Using Authorware Professional for developing courseware

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This paper describes the use of Authorware Professional, an icon-based, object-oriented authoring system, to develop courseware and on-line experiments. Notable features include direct editability, facility with many response types, and built-in variables. Shortcomings include the difficulty of learning how to use the program, inability to present stimuli rapidly, the program's linear development style, weak drawing tools, a lack of scroll bars for text, and some problems in the use of Authorware with other applications. Overall, the package is recommended for users with adequate resources.

The number of courseware packages available to psychology instructors has grown steadily in recent years, and today it is possible to find educational software addressing most of the content areas covered in an introduction to psychology (see Hornby & Anderson, 1990). Yet despite the wide range of commercially available courseware, the successful integration of computer-assisted learning into the classroom is a difficult and time-consuming process. Even among psychologists who use computers in instruction, less than a third make use of educational software (Anderson & Hornby, 1990). It is thus evident that psychological courseware has yet to live up to its oft-cited potential.

Of course, an excellent way to ensure that educational courseware, classroom demonstrations, and on-line experiments address one's particular needs is to develop them "in house." In the past, such a task would have required a team of programmers working for a period of several years; today, there are a number of authoring tools available to make the task manageable for instructors and experimenters. A recent survey in the *Technical Horizons in Education Journal* indicates that 34 companies have developed authoring software ranging in price from \$50 to \$3,000 for microcomputers, and up to \$64,000 for mainframes (Greenfield, 1990). One of the most widely respected authoring systems for the Macintosh is Authorware Professional, which is licensed to educators by Authorware, Inc. for \$995 (and retails for approximately \$8,000). Authorware Professional can be described as an authoring system (Tyre, 1989), because of its answer analysis features and behavior-monitoring and record-keeping functions, and because it permits the user to create multimedia and interactive video.

I have used Authorware Professional to develop courseware on approaches to inquiry in the social sciences (Wolfe, 1992c), student-generated demonstration experiments for an introductory social science course (Wolfe, 1992b), and

on-line research experiments (Wolfe, 1992a). I have also served as advisor for an undergraduate courseware development project in which a number of development tools, including Authorware Professional, were used (Sweeney, 1991). I will share my impressions of Authorware Professional by describing how the authoring system works and evaluating some of its distinguishing features, shortcomings, and limitations from the perspective of the psychologist who is a researcher and an educator.

Overview

Authorware Professional is an icon-based, object-oriented authoring system. Such icon-oriented systems have become the norm for courseware development tools in recent years (Greenfield, 1990). The system uses the familiar Macintosh interface with pop-up menus and dialog boxes. The courseware developer "programs" by putting design icons on a flow line (see Figure 1).

The icons on the left side of Figure 1 perform a variety of functions when placed on the flow line (right). The first is a display icon, which puts text and graphics on the screen. Second, the animation icons move objects from one point to another. Erase icons erase displays. Wait icons halt the flow until the user responds or a specified amount of time elapses. Decision icons determine which of a set of attached icons will be used next. Interaction icons present options or questions and, depending on the user's response, select and branch to attached icons for feedback to the user. Calculation icons perform calculations or execute user-written code. Map icons organize the program by creating a single icon representing larger program segments. Start and stop flags allow the courseware developer to run lesson segments during the courseware development process. Movie icons play computer animation segments. Sound icons play digitized sound segments. Finally, video icons play video segments.

As an illustration of icon-based authoring, consider a segment from a classroom demonstration experiment. In this class, groups of students generated ideas for experiments to see if subliminal messages affect behavior, and

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Figure 1. Flow line and design icons.

I implemented their ideas as on-line experiments, using Authorware Professional. The hypothesis was that a message flashed briefly on the screen would affect the rating of a picture. A picture of a crane was presented to the subjects, and (in one condition) the number 7 was flashed in the bird's reflection for approximately 80 msec (see Figure 2). The subjects rated the picture on a Likert scale by entering numbers on the keyboard. Responses outside the acceptable range of 1-7 were rejected, and the subject was cued to respond again. When an acceptable number was entered, the subject was presented with another item.

The set of icons used to develop this segment is depicted in Figure 3. The display icon labeled "Crane" contains the scanned image of a photograph of a crane. I pasted the picture into the display icon with the Clipboard, a standard feature of the Macintosh. The movie icon labeled "7" contains the number 7 and instructions to play this single-frame movie once at a speed of 120 frames per second. The interaction icon contains the Likert scale and the response prompt. The text response option is set to continue if a "correct" response is given; this "correct" response is designated as one of the numbers 1-7. If another response is made, the program branches back to the decision icon and highlights the incorrect response. When an acceptable response is made, the calculation icon appends the response to an output file. The erase icon erases the display before the next item appears.

Features

Authorware Professional has a number of features that are of particular interest for psychologists. First, the system is built around the notion of direct editability, the ability to make design changes while the lesson or experiment is being presented. This is particularly useful in the piloting phase of a project. Indeed the manual encourages one to use Authorware in the design phase, and it specifically counsels against developing flowcharts, or even visualizing all interactions before beginning a project (Authorware, 1989a, p. 3-3).

Second, the program is extremely flexible in terms of the number of permissible response types. Authorware does not limit developers to a multiple-choice format. The authoring system accepts many kinds of input from students and subjects, including text, mouse clicks, menu items, keypresses, conditional responses, and time limits. The program is particularly good with text, supporting a variety of matching strategies and accepting text of any length. The system also places no limit on the number of branch paths.

Another useful feature is the large number of built-in variables available through a pop-up menu. Authorware has over 100 variables affecting interactions, decisions, time, video, and graphics. These variables allow the courseware to alter its branching and feedback in a number of ways. For example, it is easy to provide different feedback when a given response has been made on the first attempt as opposed to the second or third. These variables also make it easy to keep track of how often responses are made and branches are taken. This is especially important when one is piloting courseware with a group of students.

Authorware has recently released a version for DOS machines running Windows, Authorware Professional for Windows. Authorware also provides a Platform Independent Media format, which converts applications from Macintosh to Windows formats. I have not used this feature.

Shortcomings and Limitations

A number of authoring languages and authoring systems are on the market, and Authorware Professional is by no means inexpensive. Thus, it is useful to have a sense of the strengths and weaknesses of the package, particularly from the perspective of the psychologist who is a researcher and an educator.

Time spent in learning the program. Learning to use Authorware Professional is very time-consuming. I spent perhaps 40-60 h doing the tutorial, experimenting, and poring over the manual as I took my first stab at courseware development with Authorware. Users (like me) who are unaccustomed to icon-based programming may find that they must adjust themselves to it. This is especially frustrating when one is first performing tasks that are straightforward when one uses a traditional programming language. Fortunately, both the tutorial exercises and the manual are quite good. With the tutorial, one learns to build a complete computer-assisted lesson on how to use

Figure 2. Stimuli used in demonstration experiment.

Figure 3. Icon sequence used in demonstration experiment.

a 35-mm camera. This exercise provides an appropriate context for the component knowledge that is acquired along the way. I also found the task of learning Authorware intrinsically motivating, and I have come to enjoy this approach to programming.

Problematic rate of stimulus presentation. In developing the subliminal message demonstration experiment, I sought to present stimuli as rapidly as possible. I found that the movie module was unreliable at speeds exceeding 120 frames per second (about 83 msec). The manual states only that "if the setting is too high to display all frames at the selected rate, Authorware will skip frames, as necessary, so as to play the movie at the chosen speed" (Authorware, 1989b, p. 2-3). Similarly, the timer variable reports elapsed time to one millionth of an hour (about 3.6 msec), but the documentation does not elaborate on this, and the system cannot be that accurate without additional boards and hardware. It may be possible to get around these problems by passing control to external timing routines (Rensink, 1990). Authorware Professional allows developers to incorporate code written in programming languages such as C and Pascal (which undoubtedly has many useful applications in addition to timing). However, I have not tried this, and if millisecond presentation and measurement are important, there are probably better approaches than Authorware Professional.

Linear development style. The flowchart-like structures created by placing design icons on the flow line tend

to promote well-structured lesson designs. However, for authors interested in developing unstructured hypermedia and hypertext environments, this linear flow of control may be unwelcome. One module of the courseware that I am developing to teach interdisciplinary social science methods employs what I call a wheel-and-spoke model of hypertext. With this design, students can click on key words in a passage to get definitions and further information. Developing this kind of hypertext is easy with Authorware Professional. However, for authors who wish to create open-ended discovery environments, a hypermedia tool such as HyperCard may be more appropriate.

Disappointing drawing capabilities. For an expensive package that prides itself on "great graphics," the built-in drawing capabilities are disappointing. Authorware Professional has a lean set of drawing tools, and no built-in painting tools. Fortunately, it is easy to create graphics with a paint package such as Canvas and paste them into Authorware. One of my students also found the animations he created with MacroMind Director far superior to those produced with Authorware. Fortunately, it is easy to import these animation sequences into Authorware.

Some limits on text presentation. Although the built-in word-processing program is quite good, I prefer to develop text in Microsoft Word and paste it into Authorware because the word-processing module does not have a spell checker. Another limitation is that one cannot put text in boxes with scroll bars that allow the user to scroll through longer segments of text than can be seen on screen at one time. Of course, one can easily create several pages of text in separate display icons (and text-heavy presentations generally make for poor courseware). Nonetheless, scroll bars for text presentation are standard on the Macintosh, and the inability to use them in Authorware seems to be an oversight.

Authorware and other software. One of the outstanding features of Authorware Professional is that it can be interfaced with other programs. For example, one of my students had no difficulty in using Authorware Professional as a shell and jumping to routines created in HyperCard and MacroMind Director. However, we found that when using other programs as the base of operation, we sometimes had trouble using routines created in Authorware. In about 1 out of 10 tries, the system unexpectedly crashed when we were attempting to jump from Authorware back to HyperCard. Sometimes we also had difficulty in getting back to the card we left, returning instead to the Home Card. When one jumps to Authorware from another program, the package has the annoying attribute

of displaying its logo and the file name, and then waiting for a mouse click before getting on with the segment. This means that a student may sit for quite some time before acting. A trick that we used to get around this problem was to name our Authorware segment "Click Here," which at least gave students some indication of how to proceed. ResEdit may provide another solution.

Conclusions

Authorware Professional is expensive, and learning to use it takes some work. It is also probably not the best package to use when millisecond timing is important, or when one lacks resources such as computer memory, disk space, and access to paint and draw programs. However, having put the effort into learning the package, I find it relatively easy and enjoyable to use. In the classroom, I was able to turn student's ideas into five demonstration experiments, collect data from 80 students, and analyze the results over a period of less than 6 weeks. In the laboratory, it was easy to modify my materials and design during piloting. For educators and researchers who would like to create sophisticated courseware and on-line experiments, Authorware Professional is a very powerful tool that merits serious consideration.

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