

The ENVARCH project

Anja-Christina Wolle and Clive Gamble

Department of Archaeology, University of Southampton, Highfield, SOUTHAMPTON, SO17 1BJ, U.K.

7.1 Introduction

Teaching the basic principles of archaeology to first year undergraduates takes up a substantial proportion of many University lecturers' time. Such teaching is essentially repetitive, providing the same basic lectures each year to the new intake of students. While these lectures are updated in response to technical developments and new archaeological case studies, we suspect they are probably some of the slowest changing parts of the undergraduate course.

With increasing student numbers we have, at Southampton, come to question the appropriateness of traditional lecture-based teaching of these essential elements. Our aim is to maintain existing teaching quality and extend it by providing students with alternative learning contexts. These have to be properly resourced and our strategy is to use computer based systems to free staff time for more productive teaching to those same students, as well as to provide access to primary sources that would not traditionally be available from a library.

In the first instance we have concentrated on environmental archaeology. We chose this area for several reasons. In the first place it currently lacks a recent text-book. Secondly it is often presented as a set of unrelated techniques and thirdly many of the principles and vocabulary are unfamiliar to first year students. All three elements suggested that a multimedia, computer based approach would be appropriate. The integration of environmental and archaeological work could be stressed. Students could self-pace their learning and the problem of a suitable text-book would be overcome. Teachers could spend more time discussing the application of environmental techniques to archaeological problems.

To emphasise integration of environmental techniques and archaeological questions we selected the sites within the area of the Neolithic World Heritage monument at Avebury (Wiltshire) as the main case study. In particular two interpretations by the late Bob Smith (1984) and Alasdair Whittle (1993) form the basis for investigating this remarkable area.

The ENVARCH package is a group of computer programs compiled using Authorware Professional 2.0 which will allow students to examine an introduction to environmental archaeology. The project was funded by the Archaeology Consortium of the Teaching and Learning Technology Programme (TLTP). A prototype had already been established in 1992 as part of an M.Sc. dissertation (Leggatt 1992).

7.2 Aims and Objectives

The aim of this program is to introduce the first year student to some of the most important techniques of environmental archaeology using the computer as a learning base. The possibilities this raises for integrating text, graphics, video and sound are very exciting, although some technical difficulties remain. They improve on the traditional medium of the book, without trying to replace it: students are encouraged to refer to key publications mentioned in the program for reference. Through the use of multimedia the importance and value of integration between those specialist studies of the past which deal either with the physical environment or the world of artefact production and use is shown. It needs to be stressed that we are providing a *learning* system in contrast to a *teaching* system.

The environmental section emphasises the importance of integration and interdisciplinary approaches by concentrating on the analysis of Neolithic Avebury. This particular region has been chosen because Avebury continues to receive a good deal of research into settlement history and landscape development. The opportunity exists to see the results of interdisciplinary research into monuments and landscapes.

The goals of the course are to provide a summary of environmental techniques within an accessible archaeological framework. The student will learn that environmental archaeology is concerned with archaeological questions and problems. The interdisciplinary nature of archaeology – in particular the links between the results of the different environmental techniques in the context of an archaeological case study – will be reinforced. By using two summarising articles as the main anchors for the framework of headings, the individual techniques of environmental archaeology can be investigated with direct reference to the impact of their results in the context of a specific study. This contrasts favourably with the traditional approach of presenting each technique to the students in turn, with a separate case study. Multimedia is used to extend the range of sources available to first year students when coming to terms with a new subject discipline. The student is introduced to a computer based learning environment. The non-specific computer skills that the student will acquire can be applied to other Microsoft Windows-based programs and, more specifically, other TLTP tutorials once all interfaces have been integrated (see below).

By navigating through the material at their own pace, students access the information that is relevant to them,

that is, where they will be most likely to remember it. The educational theory is that students must make navigation decisions, so they become more interactively involved with the learning material than passive readers of linear text or listeners to a lecture. *Learner directed* exploration of the knowledge base has a motivational impact (Duffy & Knuth 1990, 203). If there is something on which they would like more detail or perhaps they would like to repeat what they just completed, they are free to do so, as many times as necessary.

No interactive assessment is currently included in the program. All assessments so far were provided as pen and paper exercises which also included the handing in of computer printout as compiled by the program at the end of each session. The assessments took the form of series of multiple choice and short answer questions that required the students to carefully examine specific parts of the database, followed by one longer essay question which would require further reading beyond that provided by the program. Interactive assessment could be included in the program but was not developed due to time constraints. It is also possible that if students' know their interaction with the computer is being assessed they will reduce their exploration of the program, as they might think they will get negative results by straying in the wrong direction.

7.3 The ENVARCH Program

7.3.1 Completion of the project

Subject specialists were asked to write introductions to the subject, or edit existing text. As a result, illustrations were suggested and more were collected as appropriate. Specific slides and photos were also kindly supplied by a number of people. The provision of illustrations proved quite difficult as the inclusion of full screen full colour images drastically increases the overall size of the program file. Images were obtained by scanning slides and negatives straight into the computer and by scanning paper-based illustrations.

A project like this initially requires increased input from lecturers who will only at a later stage reap the benefits. There is no 'quick fix'. Furthermore, work is also needed to keep the contents of such a program up to date.

7.3.2 Structuring an extensive information-base

The existing prototype (Leggatt 1992) was heavily text based and contained virtually no illustrations and was linked in a fairly linear framework. We decided to re-use the existing text by reorganising it into smaller portions arranged in a fairly rigid hierarchical structure. The reasons for this can be found in any textbook on hypermedia: it takes about 30% longer to read text from a computer screen (Nielsen 1990, 191), so the text content has to be reduced in comparison to a paper based document.

It is far more difficult to assimilate text from a computer screen than from paper, so presenting users with large amounts of (possibly scrolling) text will not have a beneficial effect. New text writing skills are necessary which are very different from paper based documents: it is necessary to keep the text brief and concise, without literary flourishes. The structure itself will differ from a paper-based article/book: Making the text available on the computer does not just involve the installation of text files containing the contents of the chapters of a book. It proved quite a challenge to adapt the existing linear text into a usable hierarchical structure. This was particularly so for the two articles mentioned above, as they were not supposed to be altered. They were split into sections according to their original format and those in turn were divided into sets of pages that were then accessible in a linear way. There were also similar problems with the text explicitly written for the package. Its internal structure was not always obvious and it had to be rewritten in parts to include extra references to other sections that would allow for contextual links.

New problems appear with the new medium of non-linear text: Authors and readers get lost in a non-linear text. Users are not yet accustomed to the extra effort needed to keep track of all paths and open documents. The traditional progression of 'Introduction' ⇒ 'Main Argument' ⇒ 'Conclusion' will not apply anymore, since it is possible for the reader to access them in a different order. Unrestricted linkages would result in a spaghetti-like structure: This web might be useful for an experienced user, introducing new ideas and associations. However, in this case, faced with first-time users, a fairly rigid structure to guide the student through the information is needed, with freedom to explore, but with less chance of becoming lost (Hutchings *et al.* 1993, 494). The use of hierarchies rather than webs for the information base was therefore followed here. The text was arranged in hierarchies with increasing detail along each step down in the hierarchy. This structure was decided upon because it is well suited to the task at hand by providing the user with increasing detail as they progress down a line of enquiry.

Students as learners need to be guided around the material, while still feeling that they are in control. We provided them with a number of tools that would allow them to follow their own paths and find out where they were and where they had been so far (see below).

Inside each major section, the information is organised in topics with a number of sub-topics. Individual topics can be split across several pages, and the user is free to move backwards and forwards within them. Blue underlined text will take the user down one level in the hierarchy, and the *Previous Topic* button back up, whereas the arrow buttons move the reader sideways through a sequence of pages. Together, they provide the controls to move through the kind of hierarchy that is illustrated in Figure 7.1. In the *Map* menu, the structure is represented from left to right due to space constraints. Since every sequence of pages belong to one topic, so the structure

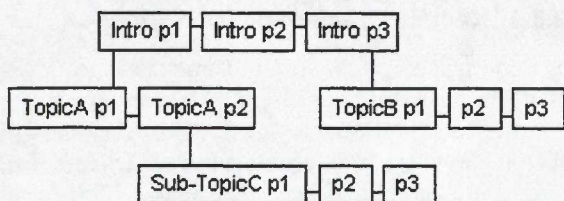


Figure 7.1: A hierarchical topic structure as implemented in ENVARCH.

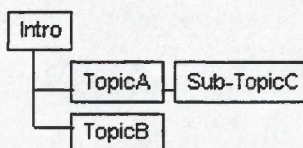


Figure 7.2: simplified representation of the same hierarchy as in Figure 1.

shown in Figure 7.1 would appear in summarised form as Figure 7.2.

The students are expected to explore the structure by starting from the Smith (1984) article and go to the individual techniques from there when they become relevant. However, direct access is always possible to any one section, either from the 'introduction' screen that is always only one step away or the *How far* menu option which allows jumps to any one section.

The individual sections are:

- The introduction.
- Article by R. Smith (1984)
- Article by A. Whittle (1993)
- The Avebury Area
- Molluscan Analysis
- Pollen Analysis
- Faunal Remains
- Plant remains
- Soil Analysis

7.3.3 Interface design

A common interface for a group of programs is desirable for political, consistency, and usability reasons. As this project is part of a larger programme producing a range of courseware for archaeology students, it is clearly an advantage if they all shared the same interface and layout, so that once students had learned how to use one program, they could apply their newly acquired computer skill to any other program from the group. However, as ENVARCH was one of the first TLTP projects to start and be completed (March – October 1993), no interface layout and development guidelines yet had been agreed by the Archaeology Consortium. These were finally laid down in the autumn of 1993 (they were officially confirmed December 1993) using a different template. Consequently ENVARCH will have to be modified later to fit in with the agreed framework. The present interface is partly based

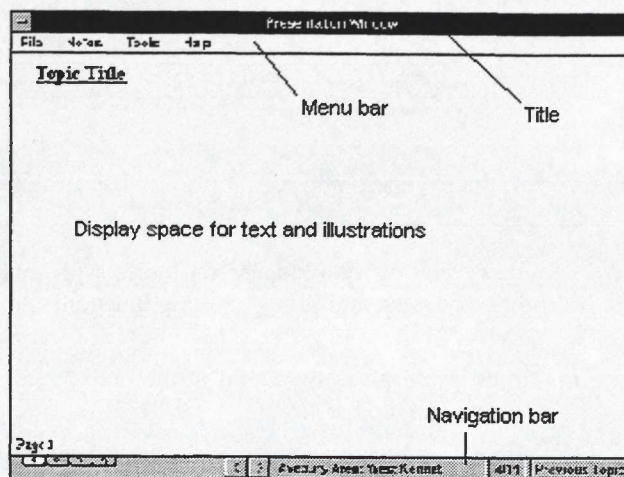


Figure 7.3: A typical ENVARCH screen, demonstrating the layout.

on a design by the Nottingham Biodiversity Consortium (Brailsford *et al.* 1993).

7.3.3.1 Main display

The main interactions are carried out by clicking on highlighted text and buttons. The text links will take the user to another topic that provides more detail on the text that was selected. Buttons are provided in some cases where an obvious text link did not exist, and are always present on the navigation bar to provide the step backwards in the topic hierarchy.

The main display is illustrated in Figure 7.3 and from top to bottom consists of:

1. *The Main Window Title* along the top of the display window which contains the title of the current section.
2. *The Menu Bar*, situated below the title bar and containing a number of pull-down menus
3. *The Display Window*, the main part of the screen, is used for the display of information. It is usually possible to click on parts of it, such as coloured and underlined text and buttons, and on other areas which are indicated in the text.
4. *The Navigation Bar* (see Figure 7.4) consists of a number of elements:
 - *Tabs with page numbers* appear for topics which are split over several pages. Where topics have large amounts of text attached to them, these were broken up into smaller sections which can be viewed by flicking through a number of pages rather than making extensive use of scrolling text. The tabs can be used to move to the specified page.

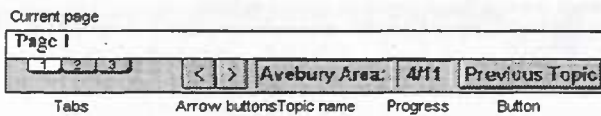


Figure 7.4: the navigation bar.

- *Arrow buttons* only appear on topics with more than one page and have the same function as the tabs.
- *Topic name* gives the name of the current main section and topic.
- *Progress* shows how many topics have been seen and how many there are overall. The figure relates to topics rather than pages, except for the article files (Smith 1984 and Whittle 1993) where the figures represent pages.
- *Previous topic button* enables the user can go back one stage in the topic hierarchy outlined above.

7.3.3.2 Individual references and bibliographies

Each section has a bibliography of further reading and key texts included in the *Bibliography* menu item. Any entries listed in this bibliography may be saved selectively by the user to a file that can be printed or saved to floppy disk at the end of a session. The text itself is full of references, each of which can be expanded by clicking on it to reveal the complete reference and provide the opportunity to save the full reference to a file for later use.

The option for the student to click on any reference in the text without having to go to the bibliography was included to make the material more accessible, and to encourage the student to follow up the knowledge gained in an individual session. In an ideal situation, a click on a reference would bring up a bibliography with the relevant item highlighted or the list scrolled forward so the item is at the top, however this could not be achieved with the current software, so the simpler solution indicated above was adopted.

7.3.3.3 Print-out and saving

Users are given the opportunity, using the Windows Notepad text editor, to add notes to a file into which all other saved references will be collected at the end of the session. They can also print out and/or save these results onto a floppy disk, provided the system has a floppy disk drive or printer attached. This means that the student can take tangible results away from the computer from which to continue learning. References can be examined in more detail, and the easier it is to extract those from the system, the more likely it is that the students might make the effort to look at them. The text file containing the annotations can also be imported into any other work. Actual quantitative results of use of these facilities are included below.

7.3.3.4 Keeping track of user progress

It is important to give a student some means of assessing how much of a particular subject has been investigated in order to assess their own progress and to keep the goal in sight. A problem often encountered with hypermedia is that of the user getting lost in the information structure. ENVARCH includes a number of facilities to address these problems:

- Direct access devices allow the user to gain direct access to any node, using an index facility, for example. In this case, the *Map* and *How Far* options provide the means to access any of the local topics and any of the other sections respectively
- Show all the information and structures with connections in form of a map and allow direct access from there. The problem here lies in displaying complex structures with many links. In ENVARCH, a simplified but complete local *Map* is presented, in which previously visited topics are indicated by highlights and from which direct access is possible by clicking on the topics displayed in the map
- History devices work by showing users where they have been, or allow them to 'back track'. In ENVARCH, this could only be implemented in the form of a 'previous topic' button, that takes the user up one step in the hierarchy. The highlights on the *Map* and ticks on the *How far* displays give a visual indication of what has been visited.
- Allow users to go back to the start. With ENVARCH, users can return directly to the introduction screen if they choose.

7.3.3.4.1 Progress within a section

The navigation bar indicates how much of the subject has already been seen and hence how much remains. Maps for navigation have been shown to be important if users are expected to explore the contents on their own (Nielsen 1990, 130), so it was considered to be an important facility within ENVARCH. A map of the main topics and their connections is included in every section, and in order to give the user some idea of their progress, all topics already visited will be highlighted. The map is also an important aid for searching for a particular topic as it shows the overall structure and allows direct access to any listed topic. If any one page of a multi-page topic has been opened, that topic will be highlighted on the map.

7.3.3.4.2 Progress between sections

As well as indicators for progress within a section, users can see which sections they have been to by selecting the *How far* option of the Tools menu. Sections which have already been visited are indicated by a tick, and from the progress display, users can click on the names of any of the other sections to jump directly to them.

How competent are you?	How difficult is the program?					Total
	very difficult	difficult	average	easy	very easy	
expert	0	0	0	0	0	0
competent	0	0	6	9	2	17
novice	0	0	9	7	2	18
Total	0	0	15	16	4	35

Table 7.1: How competence affected perceived difficulty of program: shaded areas indicate empty cells.

Used Windows before?	How difficult is the program?					Total
	very difficult	difficult	average	easy	very easy	
no	0	0	10	8	3	21
yes	0	0	5	8	1	14
Total	0	0	15	16	4	35

Table 7.2: How Windows experience affected perceived difficulty of program: shaded areas indicate empty cells.

7.4 First Reactions from Students

The program was used in 1994 for a half semester course on Environmental Archaeology for first-year undergraduates at Southampton. Since this was the first trial, students were also given one lecture a week to present additional case studies. They also had one weekly two-hour practical during which teaching staff were on hand to deal with queries and computer problems. During the practical, minor assessments gave a direction to the information search, and initiated discussions among students on where to look for the relevant information and where to find it. At other times, students could access the program on their own.

The final assessment took the form of a set of multiple choice and short answer questions that required students to carefully examine specific parts of the database, followed by one longer essay question which required further reading over and above that provided by the program.

As other studies of this technology have shown that students react favourably to the new technology, the questionnaire for which the results are presented here was designed to compare student's attitudes to lectures and computer practicals in comparison. Other questions were included to assess the usability and structure of the program. Of an original sample of 50 students, only 35 completed the questionnaire (as it was given out in a 9 o'clock lecture), so results, despite giving some insights into student attitudes should be treated with caution due to the small scale of this evaluation both in terms of numbers and timespan.

7.4.1 Expertise

With the introduction of this program to the students, two hurdles had to be overcome. The first was that the students, despite being asked to hand in only word-processed work right from the start of the academic year, were relatively new to using computers and half of them declared themselves to be novices. However, an examination of the questionnaire results shows that despite the fact that no-one thought of themselves as expert, all students found the program of average difficulty or better (see Table 7.1). So it seems that the

technology and interface were not a stumbling block. Secondly, only half of the students had used Windows before; again this seemed not to affect the perceived difficulty of using the program (see Table 7.2). These results are very encouraging for those considering introducing this new technology into their teaching methods.

7.4.2 Use of menu items

Questions referring to structure problems showed a wide variety of responses. Students were asked to what degree they felt they got lost and how often they used the map. Those who hardly ever felt lost managed to get a feel for the structure by using the map frequently, while it appears that a majority of students felt that they got lost only sometimes, and used the map sometimes. One student referred to the map as the single most useful tool in the program.

The jump out to the Notepad program was confusing for some, especially novices who preferred to stick with paper. 20 (57%) students said they preferred paper, with 6 (17%) preferring the Notepad and 9 (26%) using both. Ingenious and effective use of the Notepad were observed in some cases, especially when a better understanding of the Windows environment had been achieved. The usability of the Notepad was not improved by the fact that a bug in ENVARCH sometimes caused the program to 'forget' the user's name which made it impossible to access the notes file despite the fact it existed on disk. Novices in particular found this extremely unsettling, as they seemed unaware that they could access the files directly from any text editor without having to open ENVARCH, despite having been told so.

7.4.3 References and searching

Hardly any students chose to look up further references in the library, though this would probably have been equally true if they were just handed a reading list at a lecture. This clearly demonstrated the prevalent student attitude to work: as no major pieces of coursework requiring additional information and reading had to be prepared for assessment, there was no need to make any use of the library.

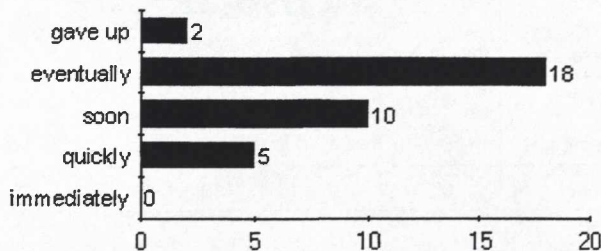


Figure 7.5: Answers to: How quickly did you find specific information.

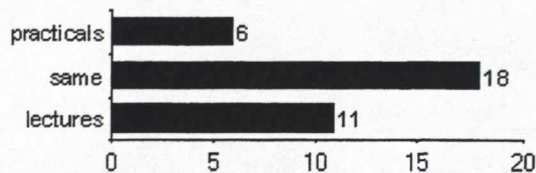


Figure 7.6: Answers to: Do you prefer practicals or lectures?

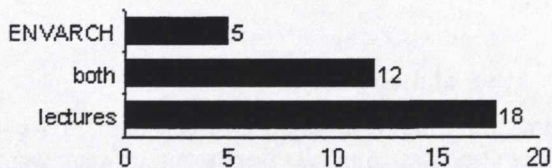


Figure 7.7: Answers to: Will you remember more from ENVARCH or from lectures?

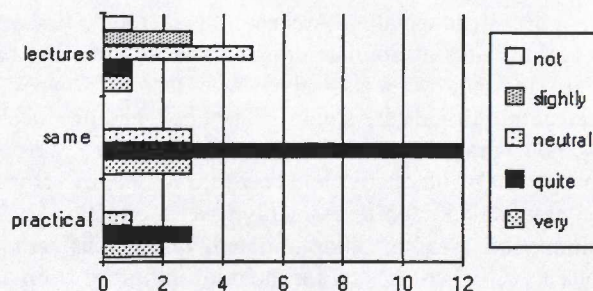


Figure 7.8: Preference for lectures as reflected in enjoyment.

Students were given assessments to ensure they would explore most of the database. Most of these were multiple-choice and single word reply questions. Some students admitted to scanning quickly through the information, without taking any of it in, simply to retrieve the replies. As this is the first time this technology has been used for teaching, new ways of assessing students need to be devised. As mentioned above, some degree of interactive assessment would be the best solution, but more time is needed to develop this.

When asked how easy they found it to locate specific information, the replies were weighted towards the more negative end of the scale, with 18 (51%) reporting that they found the information eventually, 2 (6%) said they could not find the information and gave up (see Figure 7.5). This result is probably to be expected, as students should have to make some effort in finding information to reply to questions for assessment. If information was found too quickly, there would be no challenge and boredom would set in.

7.4.4 Overall reaction and preference of lectures

The results concerning the overall enjoyment of the program by the students were encouraging. The distribution of replies is weighted towards the positive end

of the scale. Despite the fact that the program was well received, with 22 (62%) responding positively, 9 (26%) neutral and 4 (12%) negative to the question whether they had enjoyed using the program, the overwhelming result of the questionnaire was that students prefer lectures (11/31%) or have no preference (18/52%) (see Figure 7.6), and definitely think they will remember more from a lecture (18/52%) (see Figure 7.7). This result surprised some of the volunteers who also tried the program, but were not first year undergraduates. The expectation was that students would prefer this new way of interacting with the material. The cross tabulation of enjoyment against preference (Figure 7.8) shows that the bulk of replies is concentrated in the centre of the chart, with only a faint pattern of correlation between enjoyment and preference. This contradicts the expectation that those who enjoyed the program would prefer it to lectures. A similar pattern appears when examining the perceived difficulty against the preference of lectures; despite the fact that all the students found the package relatively easy to use, most preferred lectures.

7.5 Conclusion

One result of the first trial application of the ENVARCH program is that students appear to prefer lectures. In fact even those who liked the program still expressed a

preference for lectures. The reasons for this preference are clearly stated. They think that they will remember more because in lectures continuous, indiscriminate note-taking is prevalent. On the contrary ENVARCH deliberately uses an enabling rather than directive technology, requiring responsibility and decision making on the part of the student, not the lecturer. As students take even more responsibility for their own learning and are not presented with condensed lectures of the main subject matter, they will have to change their learning methods. ENVARCH makes this possible.

However, it should be remembered that students involved were first years, who are only gradually being introduced to the importance of individual research and learning, rather than the reiteration of facts as presented by the teacher. While still in this transition the latter will seem the easier option. The results of a study like this are also affected by the skill of the individual lecturer, as lectures on any topic delivered by excellent lecturers can never be replaced by a computer program. It is possibly not fair to compare a *learning* and a *teaching* system, as both are trying to address different aspects of knowledge acquisition.

However, by using ENVARCH, many students can use one resource simultaneously and when it suits them best. The lecturer is then free to give lectures and can spend more quality teaching time with students, often on a personal basis which is all too often a luxury in the current mass education system of higher education. During practicals, minor assessments give a direction to the information search, and initiate discussions among students on where to look for the relevant information and where to find it. Students can access the program on their own, although with ENVARCH, formal practical sessions as well as a lecture were arranged every week with a supervisor present to help with queries and problems. Students are also provided with multiple copies of the introductory concepts without having to hunt down the few copies of text-books. Libraries can no longer provide enough copies of such introductory texts. Purchasing all the recommended books is financially not an option for most students.

ENVARCH was received well, despite initial minor teething problems. We see a continuing role for such computer based learning if for no other reason than it forces students away from the 'easy option' of lecture-

based learning and challenges them to acquire the skills of investigation and the exploration of information which form the core of an undergraduate degree.

Acknowledgements

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