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USING MOBILE DIGITAL TOOLS FOR LEARNING ABOUT PLACES

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Abstract. To explore how mobile digital tools can bring students out from isolated classrooms, we tested several for use in design studio site visits. We focused on small, off-the-shelf tools that are inexpensive and easy to upgrade. In this paper we identify the logistical, efficiency, and learning considerations for the selection and introduction of mobile digital tools, with observations about device usability and administration that are applicable to other kinds of technology introduction. We found that adoption of a tool depends on several factors, including ease of use and inconspicuous nature. Compared to traditional tools, most of these tools require a great deal of set-up time before students can use them efficiently. In addition, they require docking with a computer to analyze the information collected in the field. As a result, most of the learning takes place in the studio, rather than in the field. Our eventual goal is to clarify the potentials of place-recording tools, making it easier to gather and use a toolkit for specific situations.

1. Introduction

In the past, a measuring tape, camera and sketchbook were adequate for architectural site examinations; now, a new tool appears on the market with great promise for architects each day. While new tools can increase efficiency, facilitate sharing and enhance information usability, they also change how people interact with the site and perceive it. Students may have a different learning experience when using digital tools: the tools may decrease students' interaction with a site by requiring attention that distracts their attention from the site itself, but may help them "bring" places into the classroom in a more complete way.

This paper looks at how new mobile digital tools can be selected and successfully incorporated into the architectural design studio. We'll start by explaining the teaching context of our study, then describe the tools we selected, and finally explain the lessons we learned about choosing and using mobile digital tools.

2. Context for Introducing Digital Tools

This project to look at ways of improving how we collect site information grew out of a site analysis problem given to undergraduates over the past four years. Seventy-five second-year undergraduate students study the small downtown of Corvallis, Oregon (U.S.A.) for a two-week period before designing for the area. Students in each section are assigned different techniques to collect, analyze, and present site information. They use site-recording methods (as described by authors Lynch, 1960; Whyte, 1980; and Crowe, 1980). Assigning different techniques to each section allows us to compare the success of a particular approach with past results.

Students share their findings through live science-fair style presentations, with reports consolidated onto a course website for later use in the design process. They jointly build both a physical and virtual model of Corvallis, with work such as creating plans and material inventories divided among the sections. (see Theodoropoulos and Cheng, 2001)

In the past few years, the options for tools to bring to the site have greatly increased. This year, we considered new mobile digital tools and selected a few different kinds that would help us collect visual and dimensional information. Through individual and small group pilot testing, we have been examining how the tools can enrich the collection of place information for design studio classes such as the Corvallis studio.

A review of the literature showed that while investigation into the use of mobile digital tools is under way in disciplines such as primary school education (Crawford and Vahey, 2002) and scientific field studies (Pascoe and Morse, 1998), field work in environmental design is limited to traditional methods.

3. Selection of Mobile Digital Tools

We selected inexpensive tools readily available with minimal customization. These small tools have shorter learning curves that suit their occasional use by novice students. Because digital products become obsolete quickly, elements in an inexpensive toolkit can be upgraded individually as newer editions and budgets become available. The potential for technology transfer is greatest with these small tools: as students graduate and begin to work for firms with constrained budgets, they bring their awareness of how small tools can be used for architectural purposes. Students involved in our pilot testing learn how to develop criteria for selecting and using new tools.

The tools were selected for specific tasks, and most require some form of downloading to a computer or use of common memory cards to share their information with other devices:

- For **digital sketching** we tested the Seiko Inklink clipboard connected to a handheld Compaq iPaq 3850 personal digital assistant (PDA) and the Logitech Io Pen. As the user sketches on paper, each tool simultaneously captures the drawing digitally.
- For capturing **spatial dimensions**, we tried the Leica Disto laser measuring device. The Disto can be connected via cables to the iPaq running PocketCAD software from ArcSecond, so that the Disto provides distance information directly to PocketCAD so the user can immediately create an accurately dimensioned plan or elevation.
- For collecting **audio clips**, we tried PocketPC Notes on the iPaq, and an Olympus still digital camera.
- For collecting **visual information**, we used digital still and video cameras.

In using these tools, we looked at how the products of the tools could become useful in descriptive catalogs and expressive interpretations of a site visit.

*Figure 1.*Clockwise from upper left: Seiko Inklink used with iPaq and a notepad, Logitech Io with special notepad, Compaq iPaq, and Leica Disto. (Photos from manufacturers' web sites.)

4. Factors Affecting Tool Usability

Our investigations showed us that logistics, efficiency, and educational questions are the key issues to keep in mind when selecting and using digital tools for use in the field.

4.1 LOGISTICAL FACTORS

Before considering how the tools affect learning, the tools must be chosen and staff and students trained in their use. We found that human factors such as appearance and weight were as important as ease of use, and that small, specialized tools cannot yet share information in the field.

4.1.1 Human Factors Affect Adoption of New Tools

For new tools, novices in particular are sensitive to ergonomic challenges and logistical difficulties. Because new techniques are always being compared to comfortable familiar ones, small impediments are magnified and only the most enthusiastic students will bother to use the equipment.

Students will disregard tools that are unreliable, or that require extra steps. For example, even after we improved the ergonomics of carrying the Seiko Inklink drawing and note-taking tool, students did not like to use it because its pen marks were not consistently transmitted to the PDA. Traditional sketches can create better results because they are not limited to a ball-point pen and scanning sketches does not require special docking hardware and software. Extra steps for mobile devices (downloading drivers, special installation, and connecting with docking devices) also made scanning sketches more attractive.

Figure 2. Some tools are easier to use than others. At left, the Inklink connects to the iPaq with a tiny cable and to a notepad with a clip, all hard to hold while sketching. By using a plastic file folder to hold the tools, center, the devices are slightly easier to use. On the right, the standalone Io pen can be used like a normal pen with a special notepad.

Figure 3. Details of the plastic file folder we improvised for using the Inklink.

Stand-alone tools are easier to deploy than those used together. Tools that are used jointly require connection-setup on both tools, in addition to connector/cable issues. When problems arise, connected tools are difficult to troubleshoot since it isn't obvious where the problem lies. For example, while the Leica Disto laser measuring device was easy to use on its own, using it for direct input into PocketCAD on the iPaq PDA was cumbersome. The combination required handling two devices and an awkwardly long double cable, as well as some practice becoming familiar with the CAD software.

Weight of the equipment is a strong consideration in its field viability. A small tool such as the iPaq is easier to carry than a lightweight laptop. Students on field visits are typically already burdened with backpacks and may be reluctant to carry more. For students of small stature, this issue may be magnified.

Tool use must be inconspicuous so that inhabitants of the study area are minimally disturbed. Impressions of user behavior are altered if the observer is the subject of user attention. Performing unusual tasks can distract others even if the gear is typical. Some of the new digital tools we in this study attract attention even with discreet use; one student using a Disto after dusk (when the Disto's laser beam is easiest to read) was confronted by a security guard. We considered tool-carrying aprons and halter-style trays to facilitate equipment handling, but found that students were much more comfortable carrying conventional cases or bags.

4.1.2 Docking Tools Constrain Mobility

Targeted tools work well for specific tasks as digital extensions of familiar tools like cameras, sketching pencils, or measuring tapes. However, they rely on hardware "cradles" integrated with other tools (usually a desktop computer) to synchronize digital information. Most cradles attach to the computer through the USB port; when several devices are in use, hardware and software conflicts can arise. In choosing various narrowly-focused tools over a single multi-functional laptop, we did not realize how critical data transfer would be. **The communication abilities of mobile tools are pivotal for place information** because fully describing a place requires putting many diverse samples of information into context.

The iPaq appeared to be a suitable compromise between size, cost, and functionality, compared to an ultra light notebook computer, especially since we were looking for tools to be used for classes with 10 to 50 students. While we can beam data between iPaqs, we lack a true wireless connection. To transfer field data between iPaqs and other tools, we depend on docking to a computer since none of the devices we tested has compatible memory cards.

Because the Logitech Io pen also must be synchronized with a computer before its sketches can be digitally shared or manipulated, its portability is similarly constrained. Robust digital data transfer between devices in the field would allow coordinated input of sketches, photos, audio, video and text notes, followed by on-site verification.

Figure 4. Cradles for transferring information lead to traffic jams at the computer. From the left: Zio memory card reader, Io Pen cradle, iPaq PDA cradle, and Wacom mouse tablet.

4.2 EFFICIENCY FACTORS

Initially, we assumed that all digital tools would provide a speed advantage. While in some cases that is true, there are other aspects of technology tools that consume more time than their analog counterparts.

4.2.1 Digital Efficiency Requires Training

To minimize training time, we first set up the equipment and identified the most relevant functions. This allowed us to demonstrate the operations and have the students try them in about 10 to 20 minutes. To support quick learning, we wrote instruction guides that summarized parts of the product manuals into instructions essential to architecture-related tasks. We improve our instructions by interviewing students as they return the equipment, and making changes to our procedures. When possible, we observe the students using the tools and are available to help them with questions or difficulties.

Simply handing a new tool to a technology-savvy student and asking the student to experiment with the tool produced disappointing results because the students didn't understand what the tools could do. When we defined procedures for a specific kind of representation, students produced better results.

For large projects such as the joint virtual site model produced by the Corvallis studio, it is crucial to provide students with a diagram of the project's workflow. In this project, students are assigned various tasks such as creating CAD plans or portions of virtual massing models, and they rely on other students' work in order to complete their own portion of the project. The diagram of the structured collaboration helps students understand how their independent efforts are crucial to the success of other students, and it helps students understand a project in which much of the process and results are hidden. Digital efficiency allows team members to share information and work jointly, but **efficiency depends on articulation of processes**.

4.2.2 Maintenance and Administration Take Time

On the administrative side, these tools have a high price tag. Managing the tools is more demanding than we expected. Compared to manual tools, all the tools in this study are complex, and all have settings that are easy for students to change inadvertently. The research assistant for this project spent a lot of time setting up the tools by downloading updated software, reconfiguring the equipment, charging batteries, maintaining instrument settings, and assisting with tool synchronization.

Although it reduced flexibility, we found it efficient to have the students download tool data at a central docking station rather than having them try to install the cradles and software at their own computers.

4.3 EDUCATIONAL CONSIDERATIONS

After accounting for logistics and efficiencies, the educational impacts can be evaluated. The effects of engagement with the site, location of the work, and a guided approach are different than the use of non-digital tools.

4.3.1 Digital Tools Reduce Physical Engagement

Digital tools tend to remove a person from physical involvement with the site. When using a tape measure, a person spans a distance with two hands, pulls the tape out a distance or walks the tape along a length. In drawing, one makes a mark by moving an implement on the paper in the same direction or shape as what is viewed. A photographer has the freedom to move around a site more quickly than someone sketching. We wondered if using a digital video camera to record moving sights would let students have make observations and analyze the context with greater speed. But students who used the video camera typically walked through the site fairly quickly. Because their attention was on the camera's small LCD screen, they didn't see or experience the space in a typical way. Students were unwilling to discuss the site with other students while they were operating the equipment for fear of recording their conversations instead of the ambient sounds. **Complex tools reduce on-site analysis.**

The speed of a particular tool can change affect engagement with the site. For example, students who used the Disto to measure buildings in a particular block of Corvallis were able to measure more than their counterparts who used a traditional tape measurements. They could take more measurements with fewer inconveniences to passersby, and they could measure heights of buildings easily. But they did not develop the understanding of distances that comes with holding one end of a tape measure and working with a partner to agree on exactly what's being measured.

4.3.2 Mobile Digital Tools Require Post-Visit Analysis

Although a student operating a video camera is experiencing the site through a small screen, the advantage in the video camera appears once the student is back in the studio and has time to review the video with other students, or to manipulate the data. For example, one student with a film-making background created hotspots on a map that activated 360-degree panning videos. The student spent a disproportionate amount of time working on the project: he made extra visits to Corvallis and devoted his spare time to learning Flash. He learned more about Flash than about the site. However his peers found that being able to access images and sounds of Corvallis helped bring the place to life. **Currently, learning aided by mobile digital tools takes place in the studio, not in the field.** We hope that as this study continues and as new tools appear on the market, students will have a more intense field experience by being able to communicate and integrate information on site.

We found similar results for the processes of creating QTVR panoramas: students learned more about the technology than the city. Technology has a seductive quality that makes it easy to focus on technology mastery instead of useful results. **It's easy to confuse mastery of the tool with mastery of the pedagogical subject.** Providing students with templates (as described in the next section) allows students to focus on the content of the project, rather than on the technology.

4.3.3 Successful Use of Digital Tools Requires A Guided Approach

Students always learn more deeply when we guide their approach. Experimental techniques and tools may require more creative thinking but often don’t communicate as well as established methods.

Digital tools require strong instruction since unfamiliar aspects can be a distraction. **If a tool is new to students, rich examples and accessible help will bring them up to speed quickly.** With a twenty-minute introduction and a strong online tutorial for iMovie, students were able to create a credible movies complete with soundtrack within a week.

With new tools, there needs to be a balance between feeding students established procedures and requiring them to invent new ones. Students who were told to create digital photo collages in the Cubist style of David Hockney had to learn how to exaggerate aspects of the site that caught their eye. Students varied in their ability to emulate Hockney's approach; many results were banal. The best students successfully created a collage that emphasized points of visual significance. Although these students involved themselves in understanding the site, the final images were still cryptic and left the audience mystified.

As we better identify the best processes for using the tools and representing the results, we plan to create templates that streamline information gathering towards structured, cross-referenced Web publishing. The eventual goal of this project is to clarify the potentials of place-recording tools and make it easier to gather and use a toolkit that fits specific situations.

5. Future Directions

Although this paper discusses specific tools, the lessons about device usability and administration are applicable to other kinds of technology introduction.

Our pilot studies have focused on capturing place information for pre-design use. Place information can also be used for academic purposes as recording master works for study, or for such pragmatic purposes as assessing buildings for sale, renovation, seismic risk or energy performance. More work could be done in making the process of collecting, analyzing and publishing specific kinds of site information more thoughtful and efficient. Approaching the tools with more particular uses for the resulting information will test the functionality of the tools in a more rigorous way and give a stronger direction for how the information is presented. In addition, following how the place representations are used in the design process could help us understand which kinds of site information are most critical for improving environmental design work. Through trials and observation we can understand these specific questions and gradually gain an understanding of how new mobile hardware can help us perceive environments.

Some questions for further study include:

- How can wireless communication facilitate coordination of on-site team efforts?
- What period of acquaintance with the tool is required to develop a more robust understanding of the its' potential?
- When are dispersed small gadgets more suitable than a consolidated multi-functional computer?

Updates to this project will be posted on the web site at http://darkwing.uoregon.edu/~arch/placetools/.

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