Access, Instruction, Application: Towards a Universal Lab

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In January 1998, the Montana State University School of Architecture embarked upon an initiative to successfully integrate computer technology into its design curriculum. At that time only a handful of student computers could be found in the design studio. By January 1999 over 95 students have and use computers in their courses. The increase in computer access and use is occurring through a five-phase initiative called the Universal Lab—a school-wide commitment to the full integration of computer technology into all design studios, support courses and architectural electives. The Universal Lab uses the areas of Access, Instruction and Application as the vehicles for appropriate placement and usage of digital concepts within the curriculum. The three-pronged approach allows each instructor to integrate technology using one, two or all three areas with varying degrees of intensity. This paper presents the current status of the Universal Lab—Phase I and Phase II—and describes the effect of this program on student work, course design and faculty instruction.

Keywords*: Design, Access, Instruction, Application, Integration*

Existing Conditions

Computer applications in the School of Architecture at Montana State University were taught in a second year one-semester course using two remote computer labs on campus and introduced students to 2-dimensional drawing, 3-dimensional modeling and desktop publishing applications. An advanced computer course explored animation and virtual reality applications while other elective courses explored lighting simulation and graphic design. The use of computer applications in the design studio, however, relied upon the initiative of individual students since no requirement for computer use existed within the traditional design studio. In addition, any student computer work was undertaken in remote locations at global labs or student residences. The remote and separate location of these computer resources greatly limited the use of digital technology within the design studio.

In addition, the MSU architecture faculty wanted to maintain the strengths in analog design and graphics that were already in place—recognizing that the value of drawing or modeling lies not only in the final product but also in the development of visual thought and perception. As such any method for integrating digital technology should supplement the existing analog methods. Similarly, the integration should eliminate the physical and intellectual separation between the design studio, the classroom and the computer lab. As such the technology should be introduced in a variety of ways focusing upon appropriate use and selective intervention. Building upon the experiences of other architecture programs

over the past decade[A], the School of Architecture developed the Universal Lab.

Towards a Universal Lab

Access, Instruction, Application

To integrate technology into the existing conditions of the architecture program, the Universal Lab proposes a multi-pronged approach emphasizing the categories of Access, Instruction and Application. The underlying philosophy behind this approach advocates that every course in the architecture program incorporate at least one aspect of digital technology whether it be digital Access, Instruction or Application. By encouraging a wide and flexible range of digital uses faculty and students can see beyond traditional CAD based computer usage and recognize the computer's ability as a medium that brings together the wide range of courses in the program. This flexible approach can also lead to a greater acceptance of digital technology by faculty and students who remain more comfortable with existing analog methods.

Access

By emphasizing the concept of digital access to information and people, students and faculty are able to see how this access will change the boundaries of their knowledge base.

Information Resources

- Digital access to design and historical resources
- On-line library catalogues, publications and product literature

Communication Resources

- Drawing and information transmission
- Digital access between instructors, students, design professionals and alumni
- Digital access to students and faculty at other institutions [B]

Instruction

Methods of digital instruction are integrated using the network infrastructure and a variety of course delivery methods.

- Use of CD-ROM animated programs
- Digital delivery of lectures and presentations
- Electronic transmission of assignments, project updates and site information
- Development and use of visual manuals for software applications
- In-class review of computer generated design solutions

Application

Digital applications parallel the efforts undertaken at other architecture programs[C], covering a broad range of software applications used in current and subsequent studio and support courses.

Digital Applications

- 2-dimensional CAD
- 3-dimensional modeling
- Digital communication
- Image processing
- Desktop publishing
- Web page publishing
- Digital presentations

Primary Digital Concepts

- Characteristics of a digital environment
- Designing at multiple scales
- Linking and layering of information and drawings
- Designing in multiple views
- Iterative nature between analog and digital media, process and communication [D]

Degree of Integration

We recognize that the degree of technology used in each course would vary in intensity from occasional

to moderate to extensive and we view this variety as a positive attribute of the proposal. For example, a traditional drawing course may not use any digital applications but can integrate Access on an occasional basis by posting assignments and drawing examples on a server. An architectural structures course can take greater advantage of Instruction and Application through a moderate use of computer generated lectures, spreadsheet applications and visual analysis programs. Finally, a computer applications course can make extensive use of all three areas. Combining the three categories of Access, Instruction and Application with a varying degree of intensity provides every course and faculty with a flexible yet directed framework for integrating digital technology into the entire curriculum. Figure 1 illustrates a possible array of intensity and use for computers within the curriculum.

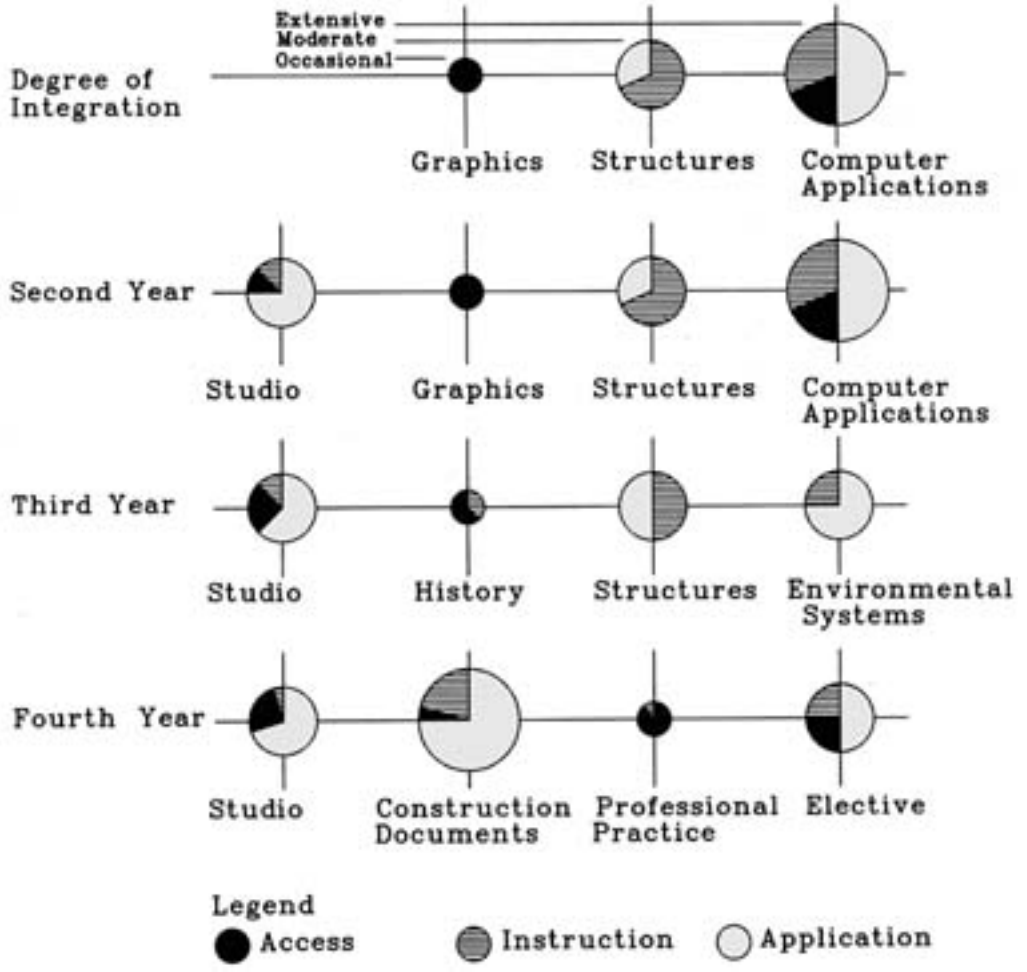


Figure 1 (right).

Increase in Access

To take advantage of the inherent flexibility within this multi-pronged approach students and faculty need greater access to the technology than was available with the existing remote computer labs. As a result the Universal Lab program requires that all second year students have a notebook computer in their design studio giving all students on-demand access.[E] The portability and compact size of a notebook computer benefits the open studio layout existing in our present facility. In January 1998, the Universal Lab began a five-phase implementation plan with an experimental Pilot Program in Phase I. This Pilot Program included twenty second year students in a digital design studio and required students to have a notebook computer. Phase II, initiated in January 1999, requires all 65 second year students to have a notebook computer during the second semester of the school year.

Learning within the Shadow of Design

The computer purchase coincides with the student's enrollment in a separate computer applications course, which is the initial introduction to digital technology within our program. This concurrent scheduling has been crucial to successfully integrating the technology in a seamless manner. To maintain the design studio focus upon the process rather than the technology, the introduction of any digital application takes place in the Computer Applications course. To emphasize the use of computers in design, however, *all computer assignments are directly related to studio projects.*[F] We found that the subject matter used, the introduction point for each application and the ordering of each assignment plays a significant role in the integration of digital technology into the curriculum. Thus the computer applications course introduces digital concepts and applications prior to their use within the design studio by employing a staggered introduction point—allowing the digital learning process to nurture within the shadow of the design studio prior to a fuller integration and emphasis within the design process.[G] As such, the computer applications course introduces students to a wide range of software programs: 2D CAD, 3D modeling, and digital communication.[H]

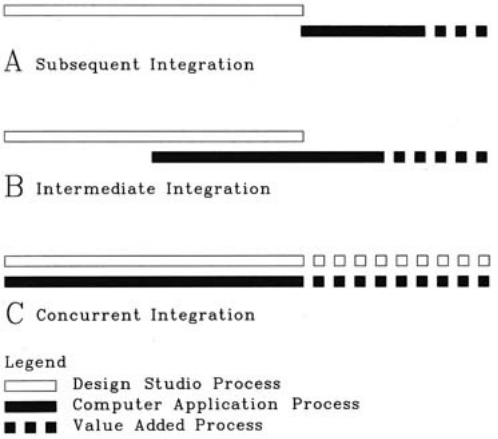
Subsequent Integration

In the first assignment the computer application does not begin until after the design process is completed—what we have called subsequent integration (Figure II-A). Using 2D CAD, students draw a plan and elevation of a small entry project completed in the previous semester. A primary goal of this assignment is to introduce students to basic drawing commands. Using a complex design project provides ample iteration of these commands while still reinforcing the design and drawing strategies introduced in the previous semester. There are many advantages to beginning with a student's design project from a previous semester. Students are invested and interested in doing a drawing of their own design and this assignment increases their technical and conceptual knowledge of the software as they develop a variety of drawing strategies in response to their design solution. By drawing a solution that is already completed, students also have the opportunity to learn the software application prior to taking on the added complexity of designing at the same time—learning in the shadow of the design studio. To add value to the design and integration process, the students manipulate their digital drawings and create a series of layered diagrams that present a formal analysis of their project—an analysis that can extend the design process.[I]

Intermediate Integration

The next assignment introduces the computer applications at an intermediate stage of the design process. Students utilize their current studio design to create a three-dimensional digital model, but the computer application is not introduced until the approximate mid-point of the studio project (Figure II-B). This allows students to make a number of design decisions prior to the introduction of the 3-dimensional

Figure 2 (right).



computer application. The advantages to this approach are similar to the 2-dimensional assignment in that students are willing to develop more complex models and construction strategies because of the investment made in their design solution. In the course of resolving the intricacies of their studio project a greater amount of problem solving occurs as students discuss their methods and frustrations with others. While bringing the computer applications closer to the foreground of the design process, students are able to extend and add value to the process by using their digital models to explore the experiential qualities of light, surface and space.[J]

Concurrent Integration

The last type of integration exists when the computer applications are introduced at the beginning of the design process—providing a constant two-way interaction between the digital media and the design solution (Figure II-C). Many students adopt this approach in their subsequent studio assignments (Figure III), but in the computer applications course the assignment focuses upon the varying characteristics of digital communication—specifically the similarities and differences between desktop publishing, digital presentations and web page publishing. Students use work from their design and graphic studios to create a portfolio in both analog and digital form creating a two-page portfolio layout, a digital slide presentation and a web page using the same digital information for each component. Throughout this process discussions take place concerning the nature of linear versus lateral communication methods that are inherent within analog and digital media. Since students are required to submit a portfolio in our program during the following year this assignment initiates that process—allowing them to learn the applications at the same time they are engaging in the process of design.

Assessment

Access

The category of Access is seen as one of the most influential components of the multi-pronged approach toward integrating technology. With the ever-growing use and acceptance of networking systems, this area is conducive to the widest range of courses and topics—from drawing to history to studio. However, this area requires a great deal of structure to fully utilize its potential and this will be addressed in future phases. Without specific assignments that require students to electronically transfer information or drawings, many students did not explore some of these possibilities. Similarly the use of network resources for research was not fully utilized without specific requirements. With additional course and project structure we hope to expand this area of use.

Instruction

An area of great concern during the initial phases of the Universal Lab program is the effect of technology on instruction within the department. Initial faculty reaction to the proposal was supportive but some anxiety existed over both the impact on design quality and the lack of sufficient faculty expertise in using the software programs.

While these are concerns that must be addressed, the introduction of digital technology and universal

Figure 3 (left).

access for all students made possible a gradual shift in teaching methods and course topics –a shift that is viewed in a positive light. In the architectural graphics course, for example, the ability to quickly create digital perspective views has led to a stronger focus upon observational and freehand drawing assignments—providing greater concentration on topics of visualization, perception and design process

Within the computer applications course, the widespread access to technology led to the development of visual manuals for each software program utilizing an extensive array of screen prints that lead students through the basic commands. These instruction manuals recognize and address the necessary linear conditions that occur at the outset of learning any new program. However, because the computer assignments use studio projects as the subject matter they require that lateral connections be made between these linear commands. Student and faculty evaluations concerning the use of 'linear-based' manuals and 'lateral-based' assignments are positive.

Application

Overall the quality of student computer work was high—particularly given that most students had little to no experience with either 2D or 3D digital applications. In part, this can be attributed to the quality of the work coming from the design studio and reinforces the advantage of taking on a staggered approach to computer integration using studio projects. The downside of using studio projects within the 3-dimensional computer assignment occurs when a student develops a design with limited geometrical patterning—creating a difficult modeling task. Some students rise to the challenge but others become intimidated and fall behind in the course. One possible alternative to this dilemma would be to focus on a smaller portion of the studio project. This would permit all students to develop a basic model and allow advanced students to develop additional detail. Interestingly, students consistently voice a desire to see more computer assignments in the studio—

expressing an interest in taking greater advantage of this technology.

Economic Impact

The requirement for each student to purchase a computer has prompted an immense amount of discussion within the department and university since this requirement shifts the primary financial responsibility from the institution to the students. Recognizing the burden that this requirement places upon students, a concerted effort has been made to support and leverage the student's financial commitment.

By requiring a computer, many students were able to apply for and use financial aid for this purchase—an option not available to students without the course requirement. In Phase I only 5% of the students utilized this option but in Phase II, 33% of the students took advantage of this option. Significant price drops within the industry also mitigate the economic impact. The average expenditure by students in Phase I totaled $3200 while in Phase II the average cost decreased to $2600. However, many students purchased their system and software for under $2000. While still a significant expenditure, the student investment has resulted in a noticeable increase in University support. Finally, 42% of the first year students in Phase I already own computers—prior to the purchase requirement. In Phase II, 55% of the first year students already own computers. Of those who did not own computers close to half (46%) state that they intend to purchase a computer sometime during their education. These results suggest that the computer purchase requirement may be following trends already taking place within the student population.[K]

Computer Usage

A primary goal of this initiative is to increase the use of digital technology within the design studio. The initial introduction of computers in Phase I saw a three-fold increase in the use of computer applications within the design studio. In their subsequent studios, the use of computers amongst this group decreased slightly—although it remained above pre-Universal Lab usage numbers. In Phase II, however, the use of computers within the studio did not increase—even though computer use in support courses and electives did show an increase. While faculty and students agree that computers were used at a much greater rate than in previous years and that the quality of work was good, the direct application on studio projects did not experience any increase—and on some projects decreased slightly—despite the additional access and emphasis. In retrospect this may have occurred because of unanticipated hardware problems, a shortened project schedule and the requirement for analog presentations in the studio. No intermediate digital studio applications were required and students appeared less willing to take on the additional time commitment to do both digital and analog methods since the final presentation requirements were still analog based. This is an area that we will address in Phase III by providing additional technical support and creating design and presentation components within the studio course to encourage a greater exploration and use of the digital technology.[L]

Conclusion

The Universal Lab program at Montana State University is still in the very early stages of its development—having just completed its first full year of implementation. As such the long term effects of this initiative remain to be seen. Even at this early stage, however, the evidence suggests at least partial success. Students have accepted the flexible approach toward integration as evidenced by the wide range of uses they have explored. Similarly, faculty have seen that there is a much broader range of digital applications beyond the traditional CAD applications and the areas of Access and Instruction have allowed the technology to be introduced into a much broader array of courses. Most importantly, the Universal Lab is fostering an attitude toward experimentation,

creative problem solving and collaboration to tackle the many technical and design problems that have arisen from such a massive influx of technology into the program. This may prove to be the most significant outcome of the Universal Lab initiative—its ability to change the perception of students and faculty so that the technology becomes an integral part of the diverse fabric that defines our program. As the program achieves full implementation in the year 2002, additional monitoring of these conditions will continue so that we can ensure that the initial goal of universal access and application throughout the curriculum becomes a reality.

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Notes

[A] Many previous efforts have been made at other institutions to integrate computer technology into the design studio and curriculum including, but not limited to, the work done at Mississippi State University, New Jersey Institute of Technology, Texas A & M, University of Arizona, University of Oregon, and the University of Utah. These and other institution's efforts were explored prior to developing the Universal Lab initiative.

[B] Initial efforts in Phase I and Phase II have not yet utilized the Access applications for studio collaborations with other institutions but progress has been made with remote applications in our Foreign Study Program.

[C] Goldman and Zdepski (1986, 1988) and Herbert (1987) identify and discuss many of the basic characteristics of the digital environment that form a foundation for this area of Applications at MSU.

[D] Adopting an approach that utilizes both analog and digital media and design processes is advocated and discussed by a number of educators and practitioners (Bermudez 1998; Herbert 1987, 1994, 1995; Kellett 1996; Neiman, 1997; Smulevich 1997). Neiman and Bermudez (1997) state "The future in not ahead, in the digital, but between the analog and the digital." Mississippi State University's approach toward utilizing analog drawing, digital applications and physical modeling is another example of utilizing the digital-analog combination (Berk 1996).

John Marx (1998), however, offers a differing viewpoint and advocates that the integration should be digital alone to fully realize the potential of the technology.

[E] Mississippi State University was the first architecture program in the United States to require their students to purchase a notebook computer (Berk 1996). Other architectural programs have followed this direction. At the time of this writing a web site—http://www.vcsu.nodak.edu/offices/itc/hotebooks/other.htm—has compiled a list of institutions and departments that currently have this requirement.

[F] The strong connection between the computer applications course closely parallels the methodology described for a digital media course at the University of Oregon (Kellett 1996) and the University of Arizona (Blazquez 1998). Similarly, our results support the experience at the University of Arizona in that "...having the computer instructor as part of the team in the design studio was crucial." Coordination between the studio and a separate applications course has been found to be essential and beneficial for both courses.

[G] Nancy Yen-wen Cheng (Cheng 1997) puts forth a curriculum model using a stepwise development to media fluency that utilizes a beginning, intermediate and advanced series of projects and recognizes the importance of ordering topics and exercises. The staggered integration proposal utilized at MSU takes advantage of an ordering strategy with all software applications. The intent is to achieve a beginning level through the process of subsequent integration, an intermediate level through the process of intermediate integration and an advanced level through concurrent integration.

[H] This approach supports the assertion by Johnson (1993) that learning multiple applications is beneficial. Given the intent for full integration across the curriculum it is even more crucial to introduce students to a wide range of applications and uses. The software students were required to have and/or use in the Universal Lab include: Bentley Microstation Triforma, Autodesk Auto

CAD R-14, Microsoft Publisher, Microsoft PowerPoint, Adobe Photoshop LE and Adobe PageMill.

[I] The first part of this assignment would be an example of the one-time, one-way shift between digital and analog that Herbert (1995) discusses since it takes a solution developed through an analog process and converts it into a digital form. The second part of the process—developing diagrams through the use of layers—takes the first step toward creating the two-way process between analog and digital that Herbert advocates.

[J] The benefits of using three-dimensional applications for spatial exploration and development are addressed in Bermudez (1995) and Smulevich (1993).

[K] Economic impact information was determined using results from student purchase surveys (Juroszek 1999).

[L] Computer usage information was determined using results from design studio surveys (Juroszek 1998, 1999).

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