

# Contemporary Chemistry: Visions of An Integrated Text/Multimedia Module Approach

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## Abstract

We report the evolution of a unique project developing an interactive textbook, linking to a multimedia module, and involving the exploration of higher degrees of student interactivity. This evolution progressed from Macromedia Director multimedia and hardcopy text, through Adobe Acrobat text with links to Flash multimedia, with the most recent combination of the multimedia features and text modules in a Flash-only format. Examples of the current status of the project can be found at <http://contemporarychemistry.com>. (*Caution: if you click this link, the in-depth exploration of the site will require a username and password, which are found later in this article*)

## Background

For over a decade, one of the authors (CT) taught a course for non-science majors entitled Chemistry and the Human Environment at the University of Delaware (J. Chem. Ed. **73**, pp 1012-1016, Nov. 1996; "Chemistry and the Human Environment. A Course for Non-Science Majors"; [copy on request](#)). The goal was to motivate students by developing an increased appreciation for what chemistry means to them in their own lives.

After much experimentation and extensive student feedback, topics were selected from those proposed by students, and the chemistry associated with these topics was presented on a need-to-know basis. The chemical fundamentals covered in this course were equivalent to those covered in most introductory courses for non-science majors.

Under-motivated students became much more interested and involved in the course because they felt they had a stake in its design. A text for the course evolved from class notes prepared by the instructor. An initial conversational question-answer format evolved into a series of questions listed at the beginning of a chapter that define that chapter's goals. However, the text lacked the desired dynamic character that might be achieved by the use of multimedia. The questions that arose were: Which tools to use? What is motivating? What is user friendly? What is pedagogically sound?

## Phase 1: Hard copy text and Multilevel Director Content

A course in Macromedia Director offered the needed impetus to start creating simple animations that added clarification and punch to our new Contemporary Chemistry multimedia project. The course content in this college course was quite different from most high school chemistry courses and therefore "hooked" most students. The non-science majors enrolled in this course had a wide variety of backgrounds, ranging from no formal chemistry course to excellent college level courses, presenting a problem about the proper level of sophistication for the text. Our first solution was to introduce four levels of difficulty for each topic within a multi-level multimedia project containing simple animations, an approach that was abandoned because of time constraints.

A chance meeting at a seminar on instructional technology brought the coauthors of this paper together. One (BK) had extensive experience with interactive Flash programming and the other (CT) was just beginning to master

the elements of Director and had programmed some content for supplementing the Contemporary Chemistry text. After some frustrating attempts at combining the Director material with new Flash animations, the multimedia project was recast completely in Flash and a major thrust was made to include many more student-oriented interactive animations. Levels(?)

## **Phase 2: Hard copy text and Flash Multimedia Module CD**

The authors developed a multimedia module that served as a supplement to a hard copy Contemporary Chemistry textbook. We chose Flash not only because of available expertise, but because it ports to the web very easily and can accomplish all of the goals of our project. This multimedia module is completely programmed in Flash, is based on the content of the Contemporary Chemistry text, and is organized by book chapter and topic. A large number of interactive animations illustrating important chemical and environmental principles are included.

This presentation is “user friendly,” designed for ease of navigation. Each multimedia computer screen contains a wealth of interactive content. In addition to the page’s main interactive animation or illustration, there are a number of interactive buttons that can be activated to enrich the content of each page:

- A “For More Information” button leads to a pop-up, text-based screen that provides more information about the animation or illustration or that delves deeper into the theory behind the page’s subject matter.
- A “Web” button leads to a web site that is dedicated to the Contemporary Chemistry Project. Clicking this button leads the student to a section of this web site that contains classified links to web sites on the World Wide Web. Each link is classified by chapter, chapter topic, and level of difficulty. For each chapter, there is a “What’s New?” link to a continually updated page that gives the latest news on chapter topics taken from sources such as Nature, Science, Science News, Scientific American, and Chemical & Engineering News. The web site will be monitored and regularly updated. New animations, illustrations, and text can be added easily at any time to appropriate chapters in the web site.
- A “Glossary” button, configured either for the entire chapter or for a particular chapter, produces a pop-up window with definitions of terms used in both the text and the multimedia. The chapter glossary can be used for student review of important terms in that chapter.
- A “Principles” button produces a pop-up window with the chemical principles introduced in the current chapter.
- A “Summary” button produces a pop-up window with a summary of the current chapter.
- On most pages, a “?” button links to a multiple choice question covering the animation. Immediate feedback is provided on both right and wrong answers. The order of answers is scrambled each time the question is accessed. This feature could be used in formal testing situations.
- The level of difficulty of the material is indicated by the words “basic” (introductory) and “advanced” on the lower left side of the screen. The text is written primarily in the “basic” level, whereas the web links range from overview through highly advanced levels. Thus it is possible for a student without any background in chemistry to move through a number of levels of chemical sophistication in our Contemporary Chemistry project.

Navigation within the multimedia module is rapid. A chapter pulldown menu makes all twelve chapters and their chapter topics immediately accessible. Within each chapter, an interactive list of chapter topics is contained on the left side of each screen. Thus switching to another topic in another chapter requires two clicks.

## **Phase 3: Adobe Acrobat Text Linked with Flash Multimedia Module**

During the development of the multimedia module, the purchase of Adobe Acrobat 6.0 Professional introduced the use of this program’s button-linking capabilities. Acrobat is a well-accepted medium for delivery of text-based content. It includes sophisticated navigation, book-marking, scaling, and print features. Buttons can be placed in any location in the Acrobat-generated Contemporary Chemistry PDF text. Thus, clicking a button in the margin of or within a PDF text section can produce a pop-up window with a Contemporary Chemistry multimedia module page containing an animation that makes the text more dynamic and interactive. Inserting interactive buttons into the text means that the

Contemporary Chemistry text must be read on a computer. Some students may be uncomfortable reading continuous on-screen text. However, having periodic button-activated interactive animations interspersed throughout the text relieves the reader of monotonous on-screen reading as well as adding reinforcement and added information to the text subject.

There are both advantages and disadvantages with this format. Content is delivered in two windows, one for the text and the other for multimedia animation content. Once attention is focused on the multimedia content, it is easy to be distracted and continue in the multimedia module and lose continuity when returning to the text. On the other hand, the browsing feature of this combination can easily combine with serendipity to pique interest in an area that might otherwise be overlooked. Having two windows can be an advantage in that the reader can alternate between reading, watching an animation that illustrates and interprets the text, and rereading the text. As currently configured, the glossary is only available in the multimedia interface. There are also concerns about sections of the text as yet unsupported by animations.

A problem arises from the use of two different programs (Acrobat and Flash) to present Contemporary Chemistry content. Flash content, available either from a CD or from the Web, must be presented to the user using either a computer with the Flash Player application or through the user's web browser containing a Flash 7 plugin. Acrobat content delivered from a CD or from a Web download must be read through Acrobat Reader 6.0. Printing the button-containing (interactive) Acrobat PDF text loses the built-in interactivity.

Thus, if interactive Contemporary Chemistry PDF text and Flash multimedia modules are both contained on a CD or obtained from the Web, the user's computer must contain Acrobat Reader 6.0 and either Flash Player 7 or have a browser containing the Flash 7 plug-in. These are fairly stringent requirements for faithful reproduction of the Contemporary Chemistry Content. If the user's computer has Acrobat Reader 5.0, the Acrobat text will open but the buttons will not be interactive. If the user's computer has both Acrobat Reader 5.0 and 6.0 on their computers, the Contemporary Chemistry text may open with Reader 5.0 and frustrate the viewer because of the lack of button interactivity. Thus extensive instructions have been prepared for the user, but these may be ignored because of their detail. For this reason, we have experimented with another configuration of the Contemporary Chemistry Project.

#### **Phase 4: Flash-only Text/Multimedia Module**

A Flash-only version of Chapter 1 is presented in our Web site. Contemporary Chemistry text from previous versions was copied and imported into Flash. New menu structure and links were embedded within the screen page and allow seamless navigation between text and interactive content within a single window. Links to additional content from existing multimedia are intact and available at all times.

An advantage of this format is the seamless flow of text and animations and the ease of navigation throughout the chapter. A side panel contains both interactive chapter topic buttons and buttons linking to all of the chapter animations. "Back to text" buttons quickly return the reader to the original section of the text containing the embedded animation button. Interactive features of the multimedia such as the glossary, web, principles, and summary buttons are present on every text page. This version avoids problems with Acrobat Reader issues and presents all content in a single window.

One disadvantage of this version of Contemporary Chemistry content is that the Flash navigation tree is not as flexible as the Acrobat text version. Text delivery in Flash is not as elegant as that delivered by Acrobat.

#### **Classified Animation Collection**

An important part of the Contemporary Chemistry Project is the Classified Animation Collection. This is a collection of all of the animations present in the multimedia module that is classified according to chapter and chapter topic. The content is presented without extensive text and other "window dressing." This Collection is intended primarily for use in the classroom where the instructor provides commentary and is used as a "lecture demonstration" tool.

Another interesting possibility is to use some of these animations as a focus for problem based learning or POGIL exercises. Student groups can interact with the animations, make observations, and draw conclusions. If the content of our project were to be presented on a central server, e.g., Web CT or Blackboard, the animations could be presented for the first time in class or in a student group, discussed, and then released on the web to the class for self-study and review. Preliminary studies using this technique and these animations are planned.

## Summary and Recommendations

Flash ports to the web very well, offers excellent opportunities for interactivity in teaching chemistry, has a nearly universally accepted presence on the web, and can be easily used with CDs or the web in the classroom. There are a number of ways in which Flash can be used in creating an interactive animated text on the web:

1. One is to use it in combination with Adobe Acrobat, using the connectivity available in version 6.0 of Acrobat. This would limit the text either to use with a CD on the student's computer or to downloading a PDF file from the web and linking to Flash files on the web

2. Other possibilities are to use Flash exclusively or Flash combined with HTML. The transitions from text to animations and back are generally smoother with these formats.

3. Some will resist the idea of reading a text on screen. For these individuals, the option with is that Acrobat PDF files can always be printed with high quality print and can be used to produce hard copy. The freestanding multimedia module can be made available either from the web or a CD or both.

## Website for Contemporary Chemistry

The introductory page for the web site dedicated to this article contains an overview of the different types of animations and interactivity contained in the project. Chapter 1 is available in the Flash-only style web page described above. Chapters 4 and 5, available in PDF downloads containing no interactive button links, are presented to illustrate the text style of a typical environmental applications chapters. Both the full multimedia module and the complete classified animation collection are available on this web site.

*To engage in the Contemporary Chemistry Project, after opening, click on the "project reviewers" button at the top of the first page and, in the pop-up window, enter "conrad" as the username and "chemistry" as the password. This project can be accessed by clicking the following link: <http://contemporarychemistry.com>*

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