Assessing Instructional Technology

A Research Initiative at Wellesley College

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Abstract: In a relatively short time, educational technology has become a basic component of instructional life at almost every college or university around the world. Its effects on teaching and learning, however, have not yet been assessed satisfactorily. Throughout the 1998-1999 academic year, the Wellesley Technology Assessment Committee (or WTAC) researched the instructional use of technology at Wellesley College. The committee's work told us that we wanted to know more, and to know differently, about how technology was affecting the nature of teaching and learning in our classrooms. We wanted to examine what was happening in human domains affected by the machine: inside human minds engaged in teaching and learning; in human social interaction; and in disciplinary knowledge, wherever and however such knowledge might be encoded. This paper details Phase I of a multi-year project. We believe that both the process we developed and the findings of this preliminary phase will interest those responsible for implementing technology plans on their campuses, and we urge other educational institutions to see our process as a model.

1. INTRODUCTION

Throughout the 1998-99 academic year, a diverse cross-institutional committee met to develop an agenda for research on the instructional use of technology at Wellesley College. The WTAC, of which the authors are members, grew out of an earlier task force charged to survey the diffusion of technology on the campus for the purposes of budget and policy planning. Our work during that first project told us that we wanted to know more, and

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to know differently, about how technology was affecting the nature of teaching and learning in our classrooms. We wanted to examine what was happening in human domains affected by the machine: inside human minds engaged in teaching and learning; in human social interaction; and in disciplinary knowledge, wherever and however such knowledge might be encoded.

This paper describes Phase I of a multi-year project, during which period we brought our larger questions into sharper focus and set the stage for further research on the roles, benefits, and dangers of using e-mail and the web. We believe that both the process we developed and the findings of this preliminary phase will interest those responsible for implementing technology plans on their campuses, and we urge other educational institutions to see our process as a model.

The rest of this section addresses the rationale behind our strategy and a brief history of the efforts to build an infrastructure for instructional technology at Wellesley College. Section 2 discusses the methodology employed by the WTAC committee, while section 3 analyzes the results of faculty and student focus group surveys. Finally, section 4 describes the current and future research plans initiated by the committee.

1.1 Rationale

A campus community reacts in complex ways to the introduction of new technology. On the one hand, faculty frequently complain that technology is being imposed on them from the top down—even as they are making their own requests for particular technological needs. And on the other hand, administrators fear that technology dollars will not be well spent, even as they struggle to move their campuses farther and faster into the technological future. Administrators have their ideas; faculty have theirs. And students (and parents), of course, have theirs.

We have granted technology a place in the classroom with little knowledge of, but a great deal of hope about, its role in instruction. It has not been instructional need driving the widespread infusion of technology into the educational setting. Campus-wide information systems (CWIS), including e-mail and electronic messaging systems, were implemented for business purposes and adapted to teaching purposes, rather than the other way around. Teachers, even at the college level, have come to technology late, and in limited numbers, so a rich understanding of the role of technology in learning has yet to be developed. (And such an understanding is complicated by the fact that technology is a moving target, constantly changing.)

And technology is expensive. Those who provide the funds to equip and maintain our classrooms with wiring and machines want to believe that they are getting a return on their investment. These providers ask, legitimately, the first questions that are inevitably asked of instructional technology: "*Does technology improve learning?*" Teachers ask a corresponding question: "*Will my investment in time pay off? Can I teach any better using technology than I can without?*"

WTAC seeks to redefine these questions. By now, it is a commonplace that technology is here to stay. A classroom devoid of technology would not interest future generations of students. And by now, teachers have had time to develop a wide variety of technological implementations. WTAC, therefore, has framed the questions differently: *"How are teachers teaching and students learning in today's technological world?"* How are teachers shaping the classroom, what challenges are they facing, what surprises have they encountered, what commonalties and differences lie across different uses of technology? Equally important to our project is deciding *who asks* the questions, *who answers* them, and *with whom* the answers are shared?

We believe answers to these questions must be sought in places previously overlooked. We must survey not only the highly visible users of technology but also those who are resistant, or who are new to this kind of teaching. Not only teachers must be surveyed but also students. Not only faculty and students must be involved, but also administrators, librarians, and learning specialists. Finally, we seek to disseminate our findings across disciplinary and administrative lines. Hence, the co-authors of this report include the Director of the Office of Institutional Research, the Chair of the Computer Science Department, and the Director of the Writing Program at Wellesley College. We three authors all served as members of WTAC and make an effort, in this report, to report faithfully the workings of this committee. We write with the committee's approval. But to the extent that our comments are interpretive in nature, we take primary responsibility for those interpretations.

1.2 History

Wellesley College, a selective liberal arts college for women, located in a quiet town just outside Boston, Massachusetts, U.S., has, for several years, enjoyed a place among "America's 100 most wired colleges" (ZDnet, 1999). However, this status has not come quickly or easily, nor do we feel that we yet fully understand how to teach well or broadly with the wiring we have.

In 1989, when the College underwent reaccredidation, the visiting committee noted as a shortcoming that Wellesley lagged behind similar colleges in its uses of technology. That committee's report prompted a series

of technological initiatives that led to a gradual expansion of instruction by technology, to the point that we are now poised to address serious questions about the impact of technology on our teaching.

Table 1 summarises key points in the history of our technological development. Each point in this history was strategically developed; looking at this history retrospectively, however, it is clear that, though we operated with a reasonably long-range vision at every stage of the planning process, our vision with regard to technology was always naturally limited.

Table 1. Development of a Technological Infrastructure at Wellesley

1969	Rental time on IBM 1130 to use for instruction
1973	Use of the Dartmouth Timesharing System part-time
1976	Purchase of a DEC-System 2040, first local system
1984	Birth of the CS Department, with concomitant increase in facilities
1989	The "Committee of the 90s" report advocates: a PC on every faculty desktop; establishment of several "PC-equipped" wired classrooms
1991	Faculty workstation project is completed
1994	"PC-equipped classroom" in every building is accomplished
1994	Every dorm is wired (the "dormnet" project) Campus-Wide Information System is established; access to WWW
1997	Media Center established
1998	Web literacy course introduced

This chronology, however, highlights only the installation of wiring and equipment—a precondition for anything substantive, but certainly not the real story of instructional technology. To tell that story, we must highlight the series of campus-wide committees charged with finding ways to move from wiring to teaching:

Table 2. Ten Years of Committees on Technology

Years	**Name**	**Objectives and Actions**
1988-90	Technology Advisory Committee	Provide technology to faculty and students, partially for purposes of curricular development Initiate major capital campaigns to support faculty workstations, wired classrooms, and grants to faculty to develop instructional applications of technology
1993-95	Task Force on Technology in the Curriculum	Recognise the pivotal role of technology in the curriculum Identify the need for a clear articulation of the role that technology plays in the curriculum Recognise the continuous need for adequate facilities
1996-98	Task Force on Information Services	Assess the diffusion of technology on the campus (both administrative and curricular) Report to the Trustees about the current state of technology, identifying areas in the infrastructure of satisfaction, problem, and need Identify need to assess technology as a tool for teaching

Years	Name	Objectives and Actions
		and learning, solutions for technological literacy and access issues of students, and concerns with technology needs for faculty research

This history clarifies that early committees concerned themselves, first with the acquisition and distribution of technology; next, with developing incentives to implement instructional technology; and then with reshaping the organisational structure to keep pace with changing technology and with assessing the new structures. Only now are we at the point where we can seriously address questions about the relationship between technology and learning.

Certain features of Wellesley's approach remain constant throughout. First, the goal has, from the beginning, entailed equal access to technology, access equally distributed to all faculty (regardless of research needs and discipline), to all students (regardless of prior experience and income level), and to all administrative and support staff (regardless of prior experience with technology). Second, Wellesley positions itself strategically in the middle of the pack, supporting well developed rather than cutting-edge technologies. And finally, Wellesley consistently employs an open planning process, whereby planning committees typically include multiple constituencies and collect data among all levels of users.

These strategies continued to serve WTAC well in 1998-99, as the following sections show, and bring us to the present, ready to undertake research rather than evaluation and assessment. This tale reveals an evolution from committees charged to enable technology in the curriculum to the current committee charged to develop an understanding of the interaction between technology and the curriculum.

2. METHODOLOGY

WTAC initially constituted itself in 1998-99 as a small committee most of whose members had served on the Task Force on Information Services. The Committee was convened by Lee Cuba, Associate Dean of the College (now Dean of the College) and Professor of Sociology, and includes, in addition to the authors, the following membership: Micheline Jedrey, Vice President of Information Services and College Librarian; Tom Cushman, Sociology; Andrea Levitt, French and Language Studies (now Associate Dean of the College); David Pillemer, Psychology and Faculty Co-director of the Learning and Teaching Center; Steve Schiavo, Psychology; Nancy

Weinstein, Belle Liang, and Angie Evans, all of the Office of Institutional Research.

The work of the WTAC committee consists of five major phases:

1) Planning and General Assessment
2) Faculty Focus Groups
3) Student Focus Groups
4) Empirical Studies
5) Dissemination of Findings

At this writing, three phases have been completed and the fourth is underway.

2.1.1 Phase One: Planning and General Assessment

The original Technology Task Force convened on a number of occasions to discuss its goals and plans for the project. The committee defined the research question (*"How does the introduction of new information technologies into courses affect teaching and student learning?"*), decided on the make-up of an expanded committee, and outlined projects for the year. These projects centered on two sets of focus groups (faculty and student) to be led by members of the committee; these focus groups would elucidate questions of concern to the entire community. These questions, in turn, would determine research projects for subsequent years. Once we had settled on the focus-group format, the committee then drafted the questions to be explored in the Faculty Focus Group sessions, and selected the faculty who would attend.

2.1.2 Phase Two: Faculty Focus Groups

Faculty representing the full range of disciplines, rank, and experience with technology were invited to meet in groups of five to eight to discuss their classroom uses of and students' responses to new technology. Four focus groups were based on "instructional method." In addition, another group comprised faculty who had shown themselves in public forums to be openly critical of or enthusiastic about technology. Almost all the faculty accepted invitations; a few declined due to prior commitments. The following groups were convened:

1) web-site group
2) foreign languages group
3) imaging group
4) mathematics and quantitative reasoning group
5) enthusiasts and critics group

Two faculty members facilitated these focus groups. The groups were prompted to discuss the following topics: classroom uses of technology; how these uses have evolved over time; how or if new technologies influenced the content or substance of their courses; how or if new technologies affected the way they teach; faculty perceptions of students' learning before and after technology implementation; and shifts in disciplinary values under the influence of technology. Most of these topics were covered spontaneously during faculty discussion; facilitators then prompted those that were not spontaneously raised.

2.1.3 Phase Three: Student Focus Groups

Fourteen students were selected more or less randomly to participate in two focus groups conducted by the Office of Institutional Research. With non-faculty members leading the groups, and students promised confidentiality, we hoped students would speak freely about their experiences of instructional technology at Wellesley. Students were prompted with questions that closely paralleled those asked of faculty. The focus groups were held during spring break.

All focus group discussions were audio-taped and transcribed; in addition, the facilitators took notes and wrote summaries of what they saw as key points developed during the discussions.

3. FOCUS GROUP RESULTS

The discussions in the faculty focus groups were very different from those in the student groups. The faculty in general had more complex perceptions; they had more detailed knowledge of technology; and they thought about the impact of technology from both the teacher's and student's points of view. The students tended to talk about what they had experienced and rarely mentioned the teacher's perspective. However, there were few if any points at which the discussions were at odds. Faculty characterisation of the students' point of view was generally consistent with the student group discussions, although often not as detailed.

3.1 Faculty Focus Groups

The most striking impression from reading the focus group transcripts is that faculty at Wellesley seem to implement technology carefully, and almost always in response to pedagogical need; there was no evidence that faculty implemented technology simply because they wanted to implement technology. Most faculty identified student engagement as a key reason for bringing technology into a course. For example, those who set up web pages asked students to help build the initial web page and reported a great deal of excitement at this shared venture. They use presentation software to make the content of lectures more accessible and understandable. They develop knowledge bases to put facts, images, and cultural materials at their students' fingertips.

Teachers expressed considerable interest in whether new capabilities afforded by technology can change what and how students learn. For instance, many teachers reported that, because it is now easy to use images to teach an idea, they now use more visuals in class. At the same time, faculty in text-based disciplines, such as languages and literature, although they too have begun to use electronic imaging to aid their teaching, expressed concern about what will happen to text: *"Is literature dying?"* they asked. *"Is the love for text dying?"* Other faculty wondered if students are able to read and remember and understand long chunks of material as well as they used to.

A consistent theme in all faculty discussion is how much time new technology takes. There is a steep learning curve; mastery of a new technology only comes with considerable experience and time investment. Sophisticated users master new products relatively easily; for the unsophisticated, the prospect of having to master a new application is daunting. They expressed worry that they may end up spending too much time on learning the technology, not on developing their teaching. When the development could be done collaboratively, it worked well; however, many faculty reported feeling isolated if they were the only ones in their departments involved. New versions of software and upgrades in hardware often cause extra work.

Still, a wide range of faculty agreed that technology frees up class time to do different things. In a number of disciplines, some of the more mechanical tasks either are taken over entirely by technology (number crunching, for example), or can be handled by technology outside class (looking up words in a foreign language dictionary; learning the strokes necessary to form characters in Chinese), allowing the teacher more time to work on "higher-order" tasks in class. However, some faculty worry about whether this leads to certain, formerly valued skills now being black boxed, downgraded in

importance. As the computer takes over more and more functions, teachers must restructure their courses, changing the emphasis of lectures and assignments.

Few teachers mentioned the most pervasive technological change affecting academic work —the word processor, but nearly everyone mentioned that other widespread innovation— e-mail. E-mail is now used extensively for communication between faculty and students; many questions now get asked and answered outside of class time. Faculty saw this as beneficial (students do not get hung up on unresolved questions) but also potentially troubling (e-mail is sometimes used as a way to avoid direct interaction; faculty may not be able to get to know some students as well as formerly).

Table 3. E-mail

	Faculty Point of View	**Student Point of View**
Positive	Convenient, timely response	Convenient, timely response
Negative	Less personal contact May take more time	Less personal contact

Disciplines: Used by almost everybody

Table 4. In-class projection (text, lecture notes, programs, images, web pages)

	Faculty Point of View	**Student Point of View**
Positive	Focuses the attention of whole class in one place; easy to demonstrate software or display material; gives flexibility in presentation	Generally positively regarded, expected
Negative	Compatibility, upgrades, obsolescence, equipment malfunction	Can be overdone, very disruptive when it does not work as expected

Disciplines: Sociology, Comp. Science, Literature, Writing, French, Art, Geography

Table 5. Software for skill training (characters, syntax, pronunciation, oral presentation)

	Faculty Point of View	**Student Point of View**
Positive	Frees up class time for "higher level" activities	Can work on own time, at own rate, as much as needed
Negative	Black boxing concepts rather than drudgery, concern whether students acquire breadth, learn underlying concept	Software comes to define what student thinks is to be learned

Disciplines: Japanese, Chinese, French, Math, Astronomy, Psychology, Language Studies

Table 6. Organised Knowledge Base (images, slides, maps, statistics, cultural material)

	Faculty Point of View	**Student Point of View**
Positive	Images can replace text, organises material, new kinds of material made available	Much liked
Negative	Copyright issues, obsolescence, time consuming to assemble, time consuming to co-ordinate	Some prefer paper

Disciplines: Art, Sociology, French, Greek & Latin, English, Literature, Geography, Physics, Spanish

Table 7. Internet Resources (linked web-page, web searching)

	Faculty Point of View	**Student Point of View**
Positive	Much information available	Much information available, no standards for information
Negative	Need for teaching students to be critical of sources	Students may use instead of library, plagiarising

Disciplines: French, Astronomy, Physics, Sociology, Classics, Computer Science

Table 8. Archival course web-site (syllabi, lecture notes, assignments, links to web resources, student, papers)

	Faculty Point of View	**Student Point of View**
Positive	makes administration of course easier, easier to connect students to information sources	generally positively regarded, helps to think visually
Negative	time consuming to develop; linked web-sites may disappear	interest may wane, may take for granted, prefer paper

Disciplines: Greek & Latin, French, English, Sociology, Biology, Computer Science

Table 9. Course Web-site for Project (student generated)

	Faculty Point of View	**Student Point of View**
Positive	very motivating when course project	Students see interconnections
Negative	A lot of work, requires technological sophistication	A lot of work

Disciplines: French, History, Spanish

3.2 Student Focus Groups

The discussion in the student focus groups was less wide-ranging and tended to reflect individuals' reactions to the uses of technology to which they had been exposed.

In moderation, students liked the use of presentation software when it was seamless and relevant to the instructor's teaching of course material. They saw real benefits to having lecture outlines on-screen. However, they also discussed the problems of going overboard with on-screen material, which they saw as a loss of flexibility and an overemphasis on detail. They thought that in-class projection was especially relevant in visually oriented courses (e.g., Art History, Astronomy) or those where simulation makes complex concepts more understandable (e.g., Physics, Oceanography, Biology). Students saw as real detriments to a course, problems arising from failure of equipment or from teachers using technology they had not mastered, and logistical problems resulting from rapidly changing hardware and software.

Students find e-mail a convenient way to communicate with their instructors and use it in moderation. They find it useful for getting quick responses to simple questions outside regular class time. Some admit that they use e-mail to handle uncomfortable situations (e.g., asking for an extension on an assignment); others conscientiously avoid e-mail and make the effort to see or call their instructors in these situations. Students participate in course bulletins only when the instructor actively contributes to the bulletin by posing interesting questions, posting responses, and supporting an interchange among the students in the course. In some classes, the bulletin becomes a sort of public e-mail where the instructor is asked questions by students and responds to them individually, but the interchange among students never develops.

Students appreciated the convenient accessibility as well as the breadth of information (e.g., links to relevant resources) on the Web. Many students understood that Web sources vary in accuracy of information and therefore thought it was useful to have the professors help them determine legitimacy of Web sites. Students liked having course materials (e.g., outlines of lectures, discussion questions, reading lists, answers to exams) accessible on the CWIS in moderation. It was important that CWIS materials be easy to find, up-to-date, and relevant to lectures. Even if materials were available on CWIS, students wanted to read them in hard copy and typically printed them out.

A number of students complained of having problems and feeling intimidated when they were required to use software for course work without adequate support and specific training. Students noted that it seemed

especially hard to find support or tutoring for software used only in specific classes (e.g., PowerPoint, SPSS, Mathematica).

Table 10. Communication

E-mail	Convenient way to communicate with instructors
	Quick responses to simple questions outside of class
	Some use e-mail in awkward situations (asking for extensions)
Course Bulletin	Students participate only when the instructor actively contributes
	Sometimes a sort of public e-mail between instructor and class members, no student-student posting
	Help shy people participate in discussions
	Help students to write the way they speak
	Help students talk about sensitive topics (e.g., pornography)

Table 11. In-class presentation software

Benefits	In moderation, students liked the use of presentation software when it was a seamless and relevant to course material
	Help focus their attention
	Help organise the lectures
	Especially useful in visually-oriented courses (e.g., Art History, Astronomy)
Problems	Too much structure, information
	Equipment failure very disruptive
	Rapidly changing hardware and software
	Teachers using technology which they have not mastered

Table 12. Supplementary Teaching Software (CD-ROM textbooks, Language drills, Mathematica, V-labs, SPSS, PowerPoint)

Benefits	Seen as tools needed in mastering subject matter
Problems	Software running on only one platform, or on the newest equipment.
	Sometimes felt lack of interaction with teacher.
	Often had insufficient training and support.
	Most a problem with software used only in a few classes.

Table 13. Easy Access to Information

Internet	Liked the convenience, accessibility and scope of information available on the Web.
	Many understood problems of reliability of Web sources and were interested in how to determine the legitimacy of information at Web sites.
Course materials	Liked having course materials accessible on the CWIS in moderation.
	Important that CWIS materials be easy to access, up-to-date, and

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4. FOURTH PHASE: RESEARCH PROJECTS

During Phase Four, the committee met to cull the results of the focus groups for areas that deserve further study. We looked for areas that were mentioned recurrently, by faculty and students alike, across disciplines and user groups, and with some degree of ambivalence. While some uses of instructional technology are clearly still rough and draw criticism from faculty and students alike (packaged CD-ROMs; presentation software), some uses are well-developed within the context of certain disciplines (SPSS), and others (e-mail, the World Wide Web) have quickly become widespread, altering the culture of learning and teaching in ways that invite reflection and question. It is these latter that the committee has decided to investigate during the upcoming year. Each of these small-scale studies attempts to explore and quantify the effects of a specific technology on teaching and/or learning. We estimate that each study can be completed in two semesters.

Of the four studies we identified, two are being conducted while the remaining have been postponed for the future. The studies under way are particularly important because they have a greater effect on the intellectual life of all members of our community and the College as a whole.

4.1 Study of Internet Resources Use

The faculty focus groups expressed much concern about the use of the Web in courses. particularly about the unreliability of information on the Web and about students' ability to assess critically the quality of the information. The first study will assess students' use of the Internet focusing on this ability. About two hundred students will be surveyed in the 1999-2000 academic year.

Recent studies of the abilities of users to locate information on the web (see e.g., Spool et. al. 99) do not address the validity of this information and its critical evaluation. Other recent studies of high school and college

students use of the web (Blumberg & Sparks 99) and evaluation of its contents (Lubans 99; McCollum 98) focus on students' *perception* of the quality of web contents, which may or may not be accurate (e.g., a student may feel that he or she has found the answer to a search, although this may not be the case). For a comprehensive survey of such studies see (Levitt & McDonald 99).

Our study plans to have students search for answers to a variety of questions (including questions that may not have answers, as well as questions that may have easily accessible, but misleading, "answers"). We will, then, evaluate the results of their searches and compare them to the students' perception of correctness in their answers, thus getting a more accurate assessment of the way they use the web resources.

4.2 Studies of E-mail and Conferencing Use

The topic of the nature of communication carried on via e-mail has come up in several contexts. Teachers have expressed concern that they have less personal acquaintance with students now that so much communication can be handled by e-mail. Students have reported how much they like the immediacy of e-mail responses—quick responses during late hours are especially appreciated. Some students report selective use of e-mail (quick answers to simple questions, asking for extensions). There is some sense that the communication at a distance provided by e-mail leads to its being used for avoiding unpleasant situations.

Starting this September, the College is switching from an old stand-alone e-mail and bulletin system to an integrated conferencing system that uses an attractive graphical user interface. It is expected that this user-friendly conferencing system will greatly increase communication among the members of the College. These circumstances, therefore, make this study timely. Two related projects are planned.

The first is a survey of how e-mail and conferencing are actually used by faculty and students. The results could provide information on the range and variation of the use of e-mail in courses.

The second project is more exploratory. The issue is how the intended content and the understood content of the message differ from what is written. A preliminary study could be done in a class, a sort of "role playing through e-mail task." The student would be provided with the description of a situation composed of a set of e-mail messages. The student's task would be to interpret the situation and then to compose a responding e-mail message to complete the exchange. Data would be collected, before they responded, on how they understood the situation, and again, after they

responded, to determine what they intended their message to accomplish and why.

Both studies could provide information on problems stemming from using or not using e-mail, and on the more successful uses of e-mail.

The following studies have been identified as worth pursuing but have not yet been addressed.

4.3 Assessment of the Form of Information Presentation

A major aspect of how technological innovation has affected teaching and learning is that it has greatly facilitated work with information in non-textual forms. Incorporating visual material (either still images or video sequences) as a part of a document or presentation is now relatively easy. These capabilities have been exploited in various courses, but it is not always clear how much they have affected the way students learn material. Sometimes they appear to have been clearly beneficial; in other instances, the benefits are less clear.

To address these issues, we propose two parallel studies. For each we will develop or find several documents in a general content area which vary with respect to how much they use images and how much they incorporate hypertext linking. One study will have a set of documents that systematically vary in the degree to which they incorporate visual and video materials. For the second study, the documents will vary with respect to how much they incorporate hypertext links.

4.4 Information Accessibility on Web Sites

The web, the academic use of the web, and course web sites in particular, were the topic of much discussion in faculty focus groups, with somewhat more limited discussion in student focus groups. Some faculty have developed course web sites, and much effort has been expended putting information on the CWIS. One of the problems in developing a web site is that the person creating the site has a very different knowledge of the site than has a naïve user. Also, it is very difficult for the developer to anticipate how the user will go about looking for information. When the size of a site gets even moderately large, it may become difficult for first-time visitors to navigate effectively and find the information they need.

This study would involve looking at the behaviour of people seeking information on web sites, perhaps using the "treasure hunt" approach. People would be asked to look for some specific facts on particular sites, and their behaviour recorded. The expectation would be that good and bad design

features, as well as efficient and problematic search strategies would be identified. From the study, we could develop a fairly simple tool which developers could use to assess the efficacy of web sites they have designed.

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