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It has been said the "school facilities are educational philosophies set in concrete." As information technologies allow innovative methods of learning, facilities must adapt to meet these new capabilities. Generic classrooms, designed for an educational era of low technology will no longer be sufficient. This article provides a glimpse of how classrooms may be structured to meet different learning styles.

THE FUTURE OF CLASSROOM DESIGN: Integrating Technology and Instructional Methods

Bill Bridges

Integrating Technology and Instructional Methods *Designing a School*

Recently I was invited to participate in a new schools design study group. The group was asked to provide the educational requirements for interpretation by architects into three new school buildings. The group spent long hours discussing restrooms, offices, teacher's furniture, classroom size, and a myriad of details. Technology installations received their share of discussion including types of systems, how many, and how they should be made available to students. The document that resulted from these discussions (USD 501, Topeka Public Schools series) was lengthy and detailed concerning the educational and technological requirements for the schools. The study was then turned over to the architects for their rendering of a school building. Although three new schools were being built—a computer science magnet, a natural science magnet, and a "traditional" school—to save money, they were to be carbon copies of each other. The architect at the direction of the District and in consultation with the design study group, presented a floor plan using all the current considerations for building schools. The classrooms were identical in size and shape, facilities in each classroom were the same, and the

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classrooms divided into pods separating students into primary and intermediate age groups. As the detailed building plans progressed, technology was integrated into the classroom based on a single decision; all teachers would use a collaborative learning method of instruction.

Reviewing the Experience

Although its too late to make changes in the foregoing design process, a review highlighted several areas that were not considered or were driven by the wrong priorities. First, the technologies were planned using the "blanket" approach—every room would have the same technological capabilities. While this approach is not necessarily bad, it takes no account of varying instructional methods and the technologies that best support them. It caters to the "one size fits all" school design principle. This "blanket" approach for technology was supported by another "blanket" decision—the collaborative learning instructional method was best and all lessons would be taught in that manner. Notice I have never mentioned curriculum. The instructional method was determined without any thought for curriculum. In fact, curriculum has yet to be written. Despite all the ongoing discussion in education forums concerning curriculum/technology integration, our group intrinsically based its technology decisions on an instructional methods decision.

Other failures in the design process included our relationship with the architect. The first of our failures was not asking the architect, before hiring, about his experience with installing technology in new buildings. My first conversation with the architects, besides perfunctory introductions, was "Who is your technology consultant?" to which I received the answer "We don't include technology in the design, you add that on after we finish building." After straightening out that misunderstanding, we continued to let the architect make educational decisions; the shape of the classrooms, their size, grouping by education levels, technological layout, and position in relation to the rest of the building facilities. That doesn't sound so bad until you realize that these are educational decisions in which educators played no part. Had we determined the curriculum first and subsequently the instructional methods best suited for each part of the curriculum, we would have been designing our classrooms and curriculum instead of the architect.

The results of all this review: instructional methods can and should affect classroom design, technology can support education better through specific application to instructional techniques, and curriculum should be the baseline for all decisions including instructional methods. Good curriculum includes varied instructional techniques which can be optimized with technologies implemented specifically to support them. Education needs to take control and build classrooms which facilitate learning through the integration of technology and instructional methods.

Classroom Design Standards

Architects have a number of standards they follow when designing buildings. Most of these standards involve building codes (UBC 1991) specifying square footage, lighting, ventilation, electrical wiring, etc. These are codes written by agencies who are concerned about safety for people. Technology has its own set of codes for wiring, ventilation, electrical emissions, and electric power (ANSI/TIA/EIA Series). These codes are concerned with equipment and environmental safety. When it comes to the design of classrooms the standards are extensions of existing building and safety codes. If we are to really design classrooms optimized for student learning, we must change our "code based" thinking about classrooms and adopt learning-centered designs. The following table summarizes some considerations concerning this change:

Concepts	Current	NEW
Classroom Size	32 sq ft per student—more for kindergarten and preschool.	Determined by the instructional methods.
Class Size	25, 28, or ?—depends on what the school board sets.	Variable—depends on the instructional method.
Curriculum	Can be taught in any classroom or a classroom special designed for the subject (i.e. chemistry).	Taught in classrooms designed for instructional methods that maximize learning—integrated.
Class Organization	Teacher has absolute control of learning—good order and discipline—follows curriculum guide.	Teacher guides students—students participate in the process—flexible curriculum.
Instructional	All methods can be used in the same classroom design with the same equipment—all teachers can use any and all instructional methods.	Instructional methods best used in classrooms designed to optimize the strengths of each—technology infused.
Learning Styles	All student learn “best” with the specified by the curriculum or the teacher.	Each student has a “best” learning style which can be accommodated in a technology-infused classroom.
Teachers	A personalized environment improves the teacher's ability to teach.	An instructionally optimized classroom using technology allows every classroom to be personalized.
Students	Require a fixed schedule—same room, same teacher for each subject—unable to cope with change.	Cope with change better than teachers—optimal classrooms allow the student to learn better.

In 1973, Stanton Leggett defined a planning process for designing new schools (De Chiara & Callender (1973)). In his article he promoted the idea of flexibility and change for school buildings. The concept was that classrooms must be designed to undergo continuous change responding to continuously changing educational programs—“don't tie education down.” This concept has influenced architects and educators for many years. It insures a continuation of the “cookie cutter” architecture for schools—the one size fits all classroom which can later be changed to another one size fits all classroom. In one respect Leggett was right—educational programs appear to change frequently. Education has now run head on into something that changes faster—technology and educators have been asked to incorporate technology into the curriculum.

A Necessary Technological Aside

For purposes of this paper, it is necessary to define technology as it will be used in the remainder of this discussion. Technology will be defined as electronic tools resulting from the invention of the microchip which can be used for learning and instruction. In general, they fall into the categories of voice, video, and data systems, or combinations thereof. Older technologies such as telephones, audio-visual systems, and mainframe computers which now benefit from or have become dependent on microchip technologies are included in this definition.

Curriculum/Technology Integration

Education has been asked to “integrate” technology into the curriculum. In most cases, we have “associated” technology with curriculum. We perform the same educational functions using technology and have made the teaching of technology skills its own subject. We really need to treat the technologies themselves as tools and integrate the “results” of technology (i.e. information and communication) into the curriculum. This view assumes that like “crayon 101” and “pencil 101”, “technology skills 101” and “technology skills 102” will be taught at the appropriate times in the curriculum to provide stu-

dents the skills they need. Why discuss this in a paper about the future of classroom design? It allows us to free the curriculum from a hardware/software orientation and concentrate on assisting teachers and learners by using technology to optimize classroom designs benefiting instructional methods.

Technology Designs

Our approach to date has been to incorporate all technologies, or as many as we can afford, into every classroom. We do this because we never know what instructional method will be in use at any given time and our classrooms must be as flexible as possible. While not necessarily “bad”, this is a costly way to use technology and our classrooms are still not necessarily optimized to leverage instructional methods. By designing our classrooms for instructional methods integrated with technology tools we can provide better environments for learning.

Some assumptions must be made concerning technology systems used to optimize classroom designs. First and foremost, learners must be responsible users. They do not abuse the technology. They understand its capabilities. Users must follow simple security measures regarding networks and software. They must also understand and abide by the legal uses of software. All technologies are part of an integrated school-wide system. The core of the system is a network capable of voice, video, and data communications which accesses people, places and information for the purpose of education and learning. Finally, the concept of “technology space” is used to define how access is organized on the network. Technology space can be either private or public. It is a location in an information storage medium where users place information for their own or others use. We sometimes refer to these locations as home directories, personal folders, or public access folders or directories. Some of the technology systems used later in the classroom designs are neither mature nor cheap. They are real systems, however, and when used to fulfill specific educational functions make sense for learning.

Technology System Design

The technology system designs for schools should be heavily based on a central education network available to all students and staff. The network must accept data from various input sources such as keyboard and scanners, digitized video from a video retrieval and distribution system and voice from integrated telephone systems for voice mail and audio recording. The schools reference library must be accessible. The network must be capable of providing connection to the Internet as well as various commercial networks and bulletin board systems. All students and staff must be able to access it through remote node, remote control, or dial-in 24 hours a day. Only with this kind of access will students and staff be able to fully utilize the technology systems for instruction and learning. Each student and staff is provided access to a personal folder which contains their class notes and work. In addition, they can access group folders for each of their courses for access to common resources. This is the technology space mentioned earlier. It allows the students and staff to move freely from class to class and classroom to classroom always able to be in contact with their own teaching or learning information and information resources. The end of the digression.

Instructional Methods

Often referred to as teaching strategies (Smith 1971), instructional methods are the way in which information is presented to the student for learning. Realizing that no instructional method remains pure where student learning is concerned, I have selected six methods which are broadly agreed upon (Smith 1971) and for which classroom design and technology can be specific to optimize the instruction. The following definitions have been used to aid in focusing on the design and integration of technology for classrooms.

Classroom Designs

The following classroom layouts have been picked to enhance a particular instructional method. I have made no attempt to fit them together into a school building. The shape of the classroom, the arrangement of the furniture, and the technology used are products of experience and the help of architects (De Chiara and Callender 1973) who have set the standards for years. While it is easier to understand these designs for secondary schools or universities, there is applicability to elementary levels as well. In some cases the classroom will look familiar, but the technology implementation is new. In others, the design, furnishings, and technology will all be new.

Skills/Repetition

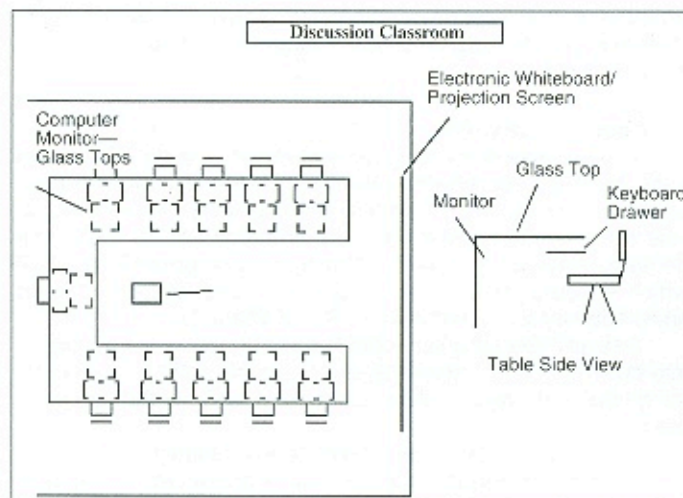
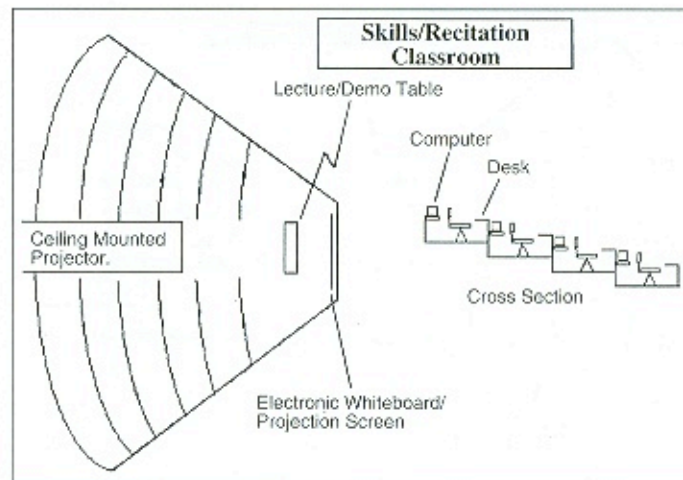
Repeated practice of a manual skill or mental operation to attain reflex response to a given stimuli. Although not a favorite way to instruct, the "drill & kill" method is often the best way to achieve a desired result (see Typing I or the multiplication tables.)

Design—Amphitheater seating, computers at the rear of each tier, screens facing the teacher, narrow desk space at the front of each tier—students face the teacher to receive directions and away from the teacher while working.

Technology—Electronic whiteboard, projector screen, suspended multimedia projector/sound system, each student has a networked multimedia workstation, teacher remote control system.

Discussion

Participation in a teacher controlled discourse to enable students to arrive at conclusions within a predetermined framework of knowledge. This usually takes the form of questions and answers by both students and teachers. It allows the teacher, who presumably has the most knowledge, to lead students into understanding of the subject and concepts under discussion. (English Literature 101).



Design—Rectangular shape, space for ten students and teacher—students arranged in a horseshoe shape for discussion purposes.

Furniture—"U" shaped table with glass top, computer monitors below glass with keyboard trays, open end of "U" faces display wall—teacher located at the head of the table.

Technology—Basic diskless student workstations for note taking, teacher with full multimedia capability, electronic whiteboard, projection screen, projector/sound system in ceiling, teacher remote controls for projection.

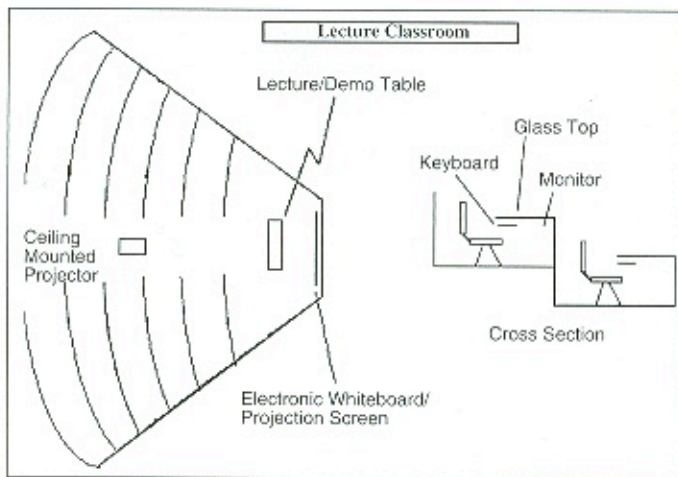
Lecture

An information reception strategy. Lecture is based on the premise that the teacher knows the information and the best way to pass it to the student is to present it serially from start to finish. Active student participation is limited to responding to questions asked by the teacher to acknowledge receipt of the information. Although is some disfavor, this method can be very effective. Good lectures are almost an art form and may require more preparation than some other methods of instruction.

Design—Amphitheater seating

Furniture—Rows of tables with glass top, computer monitors below glass with keyboard trays—teacher faces students with wide lecture/demonstration table with computer monitor below glass top.

Technology—Basic student workstations for notes, teacher with full multimedia capability and remote mouse and keyboard, electronic whiteboard, screen, suspended multimedia



projector/sound system, vertical and horizontal digital video system to record lecture/demonstration, teacher remote control for all technology.

Collaborative Learning

The process of working as a member of a group wherein each member contributes information to allow the group to attain knowledge of the whole. A method, very much in vogue, where the teacher acts as a guide and resource to assist students in staying "on task." Often a product oriented method which encourages students to discover and integrate related knowledge through their own work and interests.

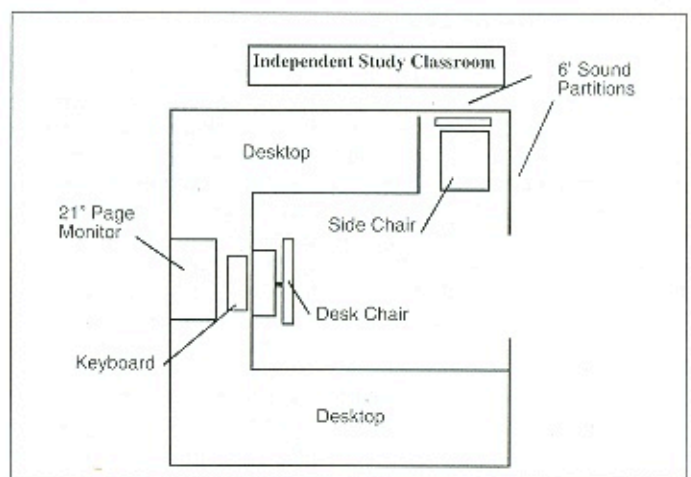
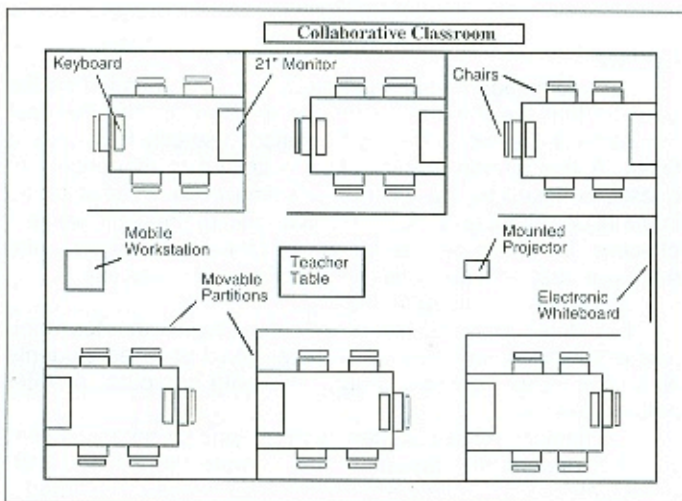
Design—Rectangular room, moveable partitions to divide into cubicles for five students, each cubicle outfitted with table for group work, teacher located at work table in the center of the room.

Furniture—Large tables and comfortable chairs.

Technology—Each cubicle has a multimedia computer with 21" monitor, teachers station mounted on moveable cart to allow relocation at any cubicle, electronic whiteboard, screen, suspended multimedia projector/sound system, teacher capable of viewing and controlling all workstations, teacher remote control of projection system.

Independent Study

A synonym for individual learning with guidance from a teacher. While not truly independent, the student works alone to master a body of knowledge on a particular subject or topic.



The teacher participates similarly as in collaborative learning, acting to direct the student's research and study and provide feedback to formulate and test ideas and conclusions. Usually a method for advanced students to allow a wider range of exposure to topics and ideas associated with the main subject of the study.

Design—8 x 8 cubicle with 6' sound absorbing partitions.

Furniture—Desk space on three sides, additional chair.

Technology—Full multimedia computer with speaker phone built-in, 21" monitor for layout and publishing.

Self Study

The attainment of knowledge through self directed study or experience in a subject area without formal guidance. Adult and continuing education has often recognized this instructional method by giving students credit for "life experience." Many people are life long learners whether they realize it or not. Their accumulated experiences, reading, study and personal and work relationships provide a vast amount of knowledge which allows them to respond and be successful in their work and personal lives. The world wide access to resources, discussions and interactions, made possible by technology will serve to focus more importance on the self study instructional method. Administrators can't design a room for self study. Learning takes place anywhere and everywhere, with and without technology access.

Change

When we think in terms of an instructional methods/classroom design/technology systems integration, there are changes that must take place in our thinking. The first is "creative leadership." Next, that instructional methods can and should affect classroom design. And last, "creative scheduling."

Creative Leadership

This is probably the most important change. School districts must begin to think in new ways. Student learning must become the first priority. Leadership that stays with the "tried and true" will fail to take advantage of technology, technology/curriculum integration, and varied instructional methods. Maximizing all three areas gives teachers the tools to take advantage of different learning styles and optimizing the district curriculum for students. Creative leadership will play the major role in providing students new and exciting learning environments.

Instructional Methods Affect Classroom Design

We can no longer afford to take a one size fits all approach to classroom design. Teachers would like to have their classrooms fit the instructional method. Experience shows

us that. It has long been recognized that some subjects benefit from a specialized classroom (i.e. music, art, science, etc.). It is time to realize that core subjects (math, English, history, etc.) can benefit in the same way. While specialized equipment is not necessary to teach these subjects, optimizing the instructional methods for teaching can have a major impact on student learning. We see some of this thinking at the university level, less at the secondary, and almost none in elementary schools. That does not mean however, that we shouldn't consider the idea for elementary students. When we consider the expense of integrating the information and communications provided by technology with our curriculum, we must plan to obtain every benefit possible for students. Team teaching, for example, where team members are strong in different instructional methods, could be maximized for the team's strengths with specifically designed classrooms.

Creative Schedules

This is what's next. The "cookie cutter" classroom makes administrators live's easier—it doesn't matter what classroom you use. When classrooms are different, and various parts of the curriculum are taught using different instructional methods, we'll have to look at a much different type of class scheduling. If you want a real challenge, try to devise a class schedule that takes advantage of specialty classrooms with specifically integrated technologies for optimizing instructional methods. This can be your next paper.

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