MicroPat — An Example for Integrating an Atlas of Digital Images into a Computer Based Training System

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1 Introduction

“The increase of information in the special field of medicine is as large as never before.“, “The half-life of the medical knowledge is only three years.“, “The lecture halls are packed.“, “The study of medicine is too theoretical.“ or “A medical atlas is too expensive and obsolete with the editing day.“ are statements which can be heard more and more. In view of this situation new didactical concepts for teaching at the university [4] like CBT (computer based training) systems are needed.

This reflection contributed to the development of MicroPat, a medical tutorial system, aimed to help the medical students of the University of Freiburg to learn the general histopathology. It is meant to offer an assistance in the course of histopathology, which is an obligatory supplement to the general lectures in pathology.

2 Realisation

On our basis of more than 20 years of experience in CBT systems [9] the project “MicroPat“ was born in the beginning of the year 1994. First of all existing applications of teaching programmes from various special fields of medicine were evaluated for faults in didactics or structure to avoid mistakes and to integrate positive elements [5][18].

As development kit Asymetrix ToolBook 3.0a [1] was chosen. This authoring tool can be used easily and is fully programmable [2][16][17]. It is, however, confined to a MS DOS / MS Windows system. As MicroPat is compatible with the computer equipment – there are much more MS Windows computers than other devices with different operating systems – and the computer availability to the students or of the University of Freiburg, this restriction can be put up with.

At the same time 900 slides from the archieves of the Institute of Pathology, which are the essential base of the programme, were converted into the Kodak Photo-CD format and edited manually in contrast, size, orientation etc..

After adding text excerpted from an extensive search in literature to the pictures the first release of the atlas was finished one year later.

During the following time we have been working on the further development of the user interface and the image processing, the didactical concept, the textual extension in the form of morphological descriptions of the slide preparations and technical improvement.

At the same time a data model has been designed, that allows to handle text and picture documents independent of the given authoring system and that can also generate applications automatically in different forms (e. g. HTML) for various system environments [17].

In the winter semester 1996/97 MicroPat will be available after two years of development. Altogether over 900 pictures and over 1200 medical texts have been included so far. The programme will be installed at working places for students in the Institute of Pathology and also be accessable over the clinical network of the University of Freiburg.

Translations of MicroPat from German to English and Portuguese are intended with contacts to foreign partners.

3 Design of the programme

3.1 Pictures

The pictures were arranged in such a way, that you can navigate in a linear fashion or by a zoom function among the enlargement and other different views. Additionally you can use an overview of the pictures, that shows all slide preparations or can help to compare two views.

3.2 Texts

The texts are divided in general sections like the definition of the disease, the pathogenesis and clinical aspects, which can be looked at independently of the picture shown currently. The morphological descriptions are available for each picture. Notes and explanations are included in hyperlink form. If the explanations are not sufficient, the user is able to add his own notes to the existing material.

3.3 CBT design

The texts and pictures are arranged by topic. Access using a keyword is also guaranteed by the index-function. The atlas of histopathology is divided in three levels (table of contents, index of organs, book of slide preparations). The idea of the atlas was, that texts and pictures are placed opposite to each other (an example is present in Fig. 1); so you can relate all elements. Restrictions to only necessary hyperlinks, the fixed arrangement of texts and pictures, the numbering of the pages and the limitation to three levels of the atlas serve to get a maximum of clearness. The user interface orientates itself to common GUI (graphical user interface) standards.

MicroPat is installed by an own application without changing any MS Windows system files. Furthermore, a setup programme helps to configurate the software.

The requirements of MicroPat are a MS Windows compatible computer (80486 with 8 MB) and a graphic card, that can display at least 256 colors in VGA mode. The demo version can be ordered from the authors.

3.4 Integrated Tutorial System

The programme was developed so, that the user can add his own material. He has the possibility to create own teaching pathways easily. Thus the students can jump directly into the special topics. Additionally they are allowed to create a training programme with multiple choice questions (an example is present in Fig. 2). So the computer is also working as an “electronic tutor“ [12]. Furthermore it is possible to prepare oneself for tests and examinations.

The teaching pathways can be constructed easily. You can choose among four masks: text with picture, text without picture, multiple choice question with picture and multiple choice question without picture. Dependent of the kind of the mask, the user imports pictures and texts from the atlas. The slide sequences can be enhanced with legends and own material. The compatibility to another MS Windows applications is guaranteed by the clipboard and the RTF format.

An additional modification or enhancement of the slides or the texts of the atlas can still be done by the developers.

4 Discussion

CBT requires an orientation towards several determinants with aspects of didactics, technique and content. These aspects cannot always be coordinated easily; many obstacles are well known since the first CBT systems were constructed [9]. Most technical problems are solved by now e. g. by the the widespread use of multimedia computers; other problems remain, e. g.: CBT needs standardized software platforms for authoring tools [15]. But the the rapid process of improvements in operating systems and new software tools or the disappearing of smaller, sometimes very good programmes agents from the market do not faciliate the standardization. With regard to all these aspects MicroPat can be regarded not only as one of many other new CBT systems but also as an attempt to find a compromise with emphasis on qualitiy, relevance and standardization.

Histological pathology is very well suited to CBT, mainly because of the large number of high quality color images, necessary teaching and the need to illustrate the process of medical interpretation of microscopic views. These pictures are difficult to be handled in a conventional manner. Access is needed not only by a single index, but by many multiple variables (disease, organ, tissue etc.). This is ideally handled by CBT. Computerizing microscopic images supports this multivariate access easily and in addition faciliates enormously the update of image collections or texts in contrast to book atlases. The CD-ROM for image storage, the large and high resolution color screen, the graphic cards and software tools offer excellent image quality and low costs [17].

The formerly used slides and audiotapes presented only a small selection of pictures and verbal explanations in old fashioned projector-tape devices only accessable at one place a few hours per week. An update of such a system is nearly impossible and has not taken place for many years. This old slide and audio show offered only one single sequence of learning [5]. Of course, the students should not be confused by too many ways through the content (many CBT and hypertext systems result in lost in hyperlinks [8]); they need the teacher’s scientific and motivating guidance [6][12]. But some links out of the main sequence and back again are necessary e. g. to give some additional explanations. MicroPat offers a modern supplement to the course and the lecture and it will replace the obsolete slide and audio show.

So MicroPat gives an overview not only of the course in microscopic pathology but also of the whole lecture in this discipline. In our opinion it is essential for a broad acceptance of a CBT system to integrate it into the normal teaching and training process of lectures and courses. This requires the local professor to deliver the local content for the CBT [7]. We are happy, that we succeeded in winning H.-E. Schaefer, head of the Pathologic Institute and Professor at the University Hospital Freiburg as author for the medical content and the basic structure of MicroPat. He is also a well acknowledged writer of teaching books in pathology and therefore we can expect a further distribution of MicroPat to other medical schools. Schaefer’s approach of content acquisition resulted in an efficient combination of scientific systematics and relevance for examination. Over many months, three medical students were directly involved in the preparation and first evaluation of the content

[14]. So we are convinced that the complete evaluation of MicroPat next year by a random sample of normal medical students will result in good acceptance, efficient, motivated learning and high examination scores in the clinical part of medical studies. Additionally already eight students used MicroPat for their preparation of the pathologic examination and they confirmed in a first preliminary statement, that MicroPat is easy to install, to handle and offers a very useful support for examinations, especially by the large amount of easily accessable pictures with exact and efficient explanations. Besides, all relevance for examination, which is of highest importance to German medical students, the scientifically correct and comprehensive content has to be rated higher. There are many more differentiated and larger text books in pathology and we have some even larger image libraries, but we did not find a unified library with more expert-explained histopathological images than our MicroPat.

The MicroPat programme was designed with regard on approved standards and guidelines: simplicity in menue structure, in control and navigation elements [3]. A notebook-function was added, the keyboard data entry reduced, mouse input and tooltips were implemented, and the search dialog was designed compatible to MS Windows standards. In order to vary the magnification of images a special zoom-function was added, which does not vary the pixel numbers but call the appropriate images out of the picture data base with about 900 microscopical images in graphically highest quality. Overall the graphical user interface is easy to handle even without computer literacy. It offers all necessary (not all possible) functions and delivers high quality pictures quickly.

A digital atlas of microsopic pictures for teaching purposes should be updated regularly but the update frequency is not high. More important with regard to adaptability is a flexible tutorial system for the teachers in order to change views on content, didactics, examination and study groups. Four different types of layout of the screen can freely be combined for this purposes: 1. text with picture, 2. text without picture, 3. multiple choice question with picture and 4. multiple choice question without picture. Simple functionbars, similar to text processing tools help to develop teaching sequences. In contrast to hypertext [11] the main line of teaching is the above mentioned sequence with very few links to freely navigate in the atlas [3]. Not only the student but also the teacher won’t loose the overview. Hyperlinks are often not well accepted by students, especially, if they are less experienced in computer applications. The teacher also needs effective and simple data structures for modelling the teaching sequence. That is why we added a graphical presentation for teaching strategies to recognize linkage errors and to improve syntactical data integrity (an example is present in Fig. 3).

The data processing in MicroPat is designed future-oriented, that it can be the base for other pictures atlases, e. g. in the microscopical anatomy. Perhaps this method is a way to combine more disciplines in the medicine in a problembased course [8], which is at the moment more and more favoured. An addition of up to 2000 slides is planned for the next release. In the future a comprehensive and detailed evaluation among the students taking the lecture and the course will show, if the programme is well-adapted to the demands of the students and the scientific purpose.

5 Summary

Like in other special fields CBT is entering the medical education in Germany slowly. The use of CBT is still based on many premises, e. g. motivation, didactical quality, cost-benefit analysis [13], coexistence and cooperation with traditional media, professional competence of the teachers or technical standards. MicroPat is a powerful programme consisting of high quality microscopical pictures with explaining texts, a zoom-, note-, picture-selection- and index-function. It is intuitively and easily used. As a further development MicroPat contains a module, that allows to create own teaching pathways with the atlas as a base and also to integrate randomized multiple choice questions. The

tutorial system represents an attempt to combine problematic fields like education compared with learning and classical compared with modern media. Even if first tests are very promising, the real advantage of this project will be evaluated in detail in the future.

6 References

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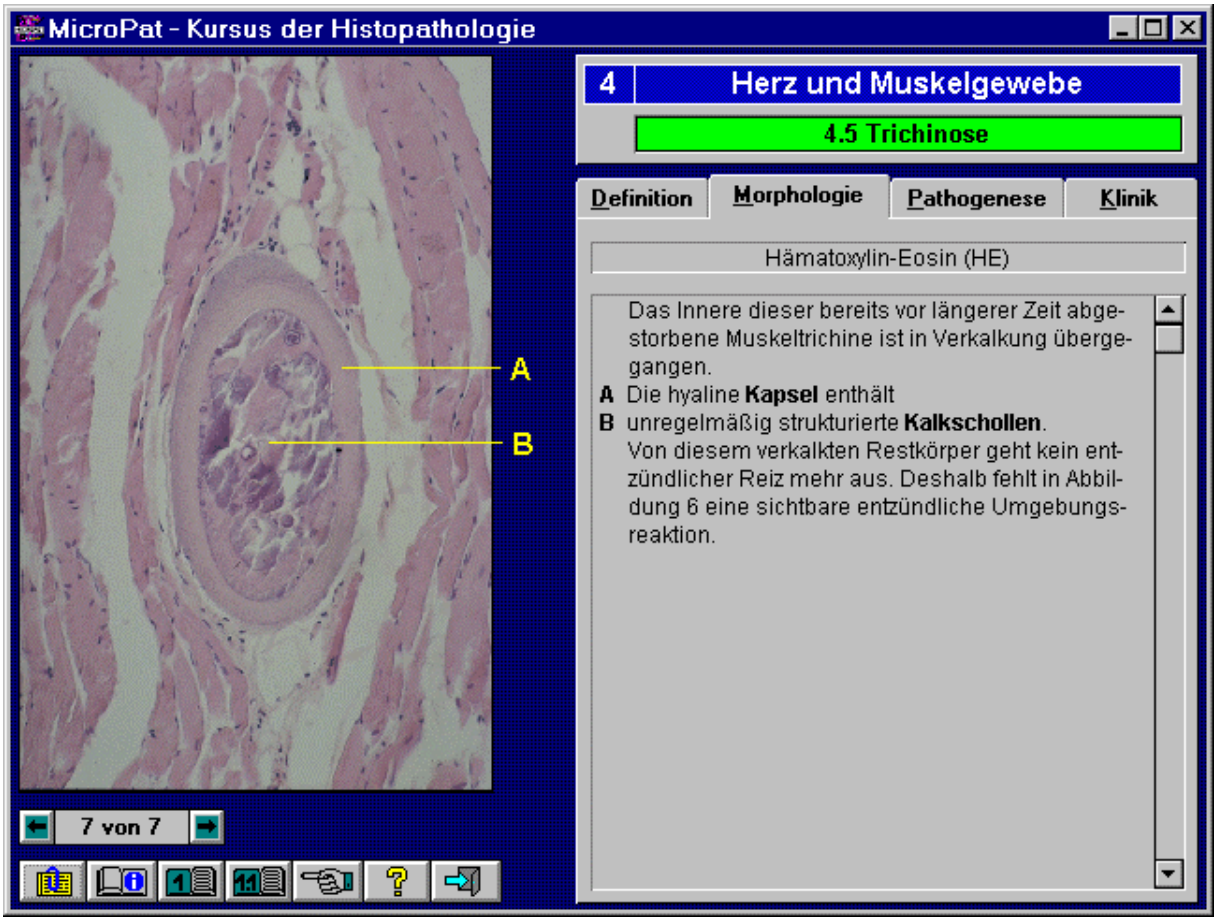

Fig. 1: Page from the histopathological atlas

Translation:

The center of the dead Trichina calcified some time ago.
A The **hyaline capsule** contains
B irregularly structured **calcified sediments**.
The residual calcification is not a stimulus any more. Therefore there is no inflammatory reaction visible around.

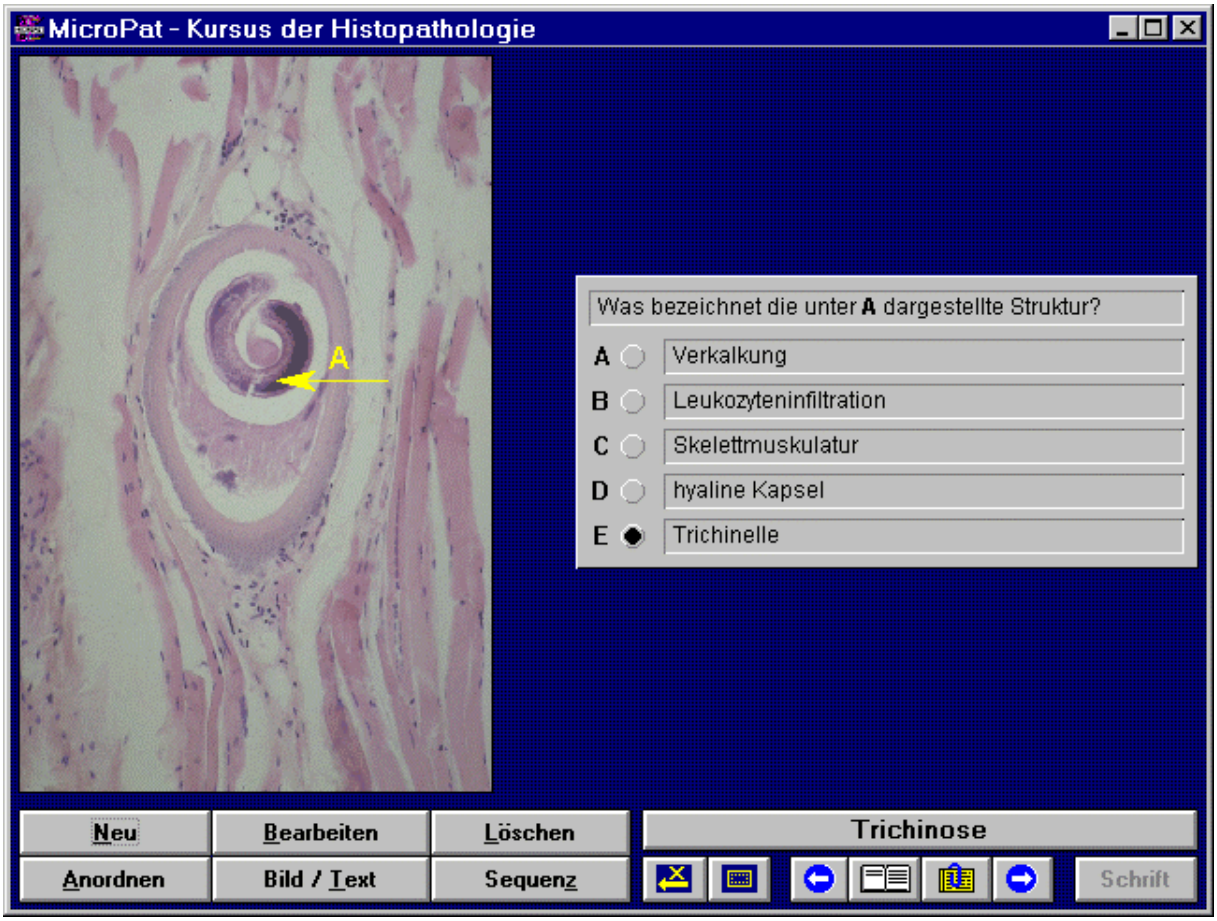

Fig. 2: Example of a teaching pathway, here in editor mode. In learner mode this page is similar; then, the most buttons are not visible.

Translation:	
	*What structure is named with **A**?*
Wrong answers:	*A: Calcification* *B: Infiltration with leucocytes* *C: Skeletal muscle* *D: Hyaline capsule*
Right answer:	*E: Trichina*

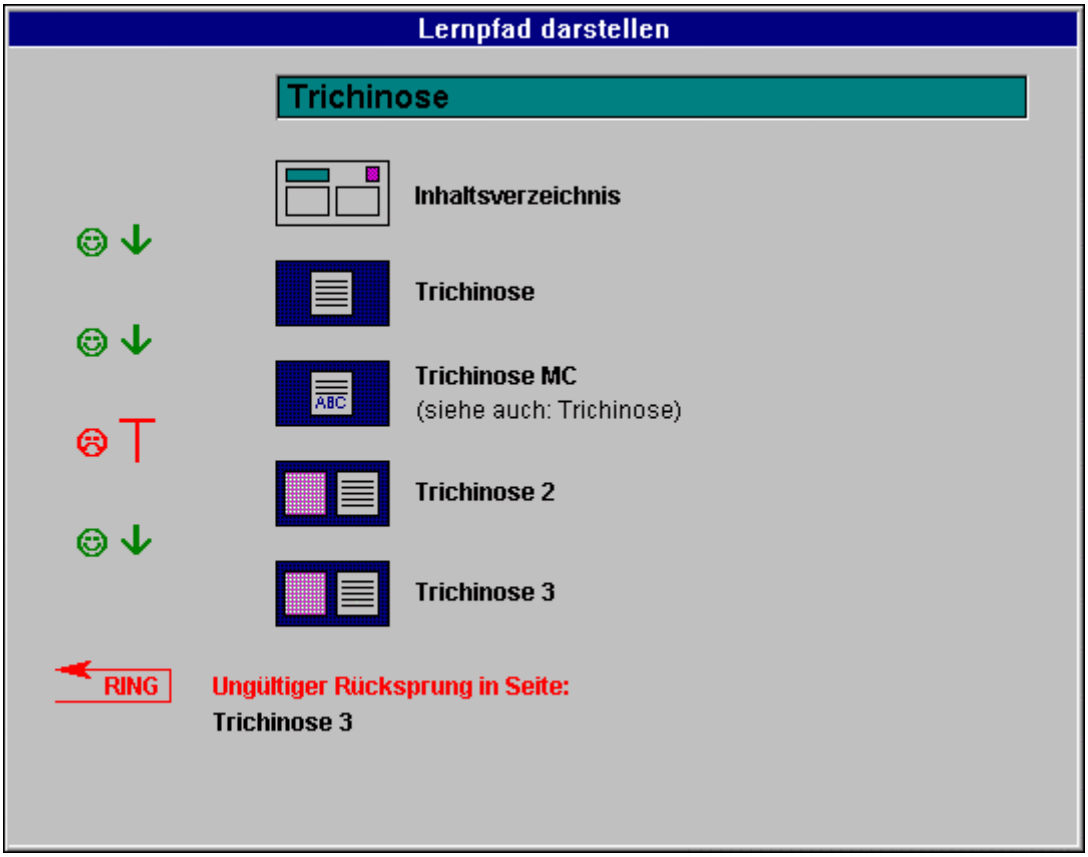

Fig. 3: Example of a graphical overview of a teaching pathway, which is interrupted at page “Trichinose 3“ because of an invalid operation. Additionally, you can find a wrong hyperlink back from page “Trichinose 2“ to page “Trichinose MC“. The string “siehe auch: Trichinose“ means the topic, which will be called, if the student wants more information about this multiple choice question.