The Use of Authoring to Produce Effective Learning Materials

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Authoring

Authoring systems are commercial systems which allow the construction of an interactive computer based package in a simple way and with minimum or no programming requirements from the author.

There are many authoring systems on the market, all differing in the facilities they offer and the way in which the total learning package is constructed. *ToolBook Instructor*[1] is one of these.

In the *ToolBook* system:

- the organising principle is a book with chapters;
- the emphasis is on screen design; and
- an author starts with content, develops screens and builds structure onto this.

ToolBook applications are created in 'author mode' and studied in 'reader mode'. Movement between these modes can be achieved by simply pressing the F3 key. Pages are turned in author mode using the 'status bar'; pages are turned in reader mode by using the navigation devices incorporated in the pages.

Objects on pages in the learning package (including navigation, fields for text, video stages, etc.) can be dragged from a catalogue or drawn from a selection of palettes. Most objects produced in this way will have pre-programmed properties (for example a 'next' button will turn a page in the package when clicked), although these can easily be modified (for example the colour of an object can be changed using the colour palette) using a variety of tools. Yet other objects can be imported into the package.

An application will normally involve hypertext (non-linear text involving nodes and links) and hypermedia (which includes text, audio, video, animation, graphics and user interactivity) and sophisticated navigation and interaction between the reader and the pages of the book.

Programming to enhance the learning package

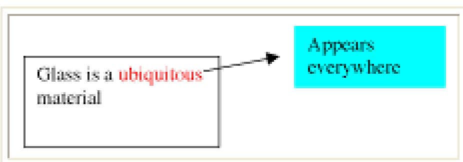
In all cases of authoring, the learning packages can be enhanced by making use of scripting languages. These are compatible with *Visual Basic* and relatively easy to master. In *ToolBook Instructor*, the language is called 'Open Script' and is based on handlers and actions. Open Script is similar to *Visual Basic* in that programs can be written for any object on a page of a learning package and the programming is object oriented.

The structure of a program in Open Script can be illustrated by the following example:

```
To handle buttonClick
Show picture "picture1"
end
```

Other very simple handlers include mouseEnter and mouseLeave.

Quite effective pages can be designed by programming a 'hotword' to show extra text as a mouse enters the text area, and to hide the text as the mouse leaves.



The program for this useful effect is:

```
To handle mouseEnter
Show field "definition"
end
To handle mouseLeave
Hide field "definition"
end
```

Distribution of a learning package

All authoring systems allow a number of ways of packaging the final product for distribution and it is important to consider this at the planning stage because not all objects available are compatible with distribution on the Web. *ToolBook Instructor* allows three alternatives for distribution:

1. on a CD-ROM, a process which imposes few restrictions on the author at the development stage;
2. on the Web as a series of HTML or Java pages, in which case the author must be aware that most Open Script programming will not be functional on the distributed product (*ToolBook Instructor* version 7 and later includes an action editor which allows the author to include such actions as 'hide' and 'show' which will be functional in HTML web pages and this must be used in place of simple programming); or

3. on the Web as a native *ToolBook* book, when all the features included by the author will be functional, but where the reader will have to download a neuron browser to read the book.

Physical chemistry experiments

The work described in this paper explains how *ToolBook Instructor* has been used to produce learning packages in physical chemistry, with the emphasis on using experimental physical chemistry as the means of studying selected topics. In most cases, physical chemistry laboratory work involves collecting data under a variety of experimental conditions and analysing that data to make meaningful links to theory. In most undergraduate courses the time available for collection of the data is short and the amount of data collected can be insufficient to make interesting analysis and links to theory. There have been many attempts to overcome this problem and computer based learning packages is one of these. Students can use these packages to quickly generate significant amounts of raw data to supplement their own laboratory results.

Four learning packages have been completed to date[2]. They cover the topics: Calorimetry; Gases and gas equilibria; Basic phase equilibria; and Basic chemical kinetics. All the packages contain the same 5 elements:

- a section on basic theory;
- a glossary of terms and definitions;
- a video section showing the techniques involved in the experimentation;
- a section on worked examples and sample data; and
- a test with appropriate feedback.

Basic theory

The learning packages are aimed at first year undergraduate level and the basic theory section reflects this. Because the packages are centred on experimental studies, the theory covers the experiments shown in the video section.

In this section extensive use is made of 'hide' and 'show' to limit the amount of material the student first sees on a page and to allow interactivity, where the student can use mouse rollover to access further details.

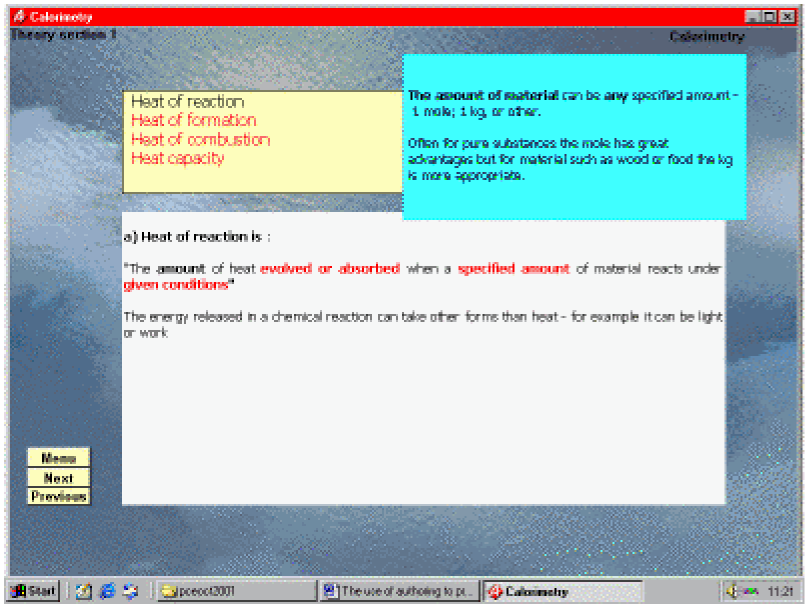


Figure 1. A page from the theory section showing a pop up box in response to mouse rollover on a 'hotword'

This section is clearly suitable for student self learning but in the authors' experience[3] it is better used in a directed learning mode.

The Glossary

ToolBook Instructor 5 and earlier versions contain a glossary wizard which makes the construction of a glossary very simple. Later versions do not include this facility but it is simple to script walk a glossary produced in version 5 to a later version of *ToolBook*.

It is possible to use *ToolBook*'s facilities to link words in the general text of, say the basic theory section, to the glossary definitions but the authors found that this was confusing to the reader in that there was a sense of 'getting lost' in the package with too many such links and thus have not included this in the physical chemistry experiments series.

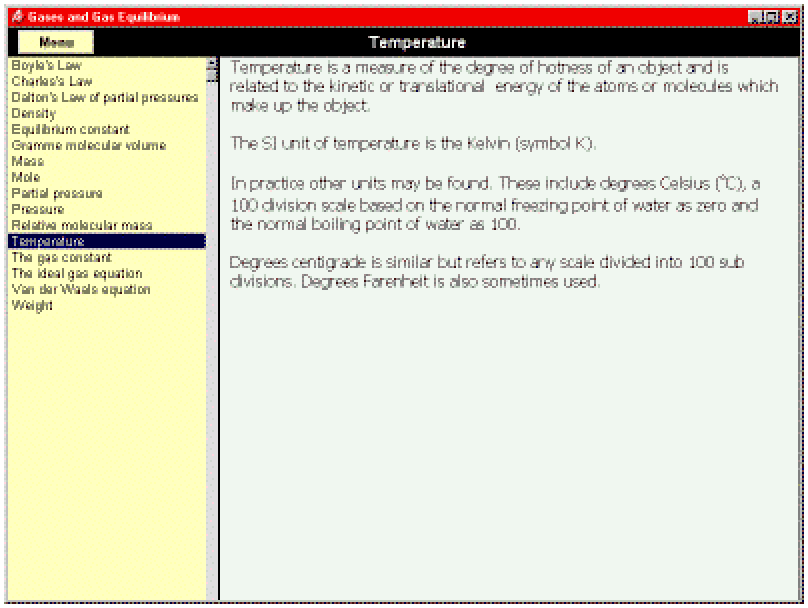


Figure 2. An example of a glossary page

The video section

The videos used in this section are taken from the basic laboratory chemistry series[4] produced by the Chemistry Video Consortium. The video page has a number of features which promote effective learning and teaching:

1. the videos themselves can be played in total or as any of a number of subsections;
2. the videos can be played on a small video stage or as full screen;
3. the videos are accompanied by the written text of the sound track;
4. the written text is scrolled and highlighted to follow the sound track of the video; and
5. the font size of the text can be changed to suit the reader's preferences.

The video section proved to be the most demanding of the tasks undertaken in the development of the learning packages and the authors advise potential developers to consider this section very carefully at the planning stage.

Video itself takes up a lot of memory and will need some form of compression before it is imported as a clip into the *ToolBook* program. Potential authors should seek advice on this at an early stage in the planning.

The *ToolBook Instructor* catalogue contains several video stages which can simply be dragged onto a book page and simply associated with a video clip. However, most use MCI controls which are not supported by later versions of Microsoft operating systems (*Windows 2000* for example). The solutions are to use the 'universal media player', available in the catalogue of *ToolBook Instructor* version 7 and later or to use *Windows media player* and distribute this with any package produced (permission will be needed from Microsoft[5]). In this series on physical chemistry experiments, the latter alternative was chosen.

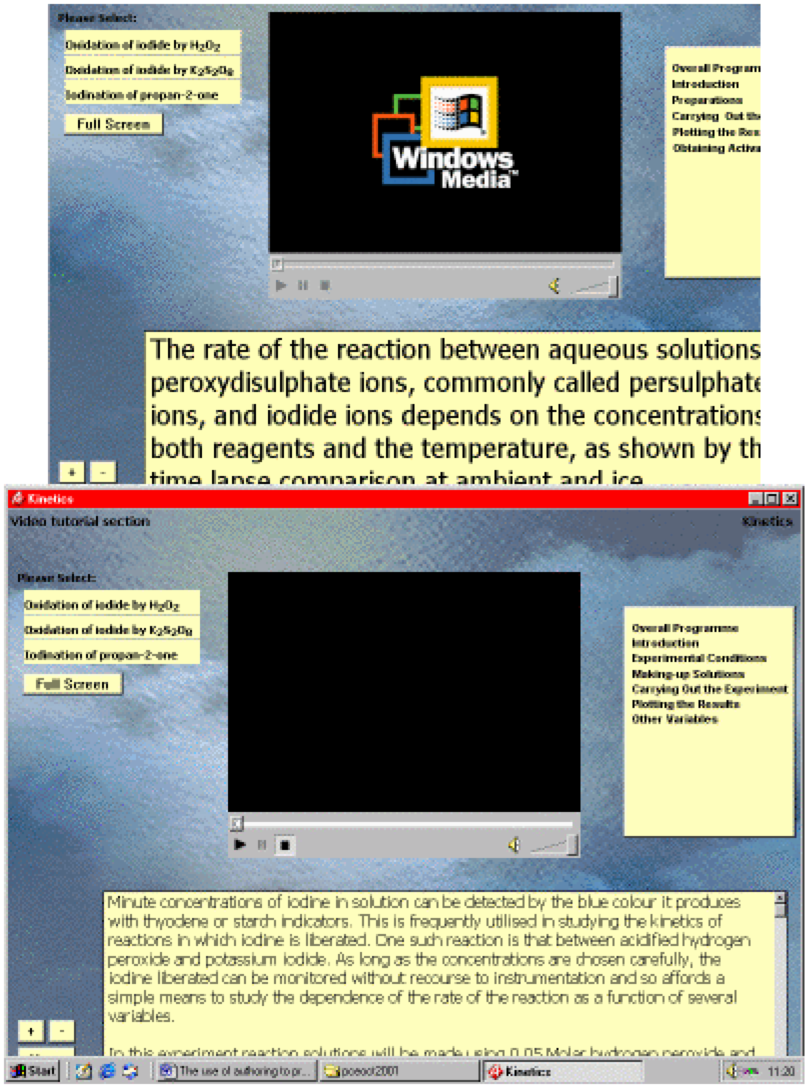


Figure 3. A video page showing video subsections and the effect of changing font size

The worked examples and sample data section

The purpose of this section of each learning package was twofold; to give readers illustrations of the approach to data analysis and to allow them to acquire raw data to supplement their own laboratory data.

The approach was varied. In some cases the illustrations are completely separate from the raw data, and it could be argued that the former would be better as either a separate subsection of the learning package or part of the theory section. In other cases the worked examples are fully integrated with the sample data and the former is included as 'hints' in the latter. This lack of uniformity over the four packages is an inevitable result of the differences in the topics chosen for the packages. Chemical kinetics allows the author to easily integrate sample data with hints on data analysis; phase equilibria more easily lends itself to the two being separated.

In all the cases, extensive use is made of 'hide' and 'show' in the worked examples so that the reader can reveal more detailed parts of calculations at his/her discretion. Also no attempt has been made to include experiment error in the sample data. This is intended to be first year material and the importance of error in experimental data will be seen during the student's own laboratory studies.

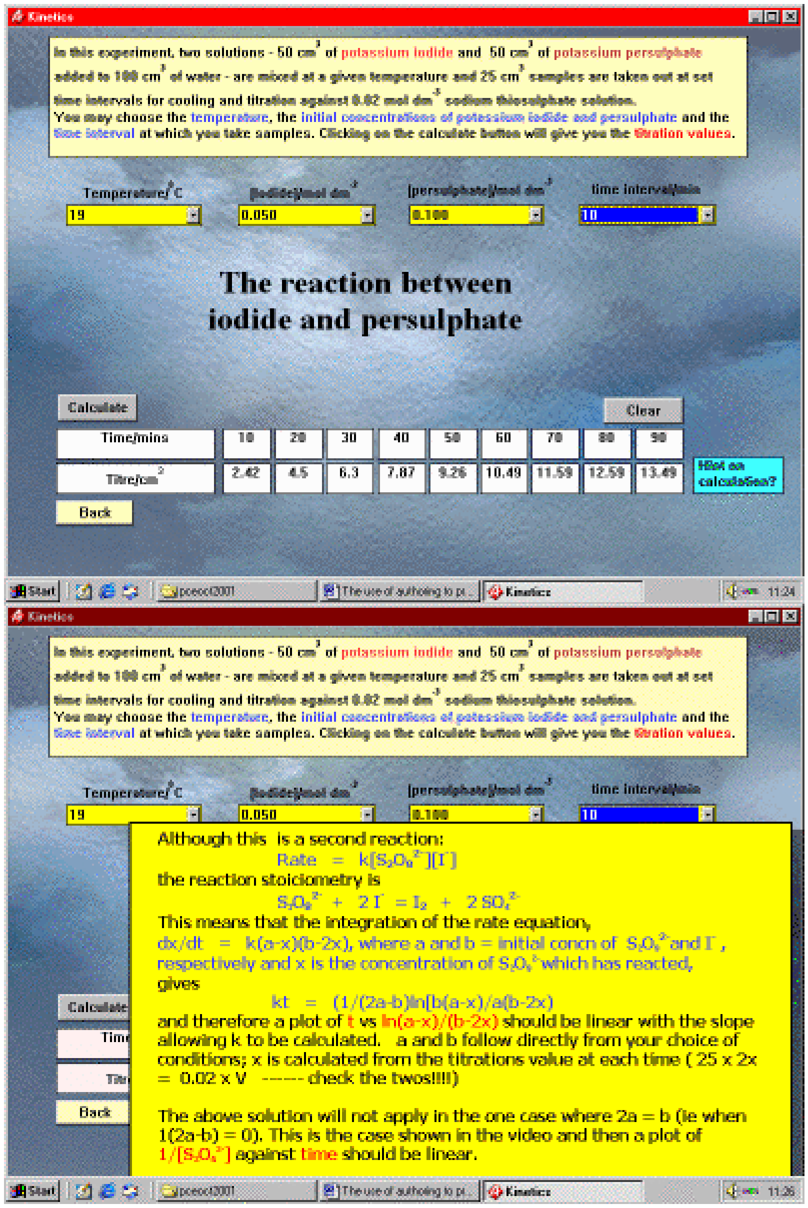


Figure 4. Kinetic sample data showing a hint on the data analysis method

The test

ToolBook Instructor allows a variety of question types to be dragged from the catalogue and there are a number of options available with these questions. The most important of these is student feedback and this is easily arranged through the question properties facility. This facility also allows the author to limit the number of attempts a student makes at a question and to limit the time a student has to read and attempt it.

It is important that authors decide at an early stage the purpose of the test. If it is to be a self test with its main role as a teaching aid, then feedback for both correct and incorrect answers is important and limiting attempts and time available is not. If the test's purpose is to provide information to the tutor, then feedback may not be important and limiting attempts and time will be.

In the physical chemistry learning packages, a middle road has been adopted. Feedback is available on both correct and incorrect answers but there is a limit of the number of attempts and there is a final score printout of the test after it has been completed.

Figure 5. A sample test question page with pop up feedback

Summary/discussion

This paper has attempted to show how effective computer based learning packages can be readily developed by using commercial authoring systems, including the one used for the work on physical chemistry experiments, described in some detail here. Potential authors will find it relatively easy to master the use of authoring systems and the associated programming languages which can be used to add interesting features such as animation and interactivity, such as the production of raw experimental data to match the readers own experimental parameters. There are some problems in developing such packages and the authors point to the importance of recognising these early in the planning stage and of seeking appropriate advice.

References

1. ToolBook II Instructor. Asymetrix Learning Systems, Inc., 110 110th Avenue N. E., Bellevue, WA 98004-5840.
2. Designed and developed by Tony Rest and Don Brattan in a joint project supported by the Chemistry Video Consortium and the Educational Techniques trust Group of the RSC. Distributed by Educational Media Film and Video Ltd, 235 Imperial Drive, Raynors Lane, Harrow, Middlesex, HA2 7HE.
3. Brattan, D., Mason, D. and Rest, A. J. (1999) Changing the Nature of Physical Chemistry Laboratory Work, *University Chemistry Education*, **3**(2).
4. HEFCE TLTP Chemistry Video Consortium. Coordinator: Dr Tony Rest, Department of Chemistry, University of Southampton, Southampton, SO17 1BJ, England.
5. http://windowsmedia.com/download/download.asp

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