Project Report:
Diversifying Assessment 3

Web Projects in Undergraduate History of Science*

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Introduction

This is the third paper in a series on diversifying assessment in undergraduate history of science programmes (Jarvis and Cain, 2002; 2003). This paper considers the use of assessable projects that either use or create Web-based resources.

Our project on promoting diversified assessment involves a survey of existing literature from the educational literature and a synthesis of practical advice on the design, implementation, and likely problems while introducing these concepts into an overall assessment strategy.

Use of the Web in course assessment is controversial in the history of science teaching community (Gooday, 2001) but, we think, for no good reason. Computer and information technology (C&IT) skills are key skills. Students use the Web extensively.[1] Parents and employers expect graduates to be adept users. Information access through libraries increasingly emphasises on-line outlets. Learning and Technology Minister Michael Willis explained in 2001 that people need C&IT skills "in almost every job. And a successful Britain needs them too." (BBC, 2001a). Tutors have a firm responsibility to develop these skills in their degree programmes.

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[1] A late 2002 Egg survey found Internet use had increased to 42% of all adult Britons, 19 million people, with use by women up ten percent in the past six months (BBC, 2001b). Web and IT use is highest among those under 35 and in other adults among those in higher socio-economic group (BBC, 2001a). Certainly some have no interest in these skills. In national surveys of all adults, *Which?* Online reports nearly a third of those surveyed claim to have no plans to use the internet, claiming it is either too expensive to use of "has nothing relevant to their lives." Yet 64% claim the internet "has become part of every life" (Ward, 2000).

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Our consideration of Web projects distinguishes evaluation and construction, then divides construction into design and implementation. This compartmentalisation provides a deliberate progression in which students develop skills sequentially. Tutors don't need to accomplish all C&IT goals in one step and can easily combine Web projects with more familiar assignments.

Definitions

On a basic level, Web sites consist of a series of linked documents. Each document (one Web page) combines text, graphics, and links to other documents located either within the site or located in other sites.

In Web site evaluation, students assess Web based resources as texts using critical reading and analytical skills. They also consider strengths and weaknesses of resources based both on principles of Web site design and on features distinct to the medium.

Constructing Web sites involves two phases: design and implementation. By the end, students can expect to have created texts and graphics, located relevant additional materials, then combined these into Web pages. They link multiple pages together into a functioning Web site. In Web design, students plan site components and consider overall site architecture. Implementation involves assembly and programming.

Web site construction can be used as the final stage of a research project that might otherwise produce a research paper. Web sites can be produced by groups or by individuals, with varying degrees of credit attached to design versus content. Web sites can be submitted on diskette or published through a course Internet site.

Benefits

C&IT skills are ever more important key skills (UCL, 1999–2000) and increasingly tied to "graduateness" (HEQC QEG, 1995). Degree programmes normally respond by encouraging rudimentary literacy and familiarity: use of electronic libraries (especially databases and on-line replacements of printed materials) in research, word processing for writing, and e-mail for communication. This basic training is admirable, but students are entering higher education with increasingly sophisticated average C&IT skills (c.f. BBC, 2001a; Kent School District, 2001). Support staff within universities normally offer basic and supplemental skills training, such as preparation for the European Computer Driving

Licence.[2] Tutors in degree programmes should press on: combining subject-specific skill development with further C&IT training.

In many departments, student use of Web based resources for research is a controversial subject (Gooday, 2001). Those rejecting the use of on-line resources argue an increasingly untenable position. A June 2002 OCLC survey reports nearly 80% of students use Web resources for most or every assignment (OCLC, 2002). Also, publishers and libraries are shifting to on-line circulation, and high quality on-line resources are far more common than several years ago. The situation on-line now mirrors the long-standing situation in print: quality varies across a wide spectrum.

Students need skills for separating the wheat from the chaff. They need to develop skills for identifying reliable versus erroneous sources and they need to develop technical skills for identifying methodological and historiographical frameworks. Creating projects that develop critical reading and evaluation skills will train students to be intelligent consumers of information regardless of the source. Whether these projects begin with Web based or print materials makes little difference. Indeed, advocates of extensive Web use argue additional attention to special aspects of the Web as a medium for communication will improve the student's ability to judge the effect of Web publication and monitor its effects on other kinds of communication. Tutors need to step up to the front and lead.

Focusing on Web site construction provides opportunities for students to learn basic principles of Web design and basic technologies for implementation. Students with basic skills already can be pressed further. Training students to become producers of Web based resources emphasises project design and management skills as well as collaboration. It also develops some second generation C&IT key skills.[3]

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[2] Details of the European Computer Driving Licence and sample curriculum are provided by UCL IS (2002).

[3] Kent School District (2001) provides a model for placing C&IT skills within a framework of progression despite the fact their plan is developed for primary and secondary schools. Intel Corporation's (2002) "Teach to the Future" program provides teacher training for curriculum design in which C&IT skills are integrated into course units. (The curriculum outline is posted by ICT, 2002.) Stephenson (2001) considers the value of increased C&IT training within the broader framework of innovations in higher education. Ward Schofield (1995:62–93) justifies learning with (rather than about) computers in humanities programmes as a way to support constructivist learning objectives. Her approach is bolstered by Bransford, Brown and Cocking (2000:206–230), and Brown, Race and Bull (1999). Balestri, Ehrmann and Ferguson (1992)

Possessing these skills can prove decisive in competitive employment environments. Guzdial, et al. (1992) stress the importance of design as a key skill. Harel and Papert (1992) argue design and implementation skills in C&IT generally promote "meta-cognitive awareness" (students thinking about their own thinking processes), cognitive control (planning and self-management of the learning process), and "meta-conceptual thinking" (students thinking about the extent of their own knowledge).

Sequencing learning outcomes from evaluation to design to implementation serves student progression. For one, it allows students to apply and extend their existing skills as they press forward. More importantly, it decomposes the overall project into many skill elements. This compartmentalisation prevents students feeling overwhelmed and provides opportunities for them to master particular aspects of a large project before moving on. In this particular sequence, experience with evaluation builds intuitions for design, and fresh design skills guide implementation. Compartmentalisation also helps tutors develop projects over several assignments or over several courses. Dropping students into implementation is poor practice and leads to low value in the result.

Sequencing also serves students who begin Web projects with skills already beyond novice levels. In a sense, compartmentalisation restrains the overeager student and forces them to concentrate on mastery of single skills. This provides opportunities for skill refinement as well as for filling in knowledge gaps. Compartmentalisation also allows for more systematic coverage of fundamentals and prevents students from using expert skills in some areas to compensate for relative weaknesses elsewhere. Compartmentalisation is more likely to contribute to peer and self guided learning, better collaboration in group work, and improved validity in assessment of group work.

Web based projects lend themselves to group work (Thorley and Gregory, 1994; Hunter, et al., 1996; Jaques, 2000). They also can be supplemented by posters or oral presentations addressing the content and design of their site (Jarvis and Cain, 2003). Publishing student work on-line contributes to an increased sense of responsibility during the project. Afterwards, it increases the sense of ownership.

Web evaluation and construction projects should improve student appraisals of fairness (Gipps, 1994). Not only does the assessment credit creative skills and encourages self-expression, but

consider ways for even simple programming to provide highly motivating learner-centred working environments.

students perceive the activity to be more enjoyable than other kinds of tasks (despite the fact few new tasks need to be introduced). A student who cannot trouble themselves to locate a reading in the library might spend hours thinking about material located through the Internet or tracing sources for a Web page that will be made widely available.

Recommendations and Implementation

A well known example of student Web projects in history of science is Van Helden (1995–2001). Though useful for interesting colleagues in the potential of Web projects in course work, this site tends to present student projects as little more than written essays converted into HTML code. Barrett, Levinson, and Lisanti (2001) provide syllabus advice for courses using Web projects, but they lean towards rather complex Web programming and work within a context in which Web design is the primary learning outcome of the course. Numerous course Web sites display student projects at various levels of expertise. Barnard History (1997–2000) usefully shows an evolving level of sophistication of design and implementation skills. Other examples include Winstanley (2001), Harvey (1998), Ayers and Thomas (n.d.). Other examples can be located by Web searching using key words "student Web presentation" and "student Web projects history". Students can be intimidated by the high standard of professionally produced Web resources. Shifting to novice sites their peer assessment of models offers a far better standard for comparison. For this, Van Helden (1995–2001) is ideal.

Projects involving Web site use can be separated into three modules: evaluation, design, and implementation. These can be treated in sequence within a single course or over a series of courses within the degree. Tutors should be certain to locate their assumptions about student skill levels within a framework for progression (e.g., Kent School District, 2001) and to clearly distinguish the needs for novice and expert learners (Bransford, et al., 2000:31–50).

On evaluation, students should consider what makes for good Web pages and sites. In some respects, Web content can be understood simply as a text to be read. Thus, evaluation makes use of critical reading skills as described generally by Fairbairn and Fairbairn (2001) and specifically by Pirie (1985). (Jarvis and Cain, 2002 discuss use of essays to develop critical reading skills.) Web evaluation projects focusing on content, perspective, methodology, and historiography can substitute for tasks focusing on the evaluation of printed sources. Hollingsworth (1999), for instance, allowed students to complete a critical review either

of a printed text or a Web site, using evaluation criteria he provided, as part of assessment in an introductory course. Tutors can select from a wide range of sites when setting projects aimed at content evaluation, especially those relevant to course topics.

Writing styles for Web sites tends to vary from various print formats.[4] Many scholars argue technologies such as interactivity, multimedia and non-linearity transform Web texts into different forms of communication (Barrett, 1988; Barrett, 1992; Barrett and Redmond, 1997). This suggests that skills in Web evaluation involve more skills than reading printed text. Murray (1997) provides helpful advice for introducing evaluation of non-linear narrative. Greenberg (1998) introduces the relation between reading on-screen and underlying cognitive processes. Neilsen (1995–2002) provides useful tips for reading Web sites as more complex texts. Tutors can develop these additional evaluation skills in stages: first using Web sites much like printed texts that use special features minimally, then considering more complex sites that display more significant differences from print.

Complete evaluation rubrics for Web sites tend to focus on five categories: ideas and content, organisation and design, value for audience, presentation, and technical features (such as navigation and use of conventions). Many rubrics for evaluating Web sites are accessible on-line.[5] Tutors can ask student peer groups to elaborate these categories using Web based research and a study of familiar Web sites. Alexander and Tate (1999b) and Harris (1999) provide superb guides for tutors developing evaluation criteria for many learning outcomes.

On evaluating design, Williams and Tollett (1998), Krug (2000) and Lopuck (2001) provide solid overviews of evaluation for beginners. Of the many on-line tutorials for Web evaluation, Lycos.com's (2002) WebMonkey programme is designed for beginners. Cato (2001) and Dalgleish (2000) present more advanced considerations focusing especially on "user-centered" features. Basic principles of graphic design in print are presented by Williams (1994) and these form some of the

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[4] Henning (2000) introduces key differences; Bonime and Pohlmann (1998) treat the subject in detail. Mcgovern, Norton, and O'Dowd (2001) and Kapoun (2000) provide a style guide for writing on-line that considers wider differences. Alexander and Tate (1999a; 1999b) provide some evaluation criteria for on-line writing. Reflecting on the differences between print and Web texts can parallel discussion of other differences resulting from format changes, such as that between print and broadcast journalism.

[5] Kapoun (2000) and Bakken and Armstrong (2000) provide well-constructed examples. WebQuest (2001) can be recommended for its sequenced presentation. For others, search using key words: "Web page evaluation criteria" and "Web evaluation rubric".

fundamental principles used in the design of Web texts. Sumner (2000) offers an on-line tutorial for use and evaluation custom made for history and philosophy of science.

As consumers of Web based resources become increasingly sophisticated, concerns over "usability" move to the foreground in evaluation rubrics.[6] McClure (1999) and Alexander and Tate (1999a; 1999b) provide extensive critical bibliographies for evaluation of complex sites and sites designed for specific purposes. Design also refers to special issues which make the consumption of information on-screen different from that on a printed page (Nielsen, 1995–2002; Greenberg, 1998; Nielsen, 2000). Students can over-emphasise the graphic arts element of Web design to the detriment of sound navigation and clear presentation.

Designing a Web site involves decisions about how to transform the resources a student creates or collects into Web pages and what kinds of architecture works best for the flow of information within the site.[7] Retrospective accounts of site construction emphasise the fundamental importance of design processes prior to implementation (e.g., Berger, 1998; Cain, 1999).

Design includes attention to information architecture. On one hand this involves the conceptual arrangement of information and resources which users move through to locate the information they want. On the other hand it involves the physical arrangement of information and pages within a Web site. Barrett, Levinson and Lisanti (2001) introduce the topic. Andres (1999), Rosenfeld and Morville (1998), and Phillips and DiGiorgio (1997) provide useful discussions.

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[6] Guides to usability range from simple (Nielsen, 1995–2002; Williams and Tollett, 1998) to complex (Nielsen, 2000; Brinck, et al., 2002) and focus on an increasing body of empirical studies concerning human-computer interactions. Students with deep interests in human-computer interactions can access this extensive discipline through (Dix, 1997). Advanced issues in design include attention to accessibility issues such as when Web resources are experienced in voice through programmes for the visually impaired. Accessibility issues are widely discussed on-line, search keywords "Web design accessibility".

[7] Guidance for tutors seeking to introduce assessment based on student production of Web resources is sparse. Barrett, Levinson and Lisanti (2001) is a rare exception though it focuses on courses dedicated solely to Web design, and it assumes advanced C&IT skills among the students. Relevant literature tends to focus directly on implementing particular design features or particular programming needs. This seems inadequate: akin to dropping a novice swimmer in the deep end of a pool and expecting not only to survive but also to build optimal skills.

Planning and design can be made operational in the story board and flow chart model described by Jolliffe, Ritter and Stevens (2001). DiNucci, Giudice and Stiles (1998:38–67) implement this approach in an easy-to-follow presentation. Planning can vary in its depth.[8] It can involve students in issues such as a site's purpose, audience, and limitations as well as considerations such as mechanisms for evaluating a site's use and success in accomplishing its goals. These are standard concerns for commercial Web producers (Andres, 1999; Dalgleish, 2000; Nielsen, 2000). Some coverage of this stage is strongly recommended. Importantly, it requires no technical knowledge of computer programming or specialised software. It can serve as an assessable outcome in itself. Design elements (such as story boards, flow charts, and strategic plans) provide useful replacements in cases where students experience substantial difficulties with implementation or other circumstances prevent on-line work. Phillips (1997) integrates design and evaluation themes.

Tutors can focus student effort by using a design brief to describe expectations for the project. For projects introducing Web design to novices, a detailed brief can provide much needed guidance. It also provides a mechanism for tutors to embed principles of good presentation, navigation, and usability. Briefs for more advanced projects can focus on specific areas for skill development. A design brief replaces an open-ended assignment with an explicit standard. Students then know when their project satisfies expectations for the purposes of assessment and can make decisions on how much more effort they wish to add. Design briefs also can emphasise some skills to the exclusion of others. For example, focusing assessment on writing skills, factual accuracy, overall site integration, and navigation means the tutor sets some design features (such as elaborate graphics or complex programming) outside the learning objectives for the project. Design briefs help students maintain their focus. Implementation involves converting resources and designs into actual Web pages. This requires access to computer hardware and software. Basic Web implementation requires no knowledge of programming codes (such as HTML, XML, CSS, and so on). Common Web authoring tools resemble word processing programmes. Peer assistance provides an important source for skill development. University computer networks normally supply students

[8] Cain (2001) provides an example of strategic planning—in this case for a departmental Web site. Barrett, Levinson and Lisanti (2001) provide examples of planning at different levels.

access to particular Web authoring tools, such as DreamWeaver or FrontPage. Students may need basic training in these software tools as well as basic training using network environments. Tutors should ensure students have access to beginner manuals and relevant support materials. Hands-on tutorials improve active learning.

Potential Problems

Web evaluation and construction projects require skill development on the part of course tutors. This is particularly true for implementation. The long-term benefits of this training are substantial; however, this will take time and resources to launch. Practical advice for integrating C&IT skills into course work and degree programmes is provided by Jolliffe, Ritter and Stevens (2001), Maier and Warren (2000), and Leask and Pachler (1999). Haydn, Arthur and Hunt (2001:173–205) present a strategic overview of C&IT competence in the classroom and a self-assessment tool for tutors regarding various C&IT skills. Kent School District (2001) provides a useful model of progression for C&IT skills.

Web implementation projects should be structured to slowly accumulate skills and material. Students might research and write text first. Next, create a single Web page. Next, consider design and create story boards and flow charts, and so on. If assigned as group work, care should be taken to ensure students cannot divide the work in ways that exclude one another from any one aspect of the process.

Tutors may need to provide advice for working within the local computing environment. Krumme (n.d.) demonstrates the kind of advice that can be useful.

Computer anxiety might inhibit some student efforts on these projects. Brown, Race and Bull (1999) report this anxiety is far more prevalent than most tutors assume and offer some suggestions for reducing these levels overall. For C&IT skills, tutors should identify the precise source of this anxiety (i.e., inexperience with computers generally, inexperience with particular software, lack of knowledge about local procedures, and so on) and direct support accordingly. Students with remedial skills can find assistance through on-line tutorials, self-help books, and training courses offered by University support staff. Assistance of peers also can be an effective means for skill development. Ward Schofield (1995) identifies many of the common barriers to student use of computers.

Another issue of fairness involves gender differences in students' responses to computer-based tasks. Brown, Race and Bull (1999) report

females are consistently more computer anxious than men. While it seems that this kind of anxiety is perhaps more enduring than expected, it can almost certainly be controlled and rendered reasonable by the appropriate use of training and briefing sessions. This may lead to the added benefit that students can overcome a long term concern about using computers which will render their transition to an almost universally computer-based vocational environment less problematic.

Discussion

Like every other technical activity, use and production of Web resources are activities that can be enhanced through training. The use of on-line resources is now a permanent feature of the higher education landscape. Tutors who ignore or restrict Web use do so at their own peril. Tutors who promote critical use will avoid growing problems over haphazard use of Web resources. OCLC (2002) reports a growing sense of need among students for these critical skills. Tutors can incorporate Web evaluation into early courses as a way to promote critical reflection about the information they consume from Web sites. A progressive programme of increasing and increasingly sophisticated use not only can improve C&IT skills but also can foster an environment rich with active learning.

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