engaging, transfer, individual, motivated; are some of the essential characteristics from the list of twelve principles of learning. Not surprising, many of these words are action words and are associated with doing something. They inherently describe creative hands-on environments. Evidence from research is clear that learning involves many dimensions and senses including thinking, moving, speaking, listening and feeling.

Goal: Active Involvement
Affiliated Learning Style(s): All learning styles
Methods: Foster cognitive activities, engage the learner and create opportunities for exploration.

Response: More than any other goal, keeping students actively involved is the most critical principle to successful learning. The best means for achieving this goal is to provide a variety of spaces for learning to occur starting within a single classroom and extending throughout the entire school. Classrooms can be many learning spaces in one. As illustrated in the diagram below (Figure 1), classrooms provide spaces for lectures, group work, lab experiments, resource area and outdoor exploration. Each of these spaces is interconnected to the activities occurring in the adjacent spaces.

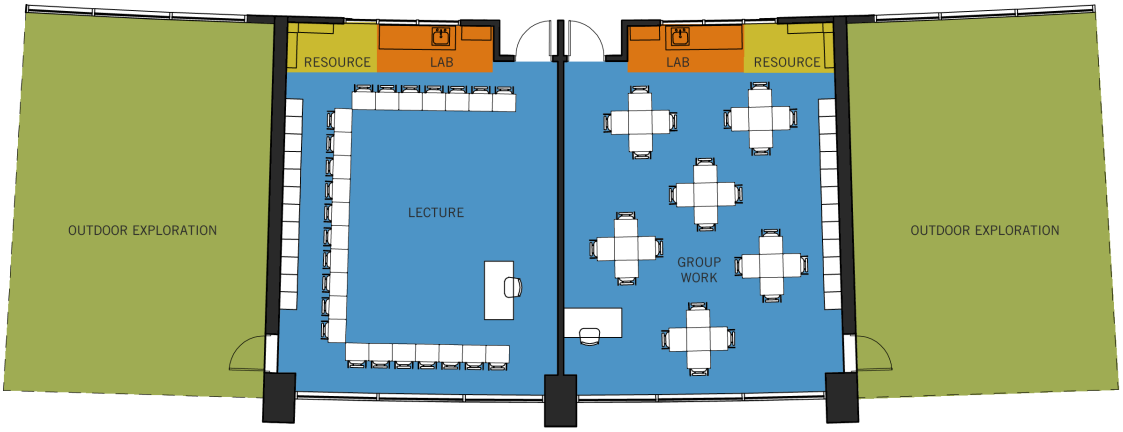


Figure 1: Mattie Lively Elementary, Statesboro, GA, 2009.

Goal: Social Participation
Affiliated Learning Style(s): Interpersonal, Logical-Mathematical, Bodily-Kinesthetic
Methods: Provide space and opportunity for group work and projects

Response: Learning is primarily a social activity. Interaction and collaboration are a part of every student's life and, therefore, should be a part of their education. The underlying success of social learning is that it is interesting and exciting. If students enjoy the activities they are engaged in they will get the most out of the lessons being taught. Design that not only allows for group work and collaboration, but celebrates the process and the results, has tremendous effects on learning. In the example below (Figure 2), a shared commons area is embedded within each classroom cluster. The commons becomes an extension of the classroom, it can function as computer labs for one group, study area for another or a meeting room for students from several classes.

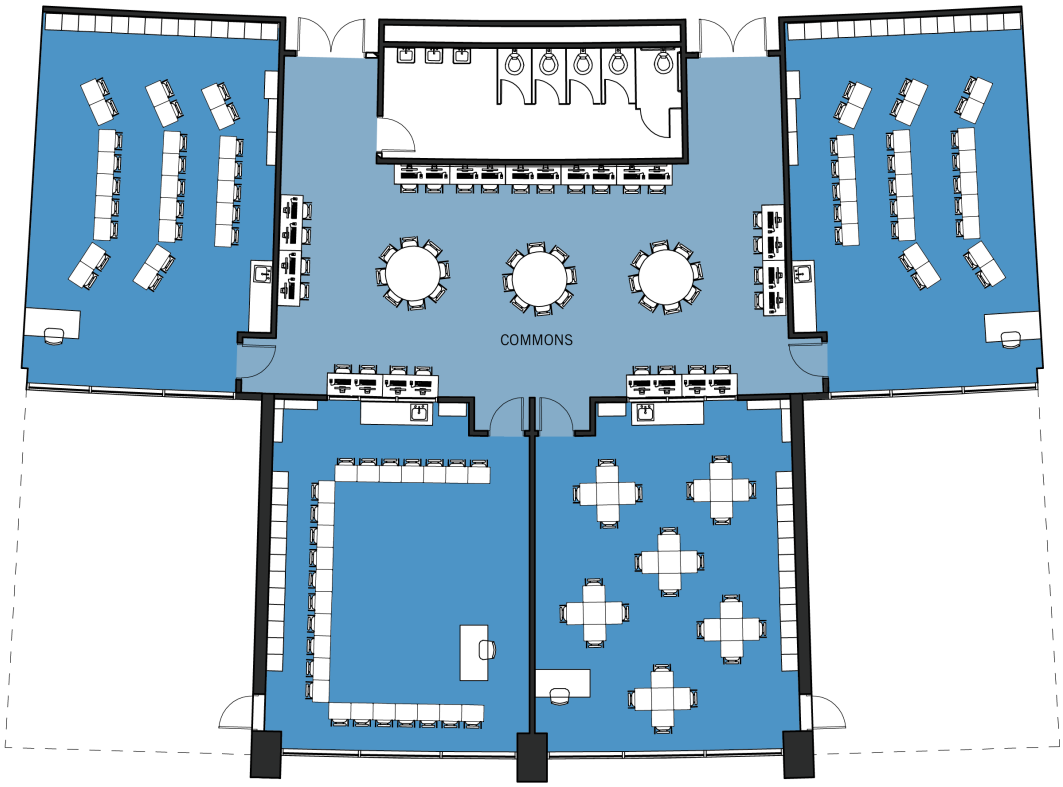


Figure 2: Mattie Lively Elementary, Statesboro, GA, 2009.

Goal: Helping Students Learn to Transfer
Affiliated Learning Style(s): Intrapersonal, Linguistic, Spatial
Methods: Bring subjects from out of the classroom into the classroom and vice versa

Response: Learning becomes more meaningful to students when they can relate personally to the lessons being taught. Connecting one subject to another through themes and experiences outside of the classroom begins to develop an atmosphere of continual learning. Not everything taught comes from the textbook and not everything learned happens in the classroom. In the example below (Figure 3), at specific locations within the school, walls of the cluster commons are designated with themes that may be related to coursework, student projects, school wide activities, etc. The integration of common space with educational topics through a graphically charged surface, such as theme walls, illustrates the power of transferred learning.

Figure 3: Mattie Lively Elementary, Statesboro, GA, 2009.

Goal: Developmental and Individual Differences
Affiliated Learning Style(s): Interpersonal, Spatial
Methods: Create various environments suited for specific student types and groups.

Response: Designing a school that meets the needs for every individual learning type is challenging since schools must be flexible and adaptable and meet the needs of the specific program and curriculum. The challenge of K-12 design is to create schools that meet curriculum needs, provide specific types of spaces for various learners, create opportunities for social engagement and handle the increasing enrollment sizes. Many of these challenges are met by the "School within a School" model that breaks down the scale of large schools into smaller learning communities. Within the smaller communities, individual program and student requirements can be addressed with an attention to detail not possible at a school wide scale. This design model is most successful with large high schools serving a large student body with a wide range of academic performance and goals. In the example below (Figure 5), a high school for 1850 students is divided among two floors with four separate academic wings or houses. These smaller learning communities include a 9th grade academy that houses all the 9th grade students, faculty and administration offices and a commons exclusively for those students. The idea behind the design is to provide a place that allows for nearly all academic and social activities of the 9th grade within a smaller community, thereby establishing strong engagement among peers, faculty and administration. The other three wings for the school may be programmed in various ways, either continuing the academy structure with 10th, 11th and 12th or dividing the wings by department and curriculum such as humanities, sciences and math.

Figure 4: Charles Drew High School, Riverdale, GA, 2009.

4.1 Technology in Schools: The Equalizer

As mentioned in the introduction, technology has dramatically transformed this generation of students just as it has the rest of our society. School-aged children are among the most skilled users of new technology; they are born into a life of technology.

This article does not intend to present a comprehensive history of technology in education, nor does it attempt to begin to analyze all the elements of education that have been and will continue to be greatly influenced by technology. One reason for this disclaimer is that although computing and internet availability has been widely used in classrooms in the US for nearly 15 years, the volume of information being disseminated by technology is very difficult to grasp, let alone record and analyze.

What can be said of technology in education is that it has undoubtedly opened up a world full of potential and possibilities to all who have access. For many students around the country and indeed around the world, the internet in the classroom has become the most powerful tool for learning, second only to the student's mind. In a pre-internet society, if one was to evaluate opportunities afforded to all students in all schools across the US and the world, it would be very clear to see that two cultures existed, "the haves and the have nots". Internet technology in the classroom has become, in many respects, the equalizer.

From the standpoint of school planning and design, current technology in education has created a need for additional spaces that are dedicated to technology and its distribution. Certainly every instructional space benefits from technology whether it be desktops for student use, projectors connected to cable television or access to the internet. The task of integrating technology into education is primarily a curriculum and pedagogical challenge more so than it is a facilities challenge. How teachers and students use technology to communicate within the classroom and beyond is something that remains to be seen.

Below are statistics on the use and accessibility of technology, specifically personal computers in the United States in a six year period prior to the new millennium[8].

In 1993:
32 percent of school age children had access to a computer at home
61 percent of school age children reported using a computer at school.

In 1997:
50 percent of school age children had access to a computer at home
71 percent of school age children reported using a computer at school.

In 1998:
89 percent of US public schools had internet connectivity
51 percent of classrooms had internet connections.

In 1999:
The US President's State of the Union Address calls for 100 percent connectivity.

4.2 Teachers/Students: A Learning Environment for Both

All of the educational theories and approaches discussed in this article have a common goal in that they all work toward improving the quality of education and the overall experience of the students. One of the notable effects of establishing student-centered education is that it inherently redefines the role of the teacher. As evidenced in many of the student survey responses and research literature, student engagement is perhaps the most critical aspect of successful learning environments. As seen in the case studies, student engagement can be fostered, to a large extent, by the spaces in which students spend their time. The same can be said for teachers who teach in those spaces. Part of a successful transition from teacher-centered to student-centered education is the decentralization of the teacher as the focal point of the classroom, the "sage on the stage model". This transition signifies a potential paradigm shift in how education can be delivered. Even when the physical environment does not change, there is a fundamental difference in how students and teachers interact, how students and students interact and how teachers interact with one another. The following diagrams illustrate how this shift could occur within a facility that remains unchanged.

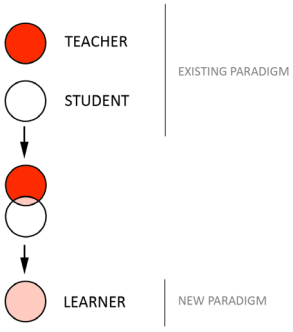
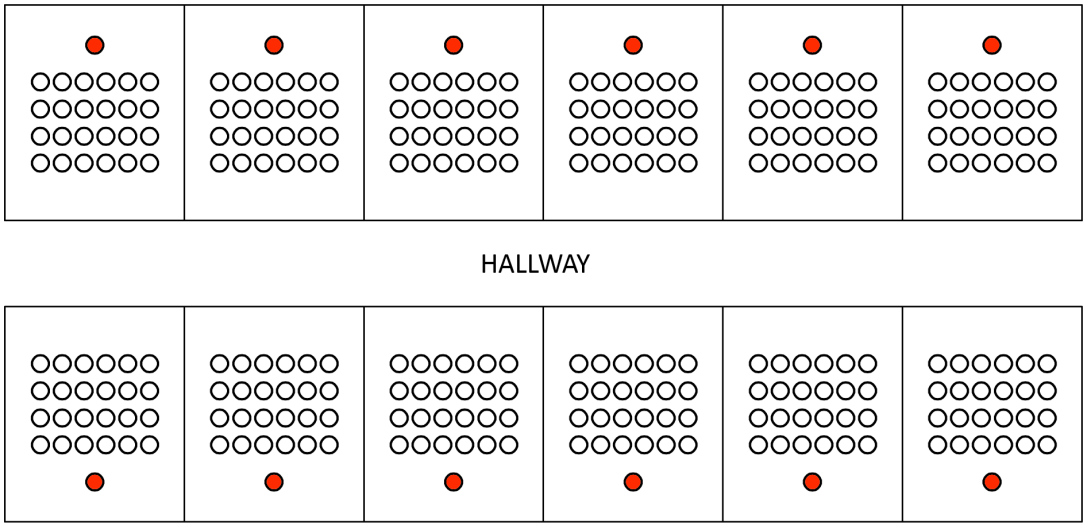
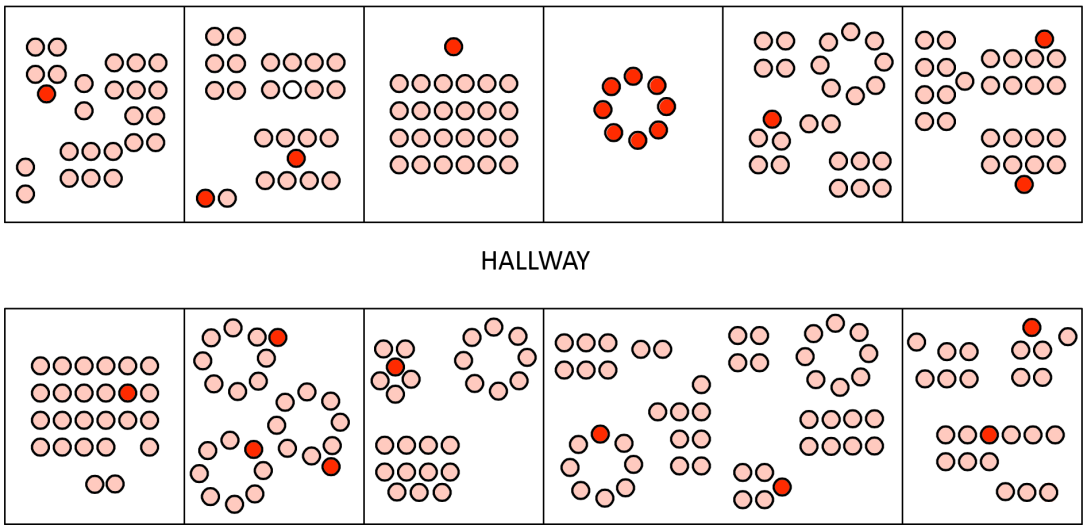


Figure 5: Adopting the mentality of both teacher and student as learner creates new opportunities for a truly collaborative educational experience.



SAGE ON THE STAGE MODEL

Figure 6: Teacher-centered education.



GUIDE ON THE SIDE MODEL

Figure 7: Student-centered education.

The diagrams above represent an exciting potential for what could be a powerful shift in educational delivery and the structuring of learning environments. The static relationship between teacher and student transforms into a fluid and dynamic setting where students can teach one another, teachers can learn from other teachers and a true learning environment is created. Although few schools have adopted this arrangement, there are examples of spaces such as this that schools can draw from as a resource. One such example is a retail chain of technology stores.

4.3 Student-Centered Learning: Using Technology as a Clue from the Everyday

As discussed in the previous section, the current generation of students are techno-natives. The millennial generation has grown up in an environment where technology is ubiquitous and, therefore, information is limitless. By combining the tenets of student-centered education and the familiarity of technology-driven environments, school facility design can begin to connect with students in an entirely new way and likely engage students who previously may have slipped through the cracks. Project-based learning is a collaborative educational model where students learn through group and individual work, theme-based projects, cross disciplinary subjects and on projects that are relevant to them.

The advancements in technology over the past twenty years has greatly expanded how project-based learning can be realized. There may be no better example of project-based learning than the modern day Apple store. On many levels these retail stores represent what today's learners are looking for: flexible and open spaces, the ability to access web-based resources, the opportunity to work independently, and access to the metaphorical brain of the Apple store the "Genius Bar" where experts in all fields of Apple technologies await eager customers who need assistance. What is described above is the operational model for how the Apple store functions, which is very relevant to today's students. The planning model for the Apple store is also very relevant to the architect designing schools.

Revisiting the concepts discussed in the previous section about fluid and dynamic environments where everyone involved is a learner in some capacity, the Apple store offers a glimpse of how this relationship might work. There are designated teachers in the form of the experts at the "Genius Bar". These staff members and their relationship to customers is similar to a traditional classroom where a teacher imparts knowledge to a group of students. There are training areas that provide a location for customers to receive one-on-one support with an employee, not unlike a teacher working with a student in a tutorial role. There are several open areas for display and browsing. It is in these areas that customers are free to explore the products and inherent technology that they provide. These areas represent the closest example of collaborative project-based labs, where students work independently or in groups and, only if requested, does a teacher step in to answer questions or provide guidance.

Below are plan diagrams, photos and renderings that illustrate how the model of the Apple store can be translated to tomorrow's learning environments.

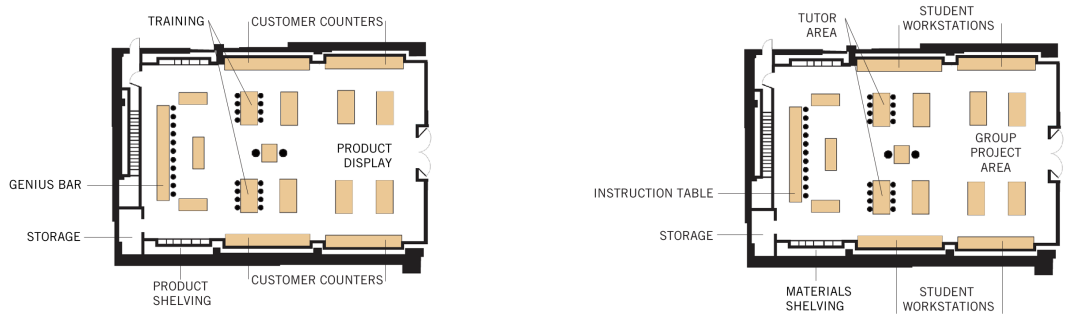


Figure 8: Apple store floor plan as reference for project-based learning lab (Case Study 1).

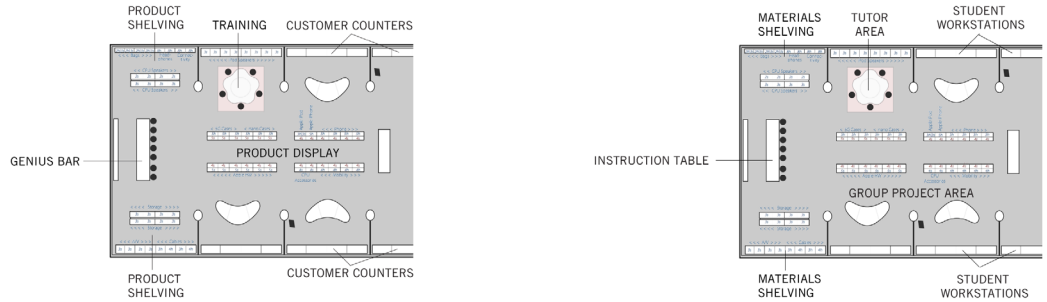


Figure 9: Apple store floor plan as reference for project-based learning lab (Case Study 2).

Figure 10: Photos from various Apple stores.

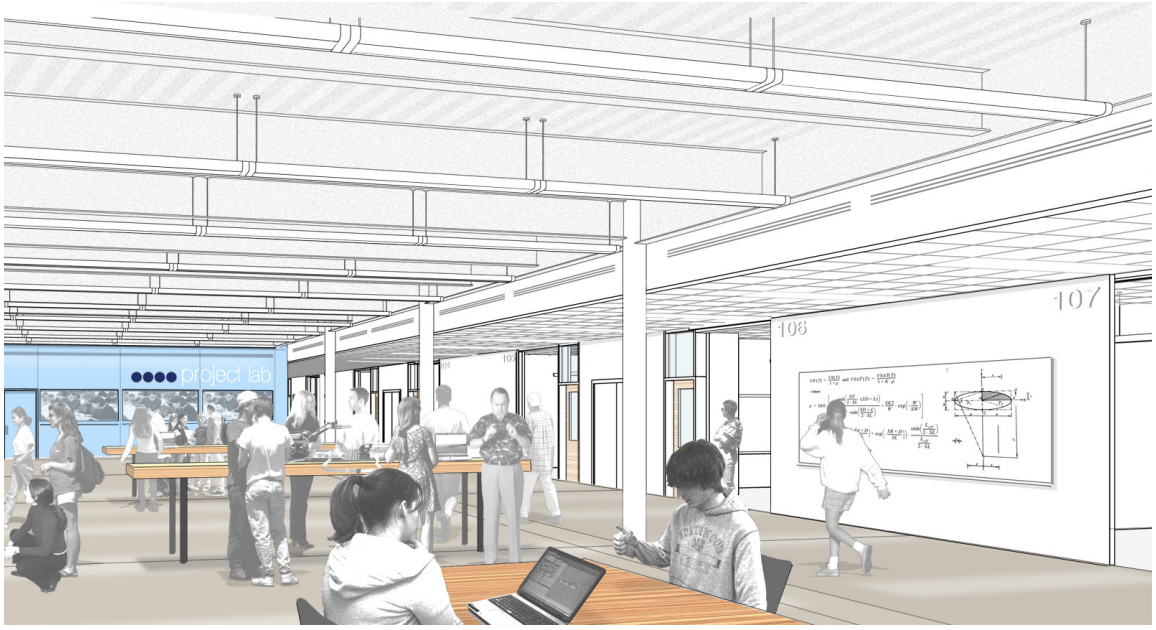


Figure 11: Rendering of project-based learning lab.

Figure 12: Diagram of project-based learning labs distributed school wide.

5.0 CONCLUSION

Collaborative, student-centered and project-based learning has significant implications regarding the design of the physical environment. In a school that is organized around these principles, the teacher is no longer the focus of a room, but an active participant with the students in a dynamic and fluid educational setting. By creating engaging environments, schools can support multiple types of learning styles to take place in spaces that are best suited for the learners.

Common to all ideas and topics discussed above is the fact that students learn in ways that often appear incongruous to a school environment. They observe, experiment, practice and, in doing so, they bend and break things, make mistakes and confuse things, complicate and misinterpret things. In all of these actions, children are open, receptive, bold, confident, excited and patient. Kids learn with an incredible collection of skills and talents. If schools can be designed to provide the time, the place, the opportunity and the reward for these remarkable events of learning, then they will make significant steps toward great education.

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REFERENCES

[1] Holt, J., (1983). *How Children Learn,* 2nd ed., New York, NY: Da Capo Press.

[2] Gardner, H., (1983). *Frames of Mind,* New York, NY: Basic Books.

[3] (2010), Key Learning Community, Retrieved 10/2010 from http://www.616.ips.k12.in.us.

[4] Chen, J., (1993). "Building on Children's Strengths: Project Spectrum intervention Program for Students At Risk for School Failure", *Biennial Meeting of the Society of Research in Child Development,* New Orleans, LA.

[5] Kornhaber, M. L., Fierros, E., and Veenema, S., (2003). *Multiple Intelligences: Best Ideas From Research and Practice.* Boston, MA: Allyn and Bacon.

[6] Vosniadou, S. (2001). "How Children Learn", Report, UNESCO/International Academy of Education, Retrieved on 8/2009 from http://unesdoc.unesco.org/images/0012/001254/125456e.pdf.

[7] Yazzie-Mintz, E., (2007). "Voices of Students on Engagement: A Report on the 2006 High School Survey of Student Engagement", Report, Retrieved on 6/2009 from http://www.indiana.edu/~ceep/hssse/images/HSSSE%20Overview%20Report%20-%202006.pdf

[8] Kinzer, C. K., and Leander, K., (2003). "Technology and the Language Arts: Implications of an Expanded Definition of Literacy", in *Handbook of Research and Teaching the English Language Arts,* J. Flood, D. Lapp, J. R. Squire, and J. M. Jensen, eds., pp. 546-566, Mahwah, NJ: Lawrence Erlbaum Associates.