ZOOM: a generic personal computer-based teaching program for public health and its application in schistosomiasis control*

G. T. Martin,¹ S. S. Yoon,² & K. E. Mott³

Schistosomiasis, a group of parasitic diseases caused by Schistosoma parasites, is associated with water resources development and affects more than 200 million people in 76 countries. Depending on the species of parasite involved, disease of the liver, spleen, gastrointestinal or urinary tract, or kidneys may result. A computer-assisted teaching package has been developed by WHO for use in the training of public health workers involved in schistosomiasis control. The package consists of the software, ZOOM, and a schistosomiasis information file, Dr Schisto, and uses hypermedia technology to link pictures and text. ZOOM runs on the IBM–PC and IBM-compatible computers, is user-friendly, requires a minimal hardware configuration, and can interact with the user in English, French, Spanish or Portuguese. The information files for ZOOM can be created or modified by the instructor using a word processor, and thus can be designed to suit the need of students. No programming knowledge is required to create the stacks.

Introduction

Schistosomiasis is a parasitic disease that is closely associated with agricultural and water resources development and currently is endemic in 76 countries, where it infects more than 200 million people (7). The disease is caused by the following major parasite species: Schistosoma mansoni, S. japonicum, S. haematobium and S. intercalatum, which are freshwater-borne and whose only hosts are humans and freshwater snails. Details of the schistosome life-cycle and epidemiology of schistosomiasis have been well documented.

Safe and effective chemotherapy with minimal side-effects is now available for schistosomiasis; the cost of mass treatment, however, is beyond the resources of many developing countries. Thus, other control interventions are needed. The aim of most control measures is to interrupt the schistosome life-cycle. These measures include the following: snail control, health education, provision of adequate water supplies and sanitary facilities, and the integration of schistosomiasis control into other primary health care activities. The success of these measures relies heavily on the dissemination of control information to the public and to health workers at all levels.

The efficient communication of such information is hampered by a number of factors. First, the amount of information on the methodology and techniques of control of schistosomiasis is vast. Second, the usefulness and relevance of the information depends on an individual's role and level of responsibility in the control programme; for instance, a chief schistosomiasis control officer at the central level will need different information from that required by a primary health care worker at the village level. Some individuals will require a broad overview of the control programme, while others will require details about specific activities. Finally, much of the information from ongoing programmes, such as prevalence data from localities under control, is constantly changing; consequently, it must be periodically updated.

In recent years, the problems of information management for disease control programmes have been reduced through the use of personal computers (PCs). Large amounts of information can be stored, organized, and quickly retrieved in this way. A PC-based global database on the epidemiology and control of schistosomiasis has been developed by WHO (2).

In 1989 we began to develop teaching software, capable of running on IBM–PC and IBM-compatible computers, to assist in the training of public health workers in schistosomiasis control. The original teaching program used a prototype software (Dan Bricklin’s Demo II)* and was evaluated in

---

* ZOOM is copyrighted by the World Health Organization.

¹ Research Assistant, Biomedical Engineering Center, Massachusetts Institute of Technology, Cambridge, MA, USA.

² Formerly, Scientist, Schistosomiasis Control Unit, Division of Control of Tropical Diseases, World Health Organization, Geneva, Switzerland.

³ Chief, Schistosomiasis Control Unit, Division of Control of Tropical Disease, World Health Organization, 1211 Geneva 27, Switzerland. Requests for reprints should be sent to this address.

Reprint No. 5226
Materials and methods

Design goals

Review of available authoring software. Software packages for the development of teaching programs are commercially available and are often termed “authoring software packages”. In the course of developing our program, several authoring software packages were evaluated. We were particularly interested in their user interface, organization of the technical information, and general approach to computer-assisted education. The following shortcomings of these programs were identified:

— They were not flexible; hence, if any change had to be made to the information in the program, the entire software had to be rewritten using a sophisticated and expensive program. This made the process of modifying and updating rather difficult.

— Available software was directed at developed or industrialized countries. As a result, it interacted with the users in one language, usually English, and required substantial investment in computer hardware, such as hard disks and high-resolution colour monitors. Little software was available in other languages.

— Most of the teaching software relied exclusively on textual information. There were few programs that allowed the users to interact with graphical information.

— Most of the software operated linearly, i.e., students were led through the material from beginning to end, without allowing for exploration of related topics or random review of the information.

— The compiled information could not be used for reference purposes, since users could not go directly to an area of interest. In addition, with most programs, there was no way of knowing what information was available.

We therefore decided to write our own authoring software package. Our design goals were specified in relation to potential users, assuming that, at best, only a few of them had computer experience. This assumption, more than any other, influenced the design; in particular, the style of the user interface and the flexibility of the software. Other limitations, such as the availability of hardware, also dictated the general framework of the development process.

Flexibility. Initially, our goal was to develop a software package that could be used to teach schistosomiasis control. Ultimately, however, the approach we took was similar to that used by database developers: the program and the data were kept separate. Just as database programs such as dBASE III+ can be used with any dBASE-compatible data, we created a software program into which any correctly formatted data could be entered. Because the data and the application are completely independent of each other, the software is general and can be used with other data sets; and also the instructor can modify material without requiring to recompile the program.

Language. Schistosomiasis is a disease that occurs in developing countries. We therefore decided that ZOOM should be able to communicate with users in the following languages: English, French, Spanish, and Portuguese. The geographical area where these languages are spoken covers the majority of people exposed to schistosomiasis. Because the teaching program can communicate in several languages, a single version of the software can be distributed globally. The command necessary to select the language is contained in the information stacks; therefore, the stacks can be written in any of the four languages, and ZOOM can be set accordingly. This and other ZOOM commands are discussed in greater detail below.

Graphics support. It is difficult to describe the shape of a parasite or the geographical distribution of a
disease using exclusively words. If, on the other hand, such information is displayed graphically it is more easily understood by the student, as well as being more interesting. We therefore included the capacity to display graphical images on the monitor.

**Hypermedia capability.** Hypermedia is a powerful technology that allows the linking of ideas, words and images, as exemplified by Hypercard, for use with Apple Macintosh computers. ZOOM incorporates a specifically created hypermedia tool for the IBM-PC and IBM-compatible computers.

Using hypermedia, the user is able to access information on several topics almost simultaneously; for example, a detailed description of the clinical manifestation of urinary schistosomiasis can be accessed while a section on *S. haematobium* is being reviewed.

**Hardware requirements.** The IBM-PC standard computer is one of the most commonly used, particularly in developing countries; the low cost of a complete IBM-compatible computer system makes it even more attractive. We therefore decided that the software should run on the IBM-PC operating system (MS-DOS). Furthermore, since the computers available in developing countries often have the minimum configuration, the software was designed to run on the most basic IBM system (8086 microprocessor, 512 Kbytes RAM, CGA or MGA screen, and two floppy disc drives). The software can also take advantage of advanced hardware features, such as a high-resolution colour monitor, mouse, high-resolution graphics adapter, extended memory, etc, and configure itself to suit the hardware available.

**Copyright.** Many teaching programs are available as public domain software, i.e., they can be freely copied and distributed. ZOOM and Dr Schisto are also public domain software, and users are encouraged to copy the software and give it to others.

**Software characteristics**

ZOOM is written in Turbo Pascal, Version 5.5. Although the program requires at least 512 Kbytes of RAM, only that portion of the program being executed resides in the memory. ZOOM can take advantage of any extended memory (EMS) capability that is available on the computer, to increase execution speed.

In the set-up mode, ZOOM displays a menu bar at the top of the screen with pull-down choices.

The main menu has five headings: File, Help, Run, Settings, and Chapters. The default language on the menu is English, but this can be changed, depending on the command contained within each information stack. The user makes a choice from the menu by using either a mouse or the cursor keys. Context-sensitive help is available at any time by using the F1 key. The help text is also available in different languages.

**Slides and subslides.** Each information stack is organized into chapters like a book (a maximum of 150 chapters per stack is available). Each chapter consists of slides and subslides that can include text, graphics, and dBASE, Lotus or Epilnfo files. The slides and subslides differ in content and in the method of access, with the slides containing more general, and the subslides more detailed information. In normal use, without accessing the “Index” or “Key words” menu choices, slides are displayed by using the Next or Previous commands. Subslides, on the other hand, are only accessible from the “Index” or “Key words” menu choice or through word search. Both slides and subslides can present text information, display a picture (if a graphics adapter is being used), ask a question and wait for the answer, and other tasks that are explained below. The pictures displayed by ZOOM are in PCX, a proprietary format that is a widely accepted standard for bit-mapped images.

**Key words.** A set of key words that is associated with each slide or subslide links slides or subslides that provide additional information about the key word. The key words are, in fact, the mechanism for hypermedia; they are accessible from the “Key words” menu choice, which lists key words unique to a given slide and are highlighted in the text of each slide. By selecting a key word, the user can access more detailed information on that topic; for example, a slide may contain information on the chemotherapy of schistosomiasis. One of the key words for this slide could be “Chemical structure”, which when selected, would present detailed information on the chemical structure of the drugs concerned. Each slide or subslide can have up to 20 key words.

**Hot areas.** These are areas on the screen that are associated with a key word which the user can use to access an associated key word. The coordinate system that defines the IBM-PC screen and IBM-compatible computers (25 rows × 80 columns) is used. A hot area can be defined by providing the coordinates of two diametrically opposite corners of a rectangle on the screen and associating it with a key word. Although a hot area must have a key

---

*From: Borland International, Scotts Valley, CA, USA.*
word associated with it, the converse does not have to apply. The resulting hot areas can be accessed using a mouse or the cursor keys. The hot areas are superimposed over whatever information is on the screen, and therefore, can contain either images or text.

**Index.** The Index file, which is a part of the Dr Schisto stack, contains all the key words and slides and subslides linked to those words; it is accessed through the “Index” menu choice, and can have an unlimited number of entries. In function, the Index is similar to key words, and provides users with the means of accessing specific information. The Index can, however, access information from the entire stack, whereas the key words can only do so for the current slide. Therefore, the Index can be considered to be a master key word list, and makes ZOOM a reference tool as well as a teaching device.

**User-defined search.** A powerful feature of ZOOM is its ability to search through the stack for a user-defined text. The search function is accessible from the “Inquire” menu. In this way, the user can specify a word or a phrase, using Boolean logic, and ZOOM will search through the stack for matching words. For example, if information is desired on praziquantel, a drug used to treat schistosomiasis, and its side-effects, the Search choice is selected from the “Inquire” menu and PRAZIQUANTEL AND SIDE-EFFECTS is entered as the search phrase. ZOOM will then search through the stack for these words, and the slides or subslides that contain them will be marked for display. The result of the search can be permanently added to the Index or discarded after one viewing.

**Types of slides.** The slides used by ZOOM can be one of the following types: text; image; question; dBase/Lotus; pointer; or executable.

Each type of slide serves a specific purpose and was designed to make ZOOM easier to use. A slide's characteristics are defined on the slide header, which includes a command word, either @Slide or @SubSlide, a unique slide label, the slide type, key words for the slide, and coordinates for hot areas if applicable. Below is an example of a slide header:

@Slide[Introl-Text-Parasitic Disease-Liver-Spleen, 10,10,20,20-]

The command starts with an initiator (@), which indicates that the word following it is a command. @Slide therefore means that this line contains the header information for a slide. The information contained within brackets ([ ] ) is used by ZOOM to process the slide. The first word, Introl, is a unique label that identifies this slide, and can be up to 12 characters long, consisting of a mixture of letters, numbers, and spaces. The second word, Text, indicates that this is a text slide. The third and fourth words, Parasitic Disease, as well as the fifth and sixth words, are the key words. These can be accessed by the user from the “Key words” menu. Therefore, this slide has three key words associated with it: Parasitic Disease, Liver and Spleen. The four numbers after Spleen define a hot area, displayed on the screen as a rectangle whose upper-left corner has the coordinates 10,10 and the lower-right corner, 20,20 (based on a standard IBM-PC text mode resolution of 25 rows × 80 columns.)

**Text slides.** Text slides provide the basic means of displaying information and are usually viewed as a single screen, limiting their size to about 20 rows × 75 columns. However, the slides can, in principle, have a virtually unlimited number of rows and columns, since ZOOM scrolls the information on the screen. The information can be displayed on the screen using different colours, and the text information can be overlaid on top of PCX images.

**Image slides.** ZOOM can display image files in PCX or PCC format. The images can be scrolled on the screen and, therefore, can be of any size. Colour images can be displayed if a suitable monitor is used.

**Question slides.** Question slides allow users to test their retention of material. The answer, which follows immediately after the question statement, can be any combination of letters, numbers, and spaces; however, the student has to duplicate the answer exactly as it appears in the slide header in order to be marked correct. After three wrong attempts, ZOOM will provide the correct answer. Question slides can contain images or text information.

**dBASE and Lotus slides.** ZOOM can display files created by dBASE III+ and compatible database programs, as well as Lotus 123 and compatible spreadsheet programs. The files are displayed as tables.

**Pointer slide.** The pointer slide points to another slide (any type) and is useful for displaying repetitious information.

**Executable slide.** The executable slide, when displayed, runs an external command. This can be another program, DOS command, or batch file. Because ZOOM can swap itself out of memory when executing an external program, a large application program can be launched from within ZOOM. For
example, a slide can launch a program such as EpiInfo, so that the user can perform analysis on real data.

The format of the stack. The ZOOM stack is an ASCII file. Any text editor, such as WordStar or WordPerfect, can be used to create a ZOOM stack, each of which is divided into chapters (up to 150 per stack) made up of a number of slides and subsides.

Although the ZOOM commands are simple, they provide a powerful structure for organizing and presenting information. Table 1 lists all the commands available in ZOOM.

Schistosomiasis Information Stack

Like the software, the material contained in the information stack was specified in relation to the user. Since the potential users include those with little or no medical background, as well as medical officers in charge of schistosomiasis control activities, the teaching material had to cover a wide range of information. The basic requirements were as follows:

- the information should be in the form of text and pictures;
- the information should be organized and presented in such a way that the newcomer is not overwhelmed and the expert is not bored;
- the user should be presented with a general knowledge base but be allowed the freedom to investigate a particular topic in depth;
- the program should have a set of questions to test the user's retention of the information and keep track of the user's performance so that suggestions can be made about material to review; and
- the information should serve as reference as well as teaching material.

Dr Schisto. Dr Schisto is the schistosomiasis information stack that has been developed to work with ZOOM. Much of the information contained in the stack has been taken from a series of documents on schistosomiasis produced by WHO (Fig. 1).

The information is organized into eight chapters, each of which is summarized below.

1. Introduction. This presents a brief outline of the schistosomiasis stack, the objectives of the teaching program, and those of the WHO Schistosomiasis Control Programme. The current global epidemiological situation is then summarized with a series of maps that indicate the location of the different schistosome species. The life-cycle of the schistosome is also briefly described using pictures of the stages of its development.

2. Epidemiology. This describes basic epidemiologi-

Table 1: List of ZOOM commands

<table>
<thead>
<tr>
<th>Command line options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-f &lt;file&gt;</td>
<td>The stack &lt;file&gt; is automatically loaded</td>
</tr>
<tr>
<td>-r</td>
<td>ZOOM skips the main menu and jumps to the stack</td>
</tr>
<tr>
<td>-ch #</td>
<td>ZOOM skips the main menu and jumps to chapter number #</td>
</tr>
<tr>
<td>-t &lt;language&gt;</td>
<td>Used for interaction; overrides the command in the stack</td>
</tr>
<tr>
<td>-bw</td>
<td>For use with black and white monitors or laptop computers</td>
</tr>
<tr>
<td>Stack commands</td>
<td></td>
</tr>
<tr>
<td>@Summary</td>
<td>The stack description as displayed when the Load stack command is issued</td>
</tr>
<tr>
<td>@Language</td>
<td>Language used for interaction: English, French, Spanish or Portuguese</td>
</tr>
<tr>
<td>@Chapter</td>
<td>Marks the beginning of a new chapter in the stack</td>
</tr>
<tr>
<td>@Slide</td>
<td>Marks the placement of slide</td>
</tr>
<tr>
<td>@SubSlide</td>
<td>Marks the placement of subslide</td>
</tr>
<tr>
<td>Slide types</td>
<td></td>
</tr>
<tr>
<td>Text</td>
<td>Slide made up of characters, numbers, lines, etc.</td>
</tr>
<tr>
<td>PCX</td>
<td>Graphic image slide for bit-mapped images</td>
</tr>
<tr>
<td>Quiz</td>
<td>Quiz slide for asking questions</td>
</tr>
<tr>
<td>DBF</td>
<td>Reads dBASE III+ compatible file and displays the content</td>
</tr>
<tr>
<td>WKS</td>
<td>Reads Lotus 123 compatible file and displays the content</td>
</tr>
<tr>
<td>Exec</td>
<td>Executes a DOS command</td>
</tr>
<tr>
<td>Pointer</td>
<td>Displays the content of another slide</td>
</tr>
<tr>
<td>Other stack command</td>
<td></td>
</tr>
<tr>
<td>@Window</td>
<td>Displays text inside window over a slide</td>
</tr>
<tr>
<td>Text slide commands</td>
<td></td>
</tr>
<tr>
<td>Colour</td>
<td>Displays the text in chosen colour, i.e., @Yellow</td>
</tr>
<tr>
<td>@Delay</td>
<td>Puts a pause in the text</td>
</tr>
</tbody>
</table>
cal concepts and terminology. Most of the information in this chapter is applicable to public health in general. Terms such as prevalence rate, age-specific rate, and sex-specific rate are explained. The concept of intensity of infection in schistosomiasis control is also introduced.

(3) **Parasitology.** This deals with the various species of schistosome and their life-cycles. A complete discussion of the schistosome life-cycle is presented together with detailed pictures of the snail intermediate host and the eggs of different schistosome species (see Fig. 2).

**Fig. 2.** Life-cycle slide, showing key words and hot areas.
Fig. 3. Global database slide and index.

(4) **Diagnostics.** Discussed are the various diagnostic techniques in schistosomiasis control together with their advantages and limitations. The following information on schistosomiasis diagnosis is covered: proper data recording, operational efficiency, training, supervision, necessary materials, suppliers for materials, and references.

(5) **Treatment.** Addressed are the various drugs used for chemotherapy and their effect on reducing schistosomal infection. The possible treatment side-effects, contraindications, and various delivery systems are also dealt with. For the interested student, the chapter also contains information on treatment schedules, treatment cost estimates, and other practical considerations.

(6) **Data analysis.** This discusses basic concepts on how data are collected, analysed, and presented. The need for statistics and a central statistical service in schistosomiasis control is stressed. Forms for data recording and analysis are provided.

(7) **Primary health care (PHC).** The meaning of PHC is discussed and how it is used for the control of schistosomiasis. The chapter includes tasks for the PHC worker in schistosomiasis control and for the diagnosis and treatment of the disease. Other PHC concerns, such as snail control, health education and surveillance are also covered.

(8) **Global database.** This chapter contains profiles for all the countries that are endemic for schistosomiasis. A map of the country, along with the population, GNP, literacy rate, number of people at risk, and the average prevalence of schistosomiasis are presented. The country data can be accessed by selecting a country from a world map or from the index (see Fig. 3).

**Conclusions**

As personal computers become more powerful and less expensive, they are beginning to take on a greater role in public health activities. Beyond their traditional role of managing databases and finances, computers are being recognized as a useful tool for teaching and for the dissemination of data. However, most computer-assisted teaching programs have been of limited use, because they were designed for specific purposes only. In contrast, ZOOM has the potential to expand the use of computer-assisted teaching programs since it can be used with any properly formatted data.

In collaboration with national institutions involved in research and control of tropical diseases, WHO will be evaluating the ZOOM format as the standard for global information exchange and teach-
ing purposes. After the limitations and advantages of the program have been assessed, the efficacy of computer-assisted instruction using ZOOM will be compared with that obtained using more traditional teaching methods.

Further information is available from Steven Yoon, 1800 East Fairmount Avenue, Baltimore, MD 21231, USA.

Acknowledgement
We thank the Edna McConnell Clark Foundation for financial support of this project.

Résumé
ZOOM: programme générique d’enseignement de santé publique sur ordinateur appliqué à la lutte contre la schistosomiase

On désigne par schistosomiase un groupe de maladies parasitaires dues à des vers du genre *Schistosoma*. Ces maladies sont associées au développement des ressources hydrologiques et touchent plus de 200 millions de personnes dans 76 pays. Selon l’espèce de parasite en cause, la maladie peut affecter le foie, la rate, le tractus gastro-intestinal, l’appareil urinaire ou les reins.

L’OMS a mis au point un progiciel d’enseignement assisté par ordinateur à l’intention des agents de santé participant à la lutte contre la schistosomiase. Ce progiciel, qui comprend un logiciel appelé ZOOM et un fichier d’informations sur la schistosomiase auquel on a donné le nom de Dr Schisto, fait appel à la technologie hypermédia pour associer les figures au texte. ZOOM est un programme autonome et convivial. Chaque instructeur peut créer des fichiers d’informations ou les modifier à l’aide d’un traitement de texte en fonction des besoins de ses élèves. Aucune connaissance de la programmation n’est nécessaire pour créer ces fichiers. ZOOM tourne sur les ordinateurs IBM-PC et compatibles, ne nécessite qu’une configuration matérielle minimale et peut dialoguer avec l’utilisateur en anglais, en français, en espagnol ou en portugais.

Les informations concernant la lutte contre la schistosomiase et les commandes nécessaires au fonctionnement du programme sont contenues dans le fichier Dr Schisto. Les informations sont présentées en huit chapitres dont chacun comporte à la fois du texte et des données graphiques, et compris des illustrations des parasites et des manifestations cliniques de la schistosomiase, ainsi que des cartes des régions d’endémie.

L’OMS, en collaboration avec les institutions nationales qui s’intéressent à la recherche et à la lutte contre les maladies tropicales, va étudier la possibilité de faire de ZOOM un instrument normalisé d’échange d’informations et d’enseignement à l’échelle mondiale. Les limites et les avantages de ce progiciel seront évalués et son efficacité sera comparée à celle des méthodes d’enseignement plus traditionnelles.

References