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für Medizinische Informatik

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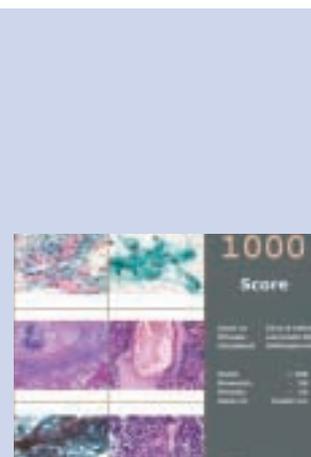
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E-learning

Ulrich Woermann

This issue of “Swiss Medical Informatics” is dedicated to e-learning. In the last few years, e-learning has been a buzzword. As often with buzzwords: they lack a clear definition. As a consequence many misunderstandings occur. Personally, I prefer a broad definition for e-learning that encompasses every form of learning that is supported by electronic media. A more restrictive definition does not help to refine the term since electronic media allow supporting learning in many different ways. There are still a lot of new applications to come. It is probably better to distinguish the different facets of e-learning, which can be described with e-content, e-training, e-collaboration, e-communication, e-assessment and e-administration. In medicine, we predominantly find content and training centred e-learning. The articles in this issue of “Swiss Medical Informatics” confirm this. Only one article out of seven deals with e-administration. It is no surprise that in half of the articles images play a major role. Medicine is an image rich science and the multimedia capabilities of modern computers ask for images or other media. Nevertheless, approaches in presenting the images and in integrating them into the curriculum vary widely. While in the articles of Basel, Berne and Geneva the collection and presentation of (predominantly microscopic) images are of central importance, in the article by Bonvin from the University of Lausanne the emphasis is put on the setting in which the students interact with these images. It is a wonderful example of how the integration of IT into a reorganized microscopy course can lead to an enhanced learning experience for medical students. The importance of “blending” e-learning with so-called traditional methods is once more demonstrated.

At the University of Basel, Glatz has together with her husband developed the image database PathoPic. This image database is the backbone to a variety of presentation formats. It contains more than 8'000 images mostly from microscopic pathology. Their pathology course is used not only in Basel, but also by other universities in Germany and Switzerland. Because of its open architecture, the system is also used by non-medical institutions such as schools.

The virtual microscope, as described by Wohlwend from the University of Geneva and also by Glatz, is a fascinating innovation which totally replaces a traditional technology. This technology is of great value for tele-diagnostic purposes. But it remains to be verified whether dynamically generated images from virtual microscopes foster better learning and understanding of histology among medical students. Research in learning anatomy with dynamic 3D-models on computer monitors has led to unexpected results. Several studies [1] showed that especially students with poor spatial ability learn less well with these dynamic models than with static 2D-images, while good students learn equally well with both methods. Additionally, after a short period key views suffice for good students.

At the University of Berne, Woermann concentrates on microscopic and other sorts of images as well as on media in general, eg heart sounds. The goal of his project is to enrich the curriculum with a growing collection of medical media, which are all presented in a uniform user interface and offer a variety of interactions. It is the goal of the project that in the end users can rearrange all media according to their needs and interests. A system like this asks for consistent metadata.

Zand from the University Hospital of Geneva describes a learning content management system. It is based on the Open Source software BolinOS. The system is used by a great number of people and institutions in the hospital. They all contribute to a growing amount of learning resources. Since BolinOS is Open Source, one can add new features in the form of plug-ins. The list of plug-ins and consequently the list of features have become quite long since the start in 2001. Zand et al. does not hide that not everyone welcomes their system despite its great and wonderful features.

In medicine, patient simulations belong to the much-appraised forms of e-learning [2, 3]. Their great advantage is that learners may make mistakes without harming anybody. Computer patient simulations can vary from simple question and answer cases to highly interactive and

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dynamic clinical scenarios. Loroach presents in his article the Virtual Internet Patient Simulator VIPS, a private initiative by M-A Raetz and himself. This patient simulation is unique with respect to its solution of how to ask questions without presenting the user already formulated questions. Loroach also stresses the importance of integrating e-learning in a setting to be successful. “Blended Learning”, the combination of traditional learning and teaching methods with e-learning, is not just a buzzword.

The article of Schnellmann from the University of Zürich focuses more on the administrative side of e-learning. The Swiss Education and Research Network SWITCH runs the federated identity management system, the so-called AAI (Authentication Authorisation Infrastructure).

This system allows registered users to access all programs with one single logon. It thus restricts access to e-learning resources to legitimated persons only. In Zürich, they succeeded to integrate the university hospital staff involved in teaching into this system.

As these articles show, e-learning has many sides and can have many forms. As the prerequisites for successful e-learning such as blending with traditional methods are increasingly applied, e-learning is more and more recognised as a valuable and important enrichment of the educational curriculum. Nevertheless, we still need to research the best ways of using and profiting from IT in the learning process [4] as well as to define the additional value of e-learning.

References

- 1 Garg AX, Norman G, Sperotable L. How medical students learn spatial anatomy. *Lancet* 2001;357:363-4.
- 2 Ziv A, Ben-David S, Ziv M. Simulation based medical education: an opportunity to learn from errors. *Med Teach* 2005;27:193-9.
- 3 Bearman M. Is virtual the same as real? Medical students' experiences of a virtual patient. *Acad Med* 2003;78:538-45.
- 4 Cook DA. The research we still are not doing: an agenda for the study of computer-based learning. *Acad Med* 2005;80:541-8.

Micropolis – blending old and new for a rich experience in histology and pathology

Raphael Bonvin,
Maryse Fiche,
Jean-Pierre Hornung

Summary

The renewal of the microscope equipment of the medical school of Lausanne was the starting point for a re-evaluation of this teaching approach and its general objectives. This led to the complete reorganization of the didactic approach and its architecture in order to combine the traditional microscopic approach with the use of computers to support collaborative work of small group of students.

How it started: 1 room, 140 microscopes

What can you do with 140 microscopes with over fifty years of due and diligent services other than renew them? Nothing else, but should those old microscopes be simply replaced by similar shiny new ones, or should we switch to a more modern computer-based approach and develop or buy a nice histology program? This very question was the starting point for reshaping our histology and pathology lab and their teaching approach at our medical school in Lausanne. The answer we gave was neither of both! Our medical school implemented, back in 1995, a mixed curriculum trying to combine traditional lectures and lab teaching with problem based learning (PBL). On the one hand there is this strong tendency -when sitting in front of a microscope or a computer- to a one-to-one interaction giving almost an autistic appearance. On the other hand there is this dynamism of the small group approach of PBL. It was enticing to go for the later but we decided to brew some-

thing on our own. Many persons from different departments were involved in the re-evaluation of our labs. The project matured over many months and emerged as a successful reorganization of our teaching.

The didactic concept: collaborative interactions

Fundamentally, the histology and pathology lab had one main function: learn to recognise normal or pathological histology structures. One decision we made was to modernise the goals of our labs by giving it a more integrative function. But how can the microscopic lab help the general learning process and what learning do we want to foster? The predominance of structure recognition was not so necessary anymore and emphasis was given on the understanding of function and the relevance and usage of those images for future medical practice. Put in other words: prepare the students to interact as a future clinician with the pathologist, and not be a mini-junior pathologist.

This change of goals forced us to rethink the didactic approach, the traditional one-to-one approach being not that adequate anymore. The three-tier approach of PBL was too complex and cumbersome for what we had in mind. We wanted the lab-session to be a complete teaching unit by itself. This would ask for some kind of feedback during or at the end of every session. The new concept that slowly emerged was to have small groups of students trying to solve collaboratively some kind of problems based on histological or pathological slides. But we wanted to keep the real slides and microscope and not switch entirely to a library of digitised microscopic images. The advantages in favour of a library of images were well known: no lost slides, no paling colours over the years, no microscope to keep up and running, and the possibility to label the microscopical structures interactively on-screen. The disadvantages were to continue to favour an individualistic approach focused on basic structure recognition. To some extent this would "virtualise" something already very virtual. The fact to hold the slide in your hands, being able to look at it directly before putting it

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under the lens gives, as we assumed, a better link to reality and a more intuitive notion of proportion and size. Moreover we did not need the interactive label part. Structure recognition should be done by the group and discussed among them when needed. Hence the microscope was still an important player in the game, but we needed another species than we were used to.

The architectural changes: 1 table, 1 microscope, 1 computer, 6 seats

To initiate the didactic concept the lab architecture needed to be revamped. Incidentally we had to move the lab from one place to another and this eased the architectural changes tremendously. We named this new facility "*Micro-polis*". The 140 working places of the old lab with as many microscopes, required 18 tables with 6–8 working places each.



We needed a microscope capable of sharing its images with all students around a table. We chose a two-headed binocular microscope equipped with a digitised camera linked to a computer (2.6 GHz, 500 MB RAM, Windows XP, DVD-CD-burner, Gigabit ethernet) and a 19" LCD-screen. Computers have free access to internet and are equipped with the software *NetOpSchool* that allowed the "teacher's" computer interact with the "students" computers to perform some basic functionalities as putting a file into a certain place on all students computer in one step, having a look at what students do, taking over keyboard and mouse control (to perform image calibration for example), overriding all or some of the students' screens to mirror the teacher's screen (very handy to give general feedback to the whole class). Another dedicated software, *IM 50*, gives the possibility to look at the microscope slides by projecting the image of the digitising camera onto the computer screen. Students can choose pictures, annotate and save them locally for further use. *IM 50* helps easily to calibrate the image to get the best possible picture. And finally all computers are equipped with Office suite (*Word, PowerPoint, Excel*) and have access to an online version of the Robins, a pathology textbook.

The learning scenario: 1 group, 1 case, many interactions

Different learning scenarios were developed and are successfully used in histology (2nd yr.) and pathohistology (3rd, 4th and 6th yr.). The basic principles of those scenarios exploiting this new lab are to give student groups a series of questions built around a clinical case. The teacher prepares in advance the case presentation, questions and additional material (pictures of gross anatomy) as a *PowerPoint* file. This file is distributed via *NetOpSchool* to every computer at the beginning of the lab session. The student groups will then use it as a lab guide or a lifeline and follow the predefined path. There will be places where they need to answer open questions, which they are invited to do directly within the *PowerPoint* slides. At some other places they will be asked to extract information from a microscope slide that they will have to comment and put into the perspective of the case. Microscopic images can be captured and labelled with *IM 50* and pasted into the *PowerPoint* presentation. The clinical case presentation, the questions and the microscope slides trigger a lot of interaction among the students around the table. They dis-



cuss intensely together to find out their best answer, to mobilise their prior knowledge, to consult textbooks or online literature. Tutors can facilitate this intensive learning process. The histology labs of the 2nd year use a handful of student-tutors, whereas pathology labs of the 3rd,

4th and 6th year use one or two pathologist as tutors. At the end of the session the teacher usually gives some sort of feedback to the students. They will be able to burn their worked-out *PowerPoint* slide onto CD-ROM (freely available) or to copy it to their virtual disk space (each student has 250 MB of storage available at the university of Lausanne).

The experience

Our Micropolis lab has now been in use for three semesters. The experience has been overwhelmingly positive even if there's much room for improvement and refinement. The students are very active during the lab sessions and this activity is highly appreciated. Students have a short introduction on the use of the computer (*PowerPoint*, IM 50, burning CDs) at the beginning of the year. Later on, spontaneous pair-teaching between tech-savvy and neophytes students seem to take place. Technical questions are seldom-asked and our surveys show that it is not always the same person that works at the computer or the microscope as in most groups all students did endorse the different roles at some point or other. We're actively exploring ways to improve our learning scenarios and we slowly discover the flexibility of this approach. The facility is also used for non-microscopic lab work such as for collaborative e-learning with various Swiss Virtual Campus Projects. *Web-embryology* is used in the 1st and 2nd year, *Immunology Online* is implemented in the second year and *Virtual Skills Lab* and *BOMS* are planned for the 2nd and 3rd year.

Conclusion

We successfully managed to remodel our histology labs starting from an individual isolated purely morphological activity to an active collaborative learning experience. The new approach is based on both studying morphology and encompassing the contextual integration and the use of this knowledge. This was made possible by exchanging the old microscope with new ones, connected them to computers and a reconfiguration of the room that led to the name *Micropolis*. We are currently exploring different didactic scenarios in the domain of morphology and discover the flexibility of this room for collaborative use of some of the distant-learning programs developed under the Swiss Virtual Campus umbrella. The experience so far has been highly successful.

Die Lernplattform PathoBasiliensis

Website: <http://www.unibas.ch/patho/>

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Summary

PathoBasiliensis is a publicly accessible learning platform for instructing pathology to students and medical doctors. Based on the image database PathoPic which comprises more than 8000 images various learning tools and learning games were developed. Some of these were adopted by other disciplines as well. More than 1000 students of several universities intensively use the online histopathology course.

With the self-developed virtual microscope vMic slides may be viewed over the internet emulating a real microscope. This new technology will open up many new applications in telemedicine.

Einleitung

Die Pathologie ist eine sehr visuell orientierte Subspezialität der Medizin und eignet sich deshalb hervorragend zur Entwicklung multimedialer Online-Lernmodule. Im deutschsprachigen Raum existieren bisher nur wenige Internet-Angebote für die Aus- und Weiterbildung im Fach Pathologie. Wir entwickeln seit 6 Jahren Lernmodule für unsere Lernplattform PathoBasiliensis. Die Komponenten von PathoBasiliensis ermöglichen es den Studierenden, den Stoff fallbezogen zu bearbeiten, systematisch zu vertiefen und die erworbenen Erkenntnisse spielerisch zu überprüfen. Durch multiple Zugänge zum Stoff wird eine hohe Adaptivität der Lernangebote an die unterschiedlichen Bedürfnisse der Lernenden erreicht. Das Projekt ist curricular eingebunden und die Inhalte sind prüfungsrelevant. Anfangs Semester findet eine gut besuchte Einführungsveranstaltung statt, in der die Lernwerkzeuge von PathoBasiliensis den Studierenden vorgestellt werden. Zielgruppen unserer Angebote sind neben Studierenden der Medizin und Zahnmedizin, Assistenzärzte, Fachärzte sowie Laien. Die verschiedenen Online-Module begleiten Studierende und AssistenzärztInnen während ihrer Ausbildung und dienen FachärztInnen in der Weiterbildung und der alltäglichen Diagnostik. Die Online-Lernumgebung besteht aus 6 Komponenten, welche – als Ergänzung zu den Präsenzveranstaltungen – für das Selbststudium der Studierenden entwickelt wurden:

1. PathoPic: Die Bilddatenbank
2. HiPaKu: Der Online-Histopathologiekurs
3. ZyPaKu: Der Online-Zytopathologiekurs
4. MatchingPair: Das Spiel zur Selbstevaluation
5. PathoSearch: Autopsiefalldatenbank für das fallbasierte Lernen
6. VMic: Virtuelles Mikroskop zum Mikroskopieren über das Internet

Alle Angebote sind im Internet frei zugänglich über die Website: <http://www.unibas.ch/patho/>
Eine Registrierung ist nicht erforderlich.

Die Bilddatenbank PathoPic (<http://alf3.urz.unibas.ch/pathopic/>)

Basismodul von PathoBasiliensis ist die Bilddatenbank PathoPic mit über 8000 Bildern aus der Pathologie. Die einwandfreie Bildqualität und die Korrektheit der zugehörigen Metadaten haben einen hohen Stellenwert. Die Bilder werden von der Pathologin über eine einfach und effizient zu bedienende Eingabemaske mit Drop-Down Boxen und Texteingabefeldern (keine HTML-Kenntnisse erforderlich) mit zahlreichen Metadaten in deutscher und englischer Sprache versehen. Diese erlauben das präzise Auffinden einzelner Bilder über die Suchmaske (Abb. 1). Auf der Basis dieser Metadaten können die Inhalte für unterschiedliche Einsatzszenarien als dynamisch generierte HTML-Seiten zielgruppengerecht aufbereitet werden. Das flexible technische Konzept ermöglicht die effiziente Wartung unabhängig von IT-Fachleuten, die Übertragbarkeit auf andere Hochschulen und flexible didaktische Einsatzszenarien. Die Erstellung dieser umfangreichen Lernumgebung durch lediglich eine Inhaltsexpertin war nur dank innovativer Technologie möglich. Die Datenbank wird kontinuierlich mit makroskopischen, histologischen, zytologischen und elektronenmikroskopischen Aufnahmen erweitert. Die Bildbeschreibungen sind mit Annotationen versehen. Werden diese mit dem Mauszeiger berührt, zeigen Pfeile auf die entsprechenden Befunde im Bild. Diese interaktive Funktion hat sich bei den Nutzern als sehr beliebt erwiesen («Aha-Effekt», Möglichkeit zur Wissensüberprüfung). Mit dem Trainermodul von PathoPic können sich die Studierenden Bilder zu einem frei definierbaren

Es besteht keinerlei Interessenskonflikt. Insbesondere bestehen keine geschäftlichen Verbindungen mit einem kommerziellen Anbieter virtueller Präparat-Akquisitionssysteme.

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Abbildung 1. Suchmaske von PathoPic. Die verschiedenen Suchkriterien können mittels Drop-Down Box angewählt und im Sinne einer AND Verknüpfung miteinander kombiniert werden. Zusätzlich kann nach einer konkreten Bilddiagnose per Freitexteingabe gesucht werden. Zu jeder Diagnose werden in der Datenbank für den Benutzer nicht sichtbare Synonyma abgelegt, um das Suchresultat bei einer Freitextsuche zu optimieren.

Themenkreis und Schwierigkeitsgrad nach dem Zufallsprinzip anzeigen lassen und versuchen, eine korrekte Diagnose zu stellen.

Das Lernspiel MatchingPair (<http://alf3.urz.unibas.ch/matchingpair/>)

Eine weitere Möglichkeit, das Wissen spielerisch zu überprüfen, bietet das Lernspiel MatchingPair.

Makroskopische, mikroskopische und zytologische Aufnahmen sind in einem Spielfeld von sechs mal sechs Bildern angeordnet (Abb. 2). Aus diesen 36 Bildern müssen gemäss der jeweiligen Aufgabenstellungen 18 assoziative Bildpaare gefunden werden. Die einzelnen Spielsets weisen verschiedene Schwierigkeitsgrade auf. Das Spiel ist universell einsetzbar. Verschiedenste Anbieter – unter anderem MineralogInnen, BotanikerInnen, SchülerInnen einer Grundschule und

LinguistInnen – haben Spielsets mit verschiedenen Fragestellungen zusammengestellt.

Der Histopathologiekurs HiPaKu (<http://alf3.urz.unibas.ch/hipaku/stud/>)

An der Universität Basel wurde vor Kurzem die Reform des Medizinstudiums abgeschlossen. Im Rahmen der Studienreform wurde gefordert, dass sich die Studierenden ihr Wissen zunehmend im Selbststudium aneignen. Deshalb haben wir für die Vermittlung der Histopathologie das Online-Kursmodul HiPaKu [1] geschaffen, auf das die Studierenden mit einem Webbrowser zugreifen können. Obwohl den Studierenden an der Universität zahlreiche Computerarbeitsplätze zur freien Verfügung stehen, haben im letzten Jahr 90% der Studierenden gemäss eigener Angabe zu Hause gelernt. Dabei haben nur 12% der Studierenden die Wartezeiten als unangenehm empfunden.

Die Online-Präparate von HiPaKu enthalten folgende Komponenten:

1. Einführende Kurztexte mit relevanten Informationen zu Pathologie und Klinik.
2. Demonstration der diagnostisch relevanten histomorphologischen Merkmale anhand von Bildern sowie Aufnahmen von Normalbefunden zum Vergleich.
3. Einen Link zur Virtual Slide Box of Histopathology der Universität Iowa [2]. Diese ermöglicht es den Studierenden, Präparate mit derselben Diagnose online zu mikroskopieren.
4. Bilder des makroskopischen Befundes.
5. Differentialdiagnosen.
6. Links zu weiterführender Literatur und zu Falldarstellungen.
7. Links zu PathoSearch, der Autopsiefalldatenbank [3] von PathoBasiliensis.

Dieser Kurs ist bei den Studierenden sehr beliebt und kommt nicht nur in Basel, sondern auch in Rostock, Regensburg und Zürich zum Einsatz. Gemäss repräsentativer Umfragen nutzen 95% aller Studierenden HiPaKu zur Prüfungsvorbereitung und dies während durchschnittlich über 30 Stunden.

Das virtuelle Mikroskop vMic (<http://vmic.unibas.ch/>)

Neuste Entwicklung im Rahmen von PathoBasiliensis ist das virtuelle Mikroskop vMic [4]. Ein virtuelles Mikroskop simuliert die Funktionsweise eines traditionellen Lichtmikroskopes bei

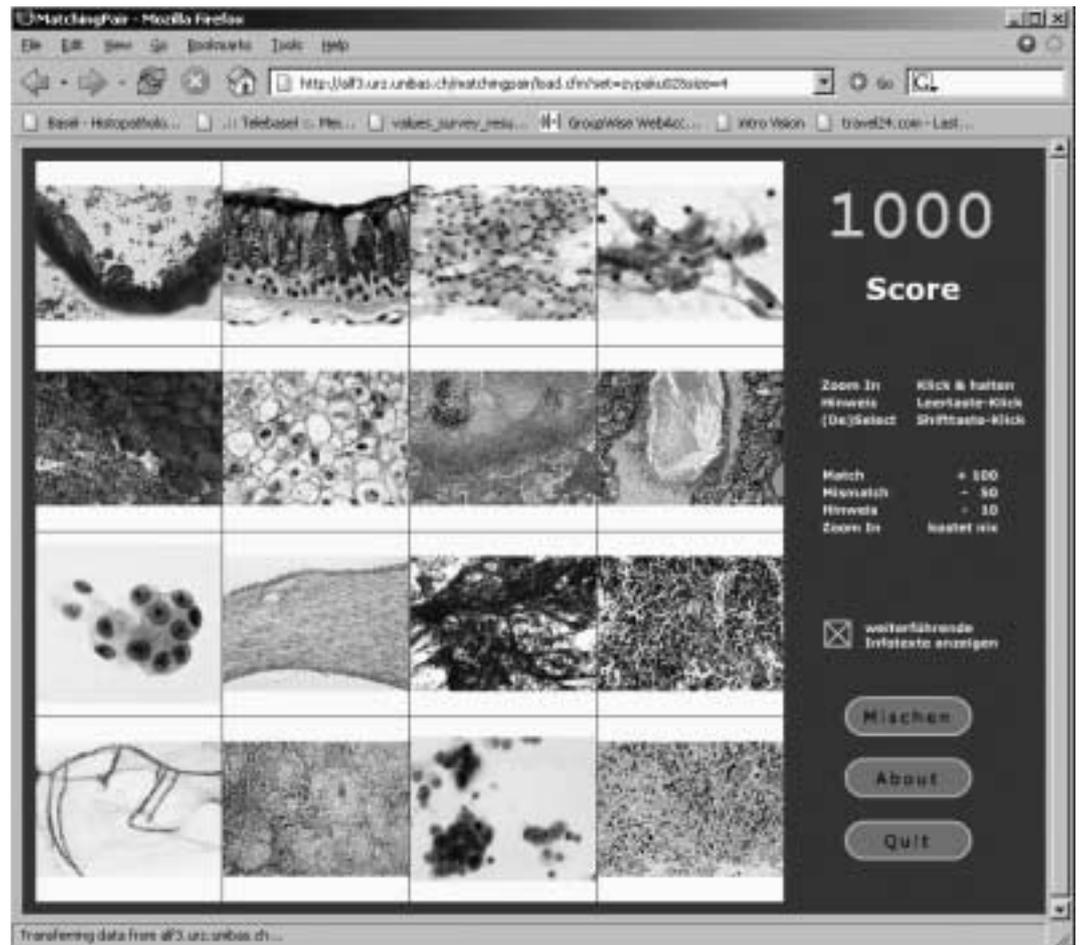


Abbildung 2. *MatchingPair.* Bei diesem Spielset müssen die Studierenden jeweils ein zytologisches einem histologischen Bild mit derselben Diagnose zuordnen.

vergleichbarer oder besserer Bildqualität. Die virtuellen Präparate (sog. virtual slides) werden bei starker Vergrößerung (400fach) eingescannt. Der Nutzer kann sich innerhalb des virtuellen Präparates frei bewegen und das Präparat in verschiedenen Vergrößerungen betrachten.

Die bis zu mehreren Gigabyte grossen digitalisierten Präparate können via Webbrowser von beliebig vielen PathologInnen oder Studierenden gleichzeitig und ortsunabhängig am Computerbildschirm mikroskopiert werden. Für die Benutzung des virtuellen Mikroskopes wird lediglich ein Computerarbeitsplatz mit einer schnellen Internetverbindung benötigt. Im Gegensatz zu vielen traditionellen Telepathologieanwendungen, die eine spezialisierte Einrichtung voraussetzen, steht die virtuelle Mikroskopie somit einem sehr breiten Nutzerkreis offen. Das von uns entwickelte virtuelle Mikroskopsystem vMic besteht aus 3 Komponenten:

Akquisition

Die Präparate werden bei 400facher Vergrößerung (40er Objektiv) mit einem Zeiss Axioskop Mikroskop mit einer automatisierten Stage eingescannt. Dabei entstehen Rohdaten von bis zu 120 Gigabyte (6 Gigabyte nach Kompression). Durch die Nachbearbeitung der Bilder in Adobe Photoshop erreichen die virtuellen Präparate oft eine bessere Bildqualität als das Original im Lichtmikroskop.

Server

Konventioneller HTTP-Server, auf dem die virtuellen Präparate bereitgestellt werden.

Client

HTML-Browser mit Flash-Plugin. Dieser lädt die vMic-Client Komponente.

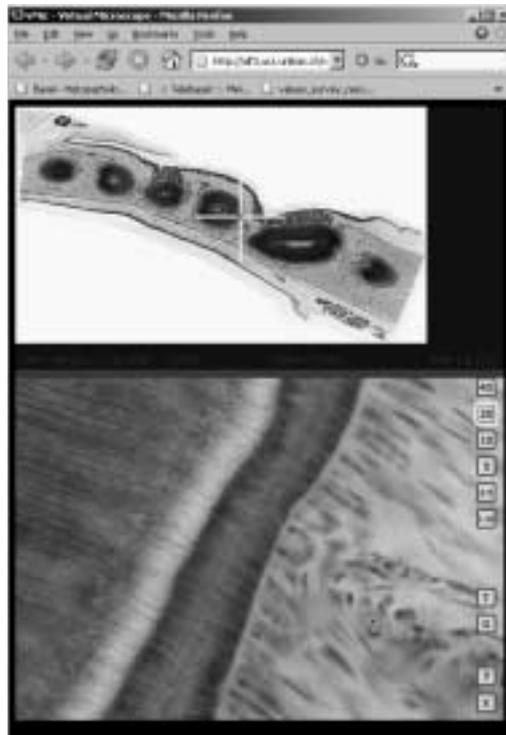


Abbildung 3. *vMic: Ein Kurspräparat aus dem Histologiekurs für Studierende der Zahnmedizin. Das Bild zeigt einen Querschnitt durch einen Katzenkiefer. Im oberen Teil des Viewers wird eine Übersichtsaufnahme des gesamten Präparates gezeigt. Das kleine blaue Rechteck im Zentrum des gelben Fadenkreuzes zeigt die Lokalisation des unten bei 200facher Vergrößerung mikroskopierten Bildausschnittes an.*

Der User kann sich frei innerhalb der Präparate bewegen und diese in verschiedenen Vergrößerungen (12,5- bis 400fach) betrachten. Ein Übersichtsbild erleichtert die Orientierung (Abb. 3). Wenn man sich in ein neues Gesichtsfeld bewegt, liefert der Server jeweils nur denjenigen Ausschnitt des virtuellen Präparates, der für die momentane Darstellung im Client nötig ist. Dadurch werden die Ladezeiten minimiert. Annotationen ermöglichen es, die BenutzerInnen an ganz bestimmte Stellen im Präparat zu führen.

Digitalisierte virtuelle Präparate setzen wir in der Ausbildung von Studierenden und der Weiterbildung von FachärztInnen ein. Im Jahr 2004 wurde der Kurs «orale Histologie» [5] für Studierende der Zahnmedizin vollständig auf virtuelle Präparate umgestellt. Die Akzeptanz der Studierenden für die neue Technologie war und ist sehr hoch. Die Bildqualität beurteilten die Studierenden als gleichwertig oder besser als bei Betrachtung der Präparate mit einem konventionellen Mikroskop. Mehrere Schnittseminarien für die Weiterbildung von FachärztInnen sind bereits online.

Neben der Lehre bietet die virtuelle Mikroskopie zahlreiche potentielle Anwendungsmöglichkeiten in der Diagnostik (z.B. Einholen einer Konsiliarmeinung [6]) und der Forschung (z.B. automatisierte Auswertung von Präparaten [7]). Die Entwicklung auf dem Gebiet der virtuellen Mikroskopie schreitet sehr rasch voran. Innerhalb der letzten Monate haben verschiedene kommerziell erhältliche Präparatescanner Marktreife erlangt [8]. Aufgrund der zahlreichen Einsatzmöglichkeiten und Vorteile gegenüber der konventionellen Mikroskopie wird sich diese Technologie in den nächsten Jahren rasch durchsetzen.

Literatur

- 1 Glatz-Krieger K, Glatz D, Gysel M, Dittler M, Mihatsch MJ. Webbasierte Lernwerkzeuge für die Pathologie. *Pathologie* 2003;24:394–9.
- 2 Harris T, Leaven T, Heidger P, Kreiter C, Duncan J, Dick F. Comparison of a virtual microscope laboratory to a regular microscope laboratory for teaching histology. *Anat Rec* 2001;265:10–4.
- 3 Glatz-Krieger K, Glatz D, Mihatsch MJ. Autopsien im Internet. *Schweiz Rundsch Med Prax* 1999; 88:499–500.
- 4 Glatz-Krieger K, Glatz D, Mihatsch MJ. Virtual slides: high-quality demand, physical limitations, and affordability. *Hum Pathol* 2003;34:968–74.
- 5 Oral Histology, Website: <http://oralhisto.unibas.ch/>, accessed on 3/2005.
- 6 Okada DH, Binder SW, Felten CL, Strauss JS, Marchevsky AM. "Virtual microscopy" and the internet as telepathology consultation tools: diagnostic accuracy in evaluating melanocytic skin lesions. *Am J Dermatopathol* 1999;21:525–31.
- 7 Bacus Laboratories, Website: <http://www.baculabs.com/>, accessed on 3/2005.
- 8 Telepathology City, Commercial Solutions, Website: <http://www.telepathologycity.com/systems.htm>, accessed on 3/2005.

The Virtual Microscope: a powerful tool for learning and teaching

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Paolo Meda

Summary

With the introduction of a problem-based learning curriculum at the Faculty of Medicine of the University of Geneva, the basic medical science curriculum has been reorganized in monthly, multi-disciplinary units dedicated to the main functions of the human body (reproduction, locomotion, etc.). Several disciplines including histology are therefore taught across these different teaching units. To optimise longitudinal integration and allow comparative analysis of histological sections, it became obvious that students should have a free and facilitated access to all histological specimen studied along the curriculum. To this end, carefully chosen specimens were digitalised at high magnification, stored in a database and made available dynamically through the web. This article describes the hardware and software infrastructure used, and the added values offered by a Virtual Microscope approach.

Description of the Virtual Microscope¹

The system that generates our virtual slide collection is based on two softwares developed for Nikon by Laboratory Imaging (<http://www.lim.cz/>): **EclipseNet**, an image archiving and networking software which includes image capture and organization as well as administration of databases and **Web DB**, an image web server which enables to search and view the virtual slides using a standard web browser.

In brief, the system configuration (figure 1) describes as follows: a Nikon Eclipse E600 microscope equipped with a Nikon DXM1200 camera and a Prior motorised stage, connected to a personal computer (Eclipse 1) running the EclipseNet software which drives the scanning of histological sections. A second computer (Eclipse 2) also equipped with EclipseNet, except for the modules controlling the microscope, the stage and the camera, allows the annotation of the virtual slides and management of the database.

1 The Geneva Virtual Microscope: <http://vslwww.unige.ch>

Image capture

EclipseNet drives the motorised stage and the camera to take consecutive pictures of selected regions of histological sections at the highest wanted magnification. The hundreds to thousands image files are automatically assembled in a single large overview (figure 2). A high-performance shading correction ensures the evenness of the reconstituted images. Lower magnifications are then calculated and reconstructed from the high-resolution scan. This simple procedure contrasts with that of other digitalisation systems, which require a new scan for each magnification to be displayed.

EclipseNet also allows the annotation of the virtual slides after scanning. These annotations are reversibly removable: a non-destructive annotation layer is stored independently of the image data within a single file.

Image organizer and Database management

All the jpg files ("tiles") and information ("vsl file") of a given section are stored in a folder, which can be readily copied to the database. The administrator of the system freely defines the set of metadata ("fields") associated with each collection ("table") of virtual slides. Most of the metadata are descriptive but also include links to other documents such as pdf, web sites or static images ("image gallery"). The user's rights can be fine-tuned to fit defined roles, eg for first year students, teachers, or administrator of a collection. If authorised, a user can edit the metadata and also pre-select specific regions of interest (ROI) through a web interface.

Image Web Server

Web DB is an application on the web server that enables viewing and querying (sorting, filtering) the database via a Web browser (Mozilla Firefox or Microsoft Internet Explorer). It includes PHP scripts, Apache web server and MS-SQL database.

The content of the web database can be displayed according to 4 different modes (thumbnails with or without metadata, single slide or comparative

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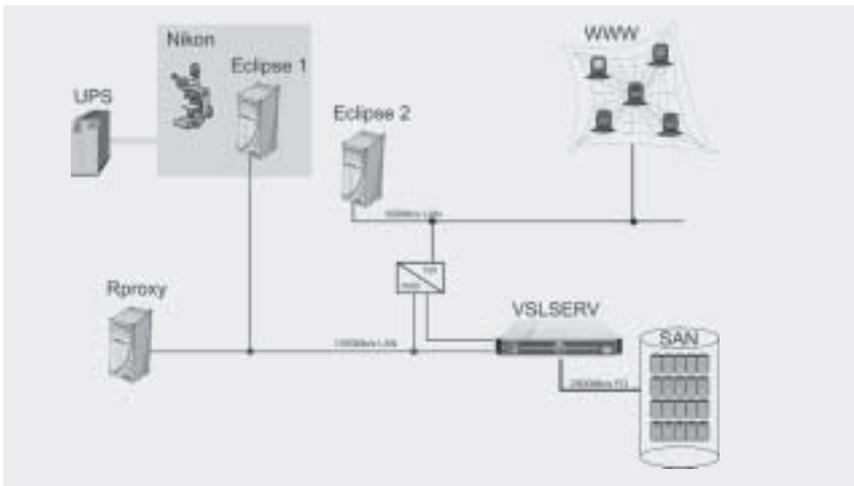


Figure 1. Diagram of the system used to generate and display virtual slides. The Eclipse 1 computer is equipped with the EclipseNet software that drives the Prior motorized stage and the Nikon DXM1200F camera of the Nikon Eclipse E600 microscope for the scanning of histological sections. The Eclipse 2 computer is also equipped with EclipseNet software (except for the modules controlling the microscope, the stage and the camera) and is used as a workstation to annotate the virtual slides and to manage the database. To accelerate transfer rates of the data, the Eclipse 1 computer is connected to the server (VLSERV) through a Gigabyte LAN. The server is equipped with the Web DB software and is connected through an optic fiber (FO) to a high capacity and high availability storage array (SAN) where the virtual slides are stored. The server is connected to the network through two Gigabyte LAN ports, one of these being mainly used for the web access. The reverse proxy (Rproxy), used as an intermediate between the web clients and the server, treats all requests from the web and transmits them to the server which is only accessible through our intranet. UPS: Uninterrupted Power Supply.

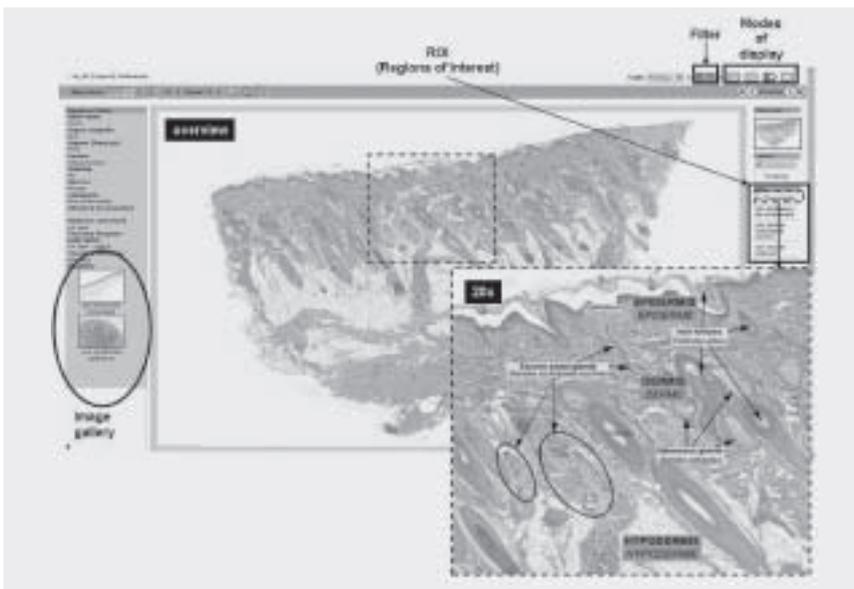


Figure 2. Single slide display by the Virtual Microscope. Available metadata (database fields) are indicated in the menu on the left side of the main window. A small overview, the links to show or hide annotation and tracking layers, as well as the links to the available pre-selected regions of interest (ROI) are indicated on the right side.

display) (figure 2: single slide display; figure 3: comparative display).

The web server sends only the «tiles» required for the selected region of the slide to be displayed. Upon moving in the virtual slide, or when changing magnification, Web DB sends the new tiles corresponding to the other selected region. Web DB is therefore faster than the systems that require pre-loading of the entire image before display.

A powerful tool for learning

With the basic functions of the system, the students can:

- **freely navigate the virtual slides**, at any magnification, from anywhere and at any time, thus providing a unique tool for self-learning throughout the curriculum
- **view the whole histological section at a glance**, which is of great topographic help to bridge the gap between macroscopic and microscopic anatomy (figure 2)
- **benefit from teacher annotations**, which help the student to identify specific regions, tissues or cells (figures 2, 3). These annotations may be removed, thus allowing self-evaluation
- **sort and filter the collection of virtual slides** according to their needs
- **have free access to rare, expensive and short-lasting specimens**, eg immunolabelled sections

Several additional educational tools have also been specifically developed, to allow the students to:

- **follow teacher-guided tours** made of pre-selected regions of interest (ROI) (figure 2)
- **display 2 slides side by side**, thus allowing comparison of different staining procedures (figure 3), normal versus pathologic specimens, etc. This comparison facilitates the training of differential diagnosis
- **consult attached documents**, eg section's drawing, handbook of the laboratory tutorials, etc.
- **view a gallery of static images** cognate with virtual slides, thus allowing further analysis of specific structures, comparison of different staining procedures, relationship with the ultrastructure revealed by electron microscopy, etc.) (figures 2, 3)
- **monitor the regions of the virtual slide already scrutinised** ("tracking"), thus allowing to control that large areas of each section have been properly screened



Figure 3. Comparative display by the Virtual Microscope. Sections of an elastic artery have been stained either with Hemalun-Eosin (left panel) or with Resorcin-Fuchsin, which specifically stains elastic fibers and lamina (right panel). On each slide, a region of interest (ROI) has been selected for comparison.

A powerful tool for teaching

The teacher can:

- **elaborate educational scenarios**, to guide the self-learning student (teacher-guided tour)
- **generate exercises on pre-selected ROI**, to be screened and identified by students
- **prepare teaching supports to be used in the classroom**, such as on-line navigation of ROI, static images derived from the virtual slides, etc.

Current usages and future perspectives

The Virtual Microscope was introduced in our Faculty during the academic year 2004–2005, as

a revision and self-assessment tool, complementary to the first year practical skill classes run on conventional microscopes. During their self-learning time, the students had to apply the knowledge acquired during the practical class to other unknown sections, eg to identify structures in pre-selected ROI. The feedback from the students was positive. Some of them have spontaneously saved images from the virtual slides, annotated them and requested teacher advice on these items.

We are currently pursuing the digitalisation of all the sections used in the teaching program of normal histology, aiming to extend the use of the Virtual Microscope to the second and third year of the medical curriculum for the next academic year. We are also planning to extend the application of the method to the teaching of histopathology, haematology and dermatology specimens.

In addition, an extensive virtual slide database should also prove useful in the continuing education of professionals, for the distance diagnosis of rare and complex cases which may require the confrontation of experts in different locations, as well as for multiple research purposes. Last but not least, the Virtual Microscope approach also provides an easy, ready-to-use teaching support for countries where access to conventional microscope is not possible.

Acknowledgements

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References

- 1 Weinstein RS, Descour MR, Liang C, Bhattacharyya AK, Graham AR, et al. Telepathology overview: from concept to implementation. *Hum Pathol* 2001;32:1283–99.
- 2 Heidger PM Jr, Dee F, Consoer D, Leaven T, Duncan J, Kreiter C. Integrated approach to teaching and testing in histology with real and virtual imaging. *Anat Rec* 2002;269:107–12.
- 3 Cross SS, Dennis T, Start RD. Telepathology: current status and future prospects in diagnostic histopathology. *Histopathology* 2002;41:91–109.
- 4 Glatz-Krieger K, Glatz D, Mihatsch MJ. Virtual slides: high-quality demand, physical limitations, and affordability. *Hum Pathol* 2003;34:968–74.
- 5 Costello SSP, Johnston DJ, Dervan PA, O'Shea DG. Development and Evaluation of the Virtual Pathology Slide: A New Tool in Telepathology. *J Med Internet Res* 2003;5:e11. URL: <http://www.jmir.org/2003/2/e11/>
- 6 Kumar RK, Velan GM; Korell SO, Kandara M; Dee FR, Wakefield D. Virtual microscopy for learning and assessment in pathology. *J Pathol* 2004;204:613–8.
- 7 Shaffer K. Teaching Anatomy in the Digital World. *N Engl J Med* 2004;351:1279–81.
- 8 Lundin M, Lundin J, Isola J. Virtual microscopy. *J Clin Pathol* 2004;57:1250–1.

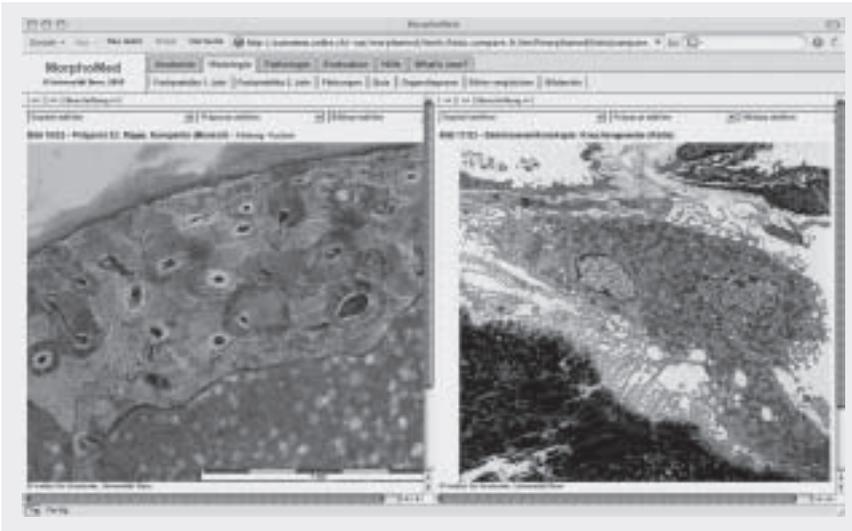


Figure 2. Screenshot of the comparison layout.



Figure 3. Screenshot of the quiz in the ophthalmology module. The image of the fundus can be moved with the mouse and pressing the shift key while the image of the pupil stays. Structured interpretation of the fundus is asked on the right side.

images and new features. Anatomy was added in 2002, neuroanatomy in 2003. New features were a magnifying glass function, an archive to search for images, a printer friendly layout, a quiz and sensitive images, which indicate the name and the extension of a structure after mouse contact. The latest improvement consists of a layout that displays two images within one window, which enables direct comparison of images (figure 2).

In parallel, other modules of image and media rich areas of medicine were and are developed

using the same technology and the same GUI. One example is the module on interpreting ophthalmoscopic images with a quiz, in which the fundus is viewed through the pupil and can be moved with the mouse (figure 3)². The realisation of a clinical endocrinology atlas is in process. The same is true for the modules on indicating and interpreting radiographs of the thorax and the skeleton. A module for pathology is planned. A module on otoscopy, laryngoscopy and endoscopy of the gastrointestinal tract and the lung are on the wish list. Also “HemoSurf”³, a training program on the interpretation of blood films developed in the nineties, shall be transferred into this format. With a module on the auscultation of the heart, we will integrate audio files and realise the idea of an “acoustic atlas”. A first version of this module should be ready this fall.

Production and maintenance over the web

The production and maintenance of so many modules is only possible, if the work flow is optimised and the work load is distributed among many people. This was made possible by a web backend, developed with the Open Source programs PHP and MySQL. This backend allows the authors to create and/or delete pages, to edit text, to upload and/or delete images and to change the sequence of the images via a web browser. The backend can be opened directly from within the module. The allocation of access rights and the modification of the hierarchical tree are under the control of the administrator. Due to this backend, the authors can work on their modules wherever they have access to the Internet. Completed modules are handed over to the teachers. They can then update and enlarge their modules on their own.

In the meantime, the online administration tool does not fulfill anymore our demands and needs. Therefore, we started to develop a new tool using another Open Source program called Typo3⁴. In contrast to the existing tool, a separate media data base will exist and templates will facilitate the creation of new learning modules.

2 *Augenfundus* <http://e-learning.studmed.unibe.ch/clinisurf/htmls/ophtha.html:clinisurf|ophtha>
 3 *HemoSurf (Demoversion)* <http://www.aum.iawf.unibe.ch/vlz/BWL/HemoSurf/Index.htm>
 4 *Typo3* <http://www.typo3.com/>

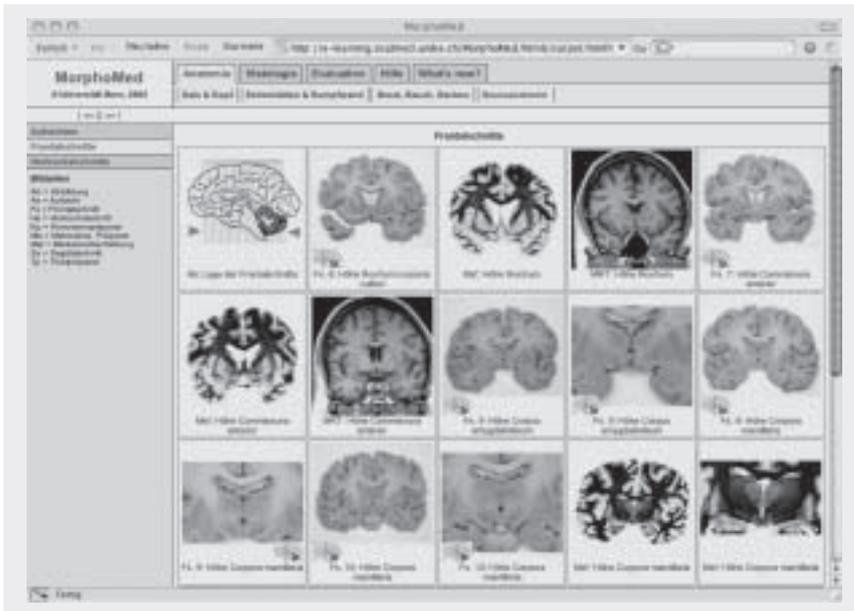


Figure 4. Screenshot of the image carpet. Each chapter starts with such an overview. It gives an important impression on the size of the chapter and its images.

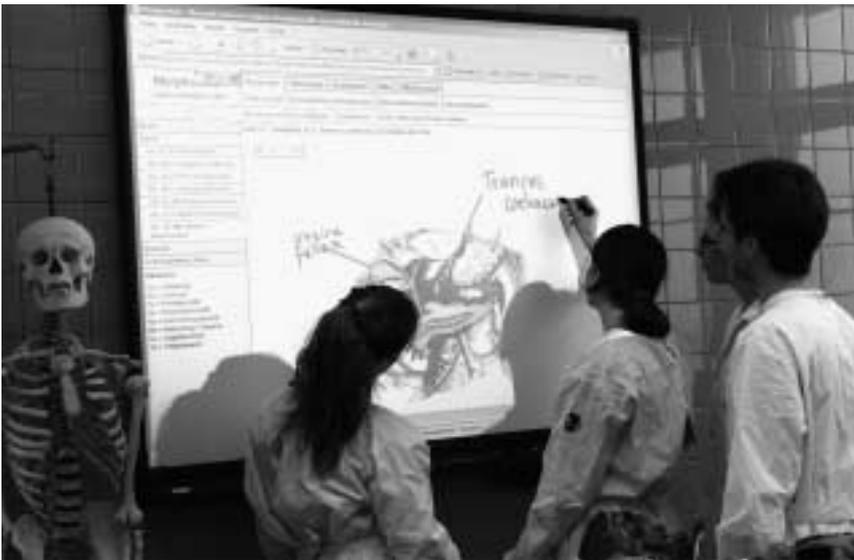


Figure 5. Students discuss in front of a smartboard an image of MorphoMed and label the structures.

An important innovation will be the use of different standards. The data model will be based on DICOM⁵ and the HEAL Metadata Schema⁶. For the indexing we will use MeSH⁷ and where applicable ICD-10⁸. We hope to start using the new tool by the end of the year.

Integration into the curriculum

As mentioned above, very positive feedback and a high utilisation rate by the students confirmed

our concept. The annual surveys showed no decrease in utilisation (almost 100% in the second year), as it can often be observed after a first enthusiastic phase. Crucial for this success was the good integration of MorphoMed into the curriculum, eg each chapter of the histology module corresponds with a practical course in histology. This allows the student to prepare and repeat the histology courses. Additionally, all images are taken from the slides they are watching with the microscope. During the practical histology course, students can access the program with computers placed on the same tables as the microscopes. Thus, they can compare what they see in the microscope with the images of the program.

In anatomy, MorphoMed is also used during cadaver sections. Having a touch sensitive SMART boardTM with projection of the computer screen next to the section tables, students can oscillate between the cadaver and the SMART boardTM to watch and discuss the images and to compare them to the situation at the cadaver (figure 5).

The integration of an e-learning resource into the curriculum is not complete, if examinations are not included. Since 2003, a computer based histology examination (figure 6) is used for the OSPE (Objective Structured Preclinical Examination), which takes place twice per year in the first and second year. A more detailed description of this examination module will be available on the web at the end of this year⁹.

Since last fall, students have the opportunity to send errors they discover from within the program to the authors. Thus, they participate in the process of quality control and develop a feeling of "co-ownership".

Continuous evaluation

Regularly at the end of the educational year, the modules histology and anatomy are evaluated with a questionnaire. These evaluations¹⁰ give important information on desired new features

5 DICOM <http://medical.nema.org/>

6 HEAL <http://www.healcentral.org/services/services-MetadataSchema.jsp>

7 MeSH <http://www.nlm.nih.gov/mesh/meshhome.html>

8 ICD-10 <http://www.who.int/classifications/icd/en/>

9 Virtopsy <http://www.virtopsy.com/>

10 Evaluation von MorphoMed <http://e-learning.studmed.unibe.ch/MorphoMed/htmls/evaluation.html?morphomed|evaluation>

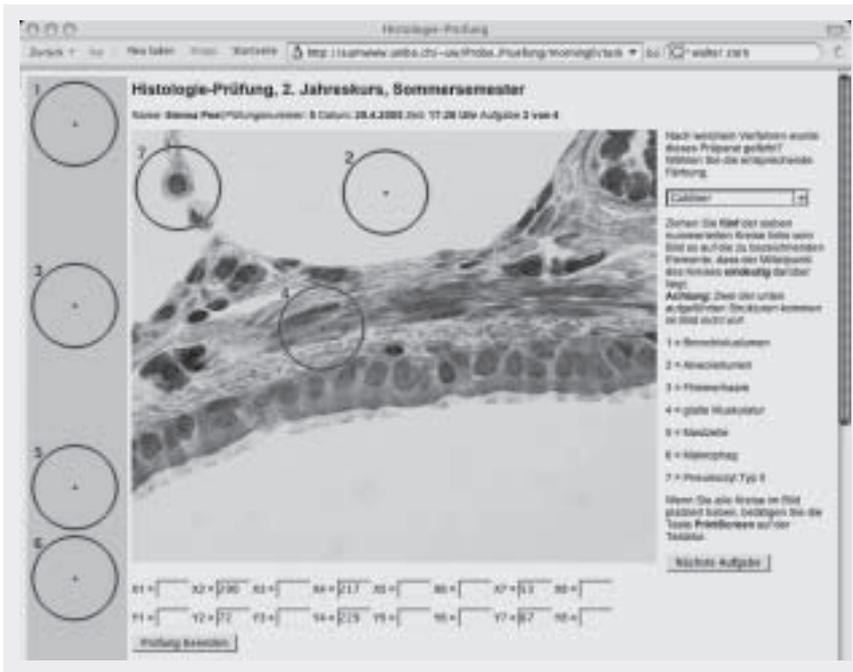


Figure 6. Screenshot of the computer based histology examination. Candidates have to recognise the staining and to denominate with a circle five of seven listed structures. Only five of the seven structures are present in the image.

and usage patterns of the students. A much requested feature in the first evaluation was better support for printing. As a consequence, a printer friendly layout was added. But the questionnaires in the following year showed that less than 20% of the students print out big parts of the program. Another much asked feature is the quiz. Introduced in the second version, it has never been big enough. The magnifying glass despite its supposed attractiveness is not much used by the students.

The anatomy and neuroanatomy modules were never used as much as the histology module. The reason might be that these modules do not cover the subject as complete as histology. This will change for the neuroanatomy modules, which were much expanded this summer.

The availability of MorphoMed on CD-ROM was always much appreciated by the students. Usage patterns evaluated with the questionnaire this year reveal that 80% of the first year stu-

dents now rely on the Internet only. While in former years, an annual series of 250 CD-ROMs was produced in advance, in the future CD-ROMs will only be produced on demand.

Future developments

In addition to the development of other modules, it is planned to create a device independent user interface. This interface will automatically adapt to the device and its screen. Thus, the modules can be viewed also with Personal Digital Assistants (PDA) or even smartphones. PDAs are much promoted in our curriculum.

In the area of image based learning, our Institute of Anatomy will try further technologies. Due to a collaboration between the project "Virtopsy" and the Institute of Anatomy, computer tomography can be used for the cadavers planned to be dissected. This winter semester, the students will have the possibility to study the bodies reading the slice images before dissecting them. The free Open Source program "Osirix"¹¹ from the University of Geneva will be used to view the DICOM data sets. With this software, students can go through the body in different directions and create 3D-views. It is still undecided, if these images or parts of it will be integrated into MorphoMed.

Conclusion

Image and/or media based learning is of great value in medical education and is much appreciated by the students. Because of the low reproduction costs and the interactive features, digital media are perfectly suited to support this type of learning. To benefit maximally of the potential of digital image and media collections, it must be possible for the user to search and rearrange the media according to his needs and interests. This fosters the so much wanted interdisciplinary and integrative thinking in medicine.

¹¹ Osirix <http://homepage.mac.com/rossetantoin/osirix/Index2.html>

Reference

- 1 Woermann U. Erfahrungen mit Computer-basierten Prüfungen im Berner Medizinstudium. GMS Z Med Ausbild. 2005;22(5) – <http://www.egms.de/de/journals/zma/index.shtml>

BolinOS – e-learning tools as an extension of open-source medical content online publication

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Introduction – online medical content management

In the private and medical professional sector people increasingly surf on the World Wide Web. Why? Its ease of use has made it a convenient and casual vector through which we can share information. Not only do we increasingly find medical literature, but we also use it in order to access specific applications, most of them related to medical practice, group organization and training. While it seems easy to access information online, it is however more complex to publish it when the needs are beyond all-access static documents, as it can be in e-learning applications. There are definite needs for a system that can readily differentiate users, simplify editions and online publications while offering simple access to a wide range of interactive applications, many of which help us to maintain and update the incredibly expanding medical-related knowledge.

In addition to share ubiquitously with professional and public audiences (texts, images, diagrams), we need to use specific applications (calculators, quizzes, libraries, decision-support) and centralise and archive valid information (links to other databases, libraries, users), directly or indirectly enhancing our medical education and work. All of these a content management system (CMS) can provide. We believe e-learning applications will have to support and integrate this web of continuously changing knowledge and publication habits. New means need therefore to be explored in that goal, and understanding diffuse integration of e-learning tools as expansions of published data might be an interesting approach.

Background – the University Hospitals of Geneva

Our project took place in the University Hospital of Geneva, in Switzerland. This over 10.000 employees infrastructure devoted to primary to tertiary care of more than 45.000 in-patients and 450.000 out-patients a year is also focused on the academic education of its diverse health care professionals. Medical informatics are studied and applied within our five campuses through

the expertise and means of the Radiology and Medical Informatics Department, an over 200 employees structure.

Objectives – unification of all web contents through a single unifying tool

Starting in January 2001, in continuity with previous initiatives, all members of the Department had to be able to participate in the creation, and publication of centralised online material. A simple tool, requiring no more than entry-level computer knowledge, was therefore necessary. This would provide global access to professional resources and organizational data. For that purpose, we decided to use and develop a content management system named BolinOS.

Users had to benefit from the tool: unique Hospital-wide identification, personal data storage (eg e-mail client, agenda, personal web space, history, bookmarks, and more) and all-nature digital contents integration and centralisation. The resulting web platform would have to be efficient, sturdy, and secure, but also well accepted by users. It would create a centralised 'what you see is what you get' (WYSIWYG) publication space with user-validation management of documents. At the same time it would blend with other active in-house information systems. It should enable easy and transparent backup and archiving of all contents and logs. E-learning applications' development should be facilitated not only by new interactive tools, but also by enabling fast access to already existing educative material.

Open-source development was chosen to give greater independence and functionalities to the project. Not only offered this licensing scheme a clear and free way for BolinOS to be used and enhanced by other interested groups, regardless of their financial and academic dimension, but it also seemed to us one of the most pragmatic and efficient peer-reviewing systems for software development.

There are many other CMS available, but the choice was BolinOS because of the reduced cost of acquisition (open source), our sturdy knowl-

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edge of it, and because of our will to guarantee essential functionality from the beginning, which was only incompletely offered by other platforms. The medical environment, where privacy and accuracy of the information flow are essential, made it essential to have a tool that could enable great security, traceability, reliability, and robustness while remaining independent of peripheral factors (eg commercial-licenses, technical black-boxes). BolinOS explicitly presents many complimentary potentialities which by combining can reach any desired state of information integrity and availability.

We expected to answer present and future needs. The modular, lego-like structure, helps us be able to adapt. Three basic types of modules co-exist:

1. **text-contents** (html, texts, javascripts, xml, ...)
2. **binary-contents** (jpegs, pdfs, movies, ...)
3. **applicative-contents** (aka one bolino, many bolini, aka plug-ins)

The plug-ins were to coexist in a small number, offering 'fundamental abilities' that together would enable the creation of a website by individuals or groups, and the integration of other types of contents for the creation of almost any online application. This is important as it enables the creation of e-learning material directly linked to other 'casual' sources of data, that can in turn

also use and link to other everyday-expanding contents. These are easily manageable and combinable through a coherent and simple web interface. The construction of the multimedia web pages from the modules is sequential and each is linked to a unique URL / file-system-folder.

The system is computer operating system independent, therefore of the future computer infrastructure means and trends, and can work on even a very economical infrastructure. One last but not least ability is the system's management of multilingual contents, not only during creation and publication, but also towards targeted end-user display.

Materials and methods – technical specifications and infrastructure

We chose PHP¹ as the core language for development as its worldwide community is not only one of the largest and most active, but as it includes very variable levels of expertise. Individuals in this community range from personal-homepage week-end leisure developers to extremely dedicated professional senior coders. This is important as it merges the very diverse point of views on what web publication must provide, much more than those alone of computer-scientists. This is essential to the development of a better-suited platform for the development of real-world contents and applications destined to medium computer-knowledge savvy users, as are average healthcare professionals. Moreover BolinOS can be installed on almost any of the machines we already had, have and might get, enabling coexistence with other non-BolinOS in-house applications.

From image manipulation libraries to pdf creation, encryption, data-analysis, file management, network access, binary compression and decompression most of what we needed for medical content management and applications was readily available. We 'only' needed to insert it into our BolinOS framework.

The project was launched in February 2001, with our first Mac OS X development server

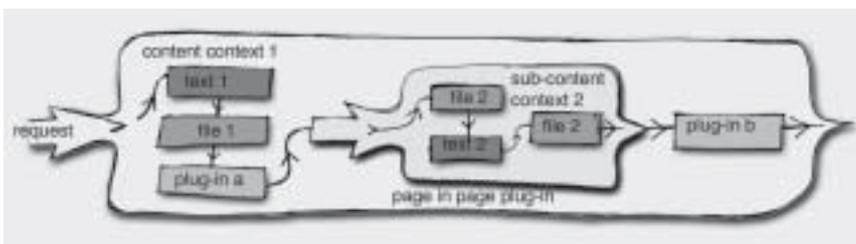


Figure 1. Schematic representation of the page creation sequence using BolinOS.

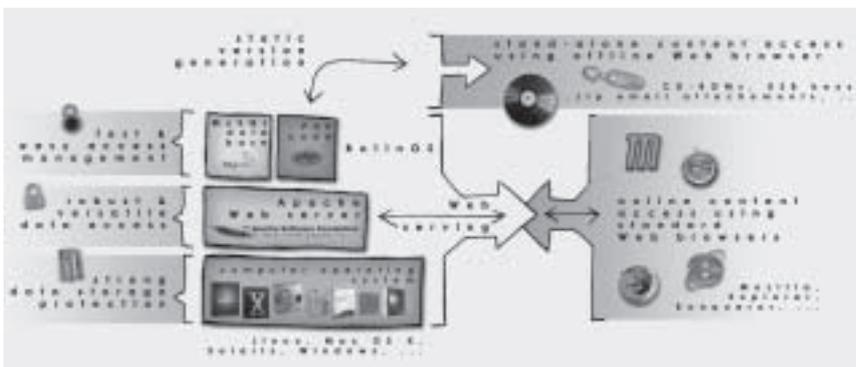


Figure 2. Schematic representation of the BolinOS platform and of the inter-relation between applications.

1 PHP Pre Hypertext Processor language: open source web programming language official home page. www.php.net
MySQL database: open source database official home page. www.mysql.com



Figure 3. Here is a glimpse of a few independent health-oriented websites that use BolinOS for their online content creation; the free application has made it very easy to start these projects and focus on contents, not technology.



Figure 4. Widespread use of the PDA multimedia medical files Syncpad plug-in, has greatly helped spread BolinOS to other health applications in, but also outside our hospitals.

(G3 400Mhz), and pre-production and intranet server running Windows 2000 (Pentium 3 400Mhz). Currently we also use Linux and Solaris based machines, both for production and development. The network connectivity was provided by the pre-existing Geneva University Hospitals' infrastructure. BolinOS was already used in various non-medical websites, and while many of today's capabilities were not present, the main concepts and architecture had already been implemented. Our first web pages were published with it in less than half a day.

The Intrad development workforce until March 2005 ranged between a one (20 h/week total) and a three (84 h/week total) person workforce, including occasional medical informatics students. These individuals have been active in coding, editing instruction of documents, and managing website contents and applications.

Results – non exhaustive realisation and observations

Today, all our employees use BolinOS. Other in-house projects started using BolinOS for their web-side applications (eg Dr Mathias Tschopp's Palm HUG online and handheld medical files database for PalmOS and Pocket PC, GRAC's Radioanatomic Files for PDAs and the web², Etude Dames random multi-centric study on macrosomia³, Wadi Lotfi's Surgery Department Library⁴, the FMH Radiology Quiz⁵). The platform has transparently gained a wide user base, actively accessing online databases, applications, and schedules.

Using basic document management plug-ins, users have been able to publish agendas, charts, plans, lists and many casual-use documents, thousands of pages now ubiquitously available. Using simple cut and paste between third-party applications and the BolinOS interface, useful information has been easily published on our websites, ranging from standard descriptive pages to radiological-report templates used in dictation

2 GRAC's Radio-anatomical Files for PDAs and the web. <http://www.intrad.ch/intrad/pda/anatomy/files/>

3 Etude Dame: site and applications for the multi-centric study on Estimated Macrosomy 'DAME'. <http://www.etudedame.ch/>

4 Library of the Surgical Department of the University Hospitals of Geneva: reference and search website for the surgical department. <http://www.bibliochir-ge.ch/>

5 FMH Online Radiological Examination: <http://www.intrad.ch/intrad/quiz/>

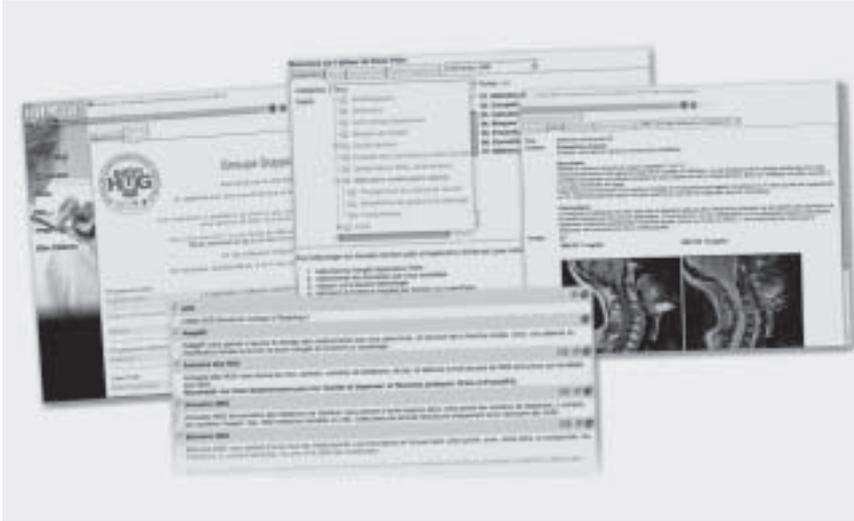


Figure 5. PDA files are multimedia thanks to the global image and text functionalities included in other modules.



Figure 6. Through courses, BolinOS was effectively taught for daily online publication and work organisation.

of radiological-interpretations, through guidelines, bulletins, research notes, image collections, and url bookmarks. This implicitly integrated e-learning in a transparent mesh throughout the department's web pages.

Individual users have created quick notes using simple cut-and-paste text editing, or have included Flash, Word and PDF documents for others to download. Others simply use the system as a files-container, to securely access them from any place on the Internet (eg PowerPoint presentations, publications, images, etc.). Forums have been used to manage group task-lists, and the data-manager plug-in has been devoted to store and recall many data types, using simple web interfaces. Today's casual uses are numerous. For

instance, there is a webcam integration that warns radiologists who work most of the time away from windows (the Radiodiagnostic division is located in the basement), to not forget an umbrella when going out. As this seems trivial, it has however increased the implicit attractiveness of educative material by enlarging the digital-vicinity of the diverse educative contents.

Our team has developed tools explicitly aimed at e-learning or knowledge evaluation (eg the secure quiz / image collections management, efficiently replacing standard film duplication of radiological images used in the course of second-part FMH specialisation examinations [3], for the Palm medical files applications [1], ...), but most of the educative content is dispatched on numerous webpages using hyperlinks and BolinOS data-cloning.

To widen the audience of scientific posters, the use of 'content collection' and 'image collection' plug-ins have for example made it easy to create an online version, with zooming and image navigation capabilities, from the source poster data. Again the readily available CD-ROM exportation of BolinOS can here be used to make an easily shareable offline version.

To add user-attractiveness to online contents, we have designed nearly 100 specific plug-ins. The BolinOS core-system relies on an interesting architecture, the tools we use to integrate contents are plug-ins themselves (it is a bit the chicken and egg idea: once the system is up both generate one another). Combining these blocks with texts, html and binary files (images, videos, pdf, word docs, ...) can result in complex web pages construction, therefore rich e-learning material, simply.

Discussion – what we have gained, what we expect of the future, what we can hope

The many positive results can be resumed in a few non-exhaustive points. We have a working and stable web publication and applicative platform including many applications we would have probably never had otherwise. We delivered 100% of the tools we were asked for. This is a major success. During the years, cost of development and maintenance were kept within what was available to the one web-master. This last activity often actually transformed into a new publication-tool refinement, thus achieving recurrently useable features for all instead of punctual publications.



Figure 7. The transparent integration of any kind of database with many filtering and parsing functions pre-existing in the system core, makes the creation of efficient classification tools easy, e.g. ACR and ICD 10 classifications.



Figure 8. Wysiwyg edition mode enables even the less un-savvy computer users easily manage multimedia contents, the online file browser enables fast online files access for integration into web pages. With the help of the personal “virtual desktop”, rights and accesses are preserved according to one’s set profile.



Figure 9. The BolinOS IntRad quiz plug-in made it possible to get past the old-fashioned and unpractical film displaying technique of examination for radiology specialisation, and delivered an economically sound solution.

We gained valuable expertise in extremely diverse web applications development. From image-manipulation to XML-generation and parsing, through graphical-user-interface design and network optimisation. Though we did develop some applications without end-user request, most of our work was end-user-centric. The range of applications we now propose exceed far beyond what we imagined, and far beyond what we thought would suffice for medical use due to continuous user feedbacks. We have directly and indirectly integrated much of the know-how that the open-source communities we worked with had. While this doesn’t mean we can do anything anytime, our global knowledge makes it much clearer for us now to evaluate future applications, and readily work on it.

However, the relative originality and youth of the open-source nature of the solutions often inspired cautiousness and even reluctance from colleagues. The lack of open-source-aware computer programmers and decision-makers in-house was and still is not in our favour. Together with in-house competing projects or objectives this has led to rejections of BolinOS applications, although they technically fulfilled what they were designed to, or would definitely have been easily implemented on our platform. For example, the in-house physicians’ agenda plugin, never gained any support from those who managed it. Nor was the system ever granted the secure access to an external radiological case-database, although it could have brought many potent education-oriented contents to all users.

Conclusion – e-learning tools integrated as extensions of pre-existing online material is promising

After nearly four and a half years of health-oriented BolinOS development, we have seen our websites develop, slowly but steadily. The BolinOS project has not reached all goals, but the positive results overshadow the negative ones. Today, we do have a pragmatic, economically sound and efficient tool, which has integrated many educative contents as well as new applications readily available for e-learning purposes. Though it was not the prominent goal of the project, it has enabled the implicit integration of these into the all so numerous casual uses one can have in our department. This was achieved while we gained an expertise of what web content creation and publication in the medical field can be.

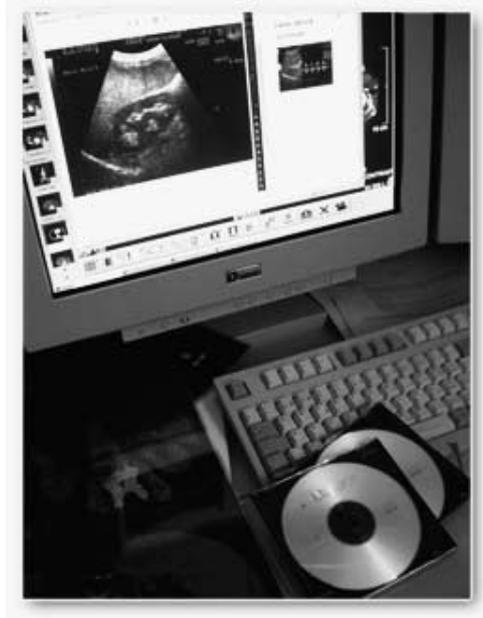


Figure 10. *Creation of static versions of online BolinOS contents has made it a practical way to rapidly create interactive CD-ROMs.*

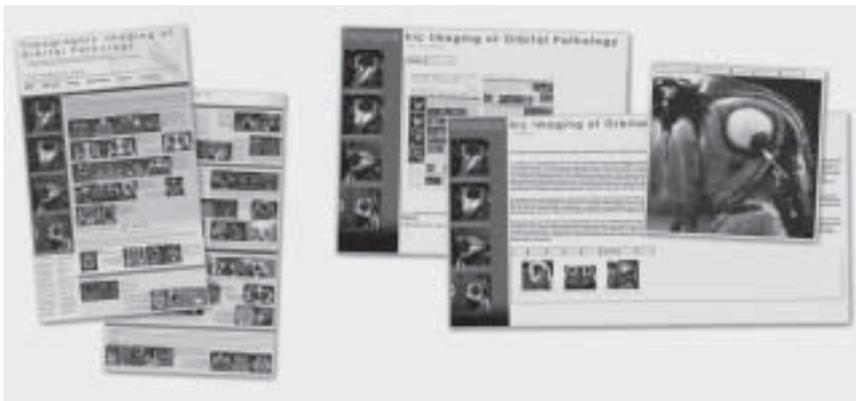


Figure 11. *Cut and paste abilities combined to the image collection plug-in enables fast interactivity addition to previously released material, here an example using a poster about orbital pathology.*



Figure 12. *Templating of pages included in the system enables simple maintenance of specific graphic designs in websites, here the Department of Radiology's extranet.*

Our relative focus on enhancing fine-tuned content-creation plug-ins has shown mid and long-term advantages over content-creation only: the latter is increasingly being taken care of by non-webmaster users, thus creating more and better contents than what we could have done as webmasters. We can only hope now that the people who would be most potent for e-learning content creation will take the opportunity to use these. Today, we have a strong and sturdy open-source application platform on which we cannot only store data but also build new means for users to enhance their education while easing their work.

Exportation of our source code enhancements to the worldwide open-source community has provided us with many feedbacks, bug-reports, enhancements, comments and contacts; many other groups are studying the tool, while some have already chosen it (in our Hospital, and worldwide: 50'000+ installer downloads in more than 120 countries according to statistics of the BolinOS.net website as of December 2004).

Finally, and not the least, the BolinOS project has made it clear that the open source philosophy in medical application development is not just a nice concept. It is an efficient and powerful mean to reach economically sound applications for online contents and groupware creation, opening new paths for e-learning applications creation.

Non-exhaustive list of BolinOS plug-ins up and running.

Medical

ACR code – American College of Radiology anatomopathological classification interactive dictionary

Blast – nucleotide code analysis plug-in

ICD10 – international classification of disease interactive dictionary

Data

Bibliothèque – multimedia library management plug-in

Bozilla – version and software development suite

Customisable bibliothèque – advanced library management plug-in

Data manager – simple online spreadsheet

Glossary – glossary manager

Help manager – online documentation management plug-in

Palm pdb manager – converter for Palm format databases

SyncPad 2 – multimedia files authoring tool for Palm and Pocket PC uses

DB manager – multiformat db browser and editor

phpMyAdmin includer – BolinOS integration of the popular phpMyAdmin open source mySQL managing suite

User interface

Language selector – offers pages' navigation between languages

Page editor – complete editing suite for BolinOS pages

Connexion – login and logout session manager, and interface

User bar – the virtual desktop application

Page refresh – enables automatic page refreshment

Administration

About – offers commentary capabilities to web contents

Benchmark – enables comparison between servers running BolinOS

Plugins Editor – enables fast plug-in edition

Plugins informations – manages plug-in related information

Scheduled actions – to manage scheduling of diverse scripts

Sites statistics – suite to analyse logs and audiences

Synchro Bolinos DB – File System

User registration – simple tool to register new users for specific events

Admin bolinOS securities – generic tool to administer security schemes related to BolinOS

Admin bolinOS sites – complete tool for website administration

Admin groups – generic tool to manage groups and their users

Admin pages – page administration tool, to edit all specific parameters

Admin sessions – viewer and interactive tool to manage online sessions

Admin users – generic tool for user administration, and their parameters and rights

Apache security – generic tool to manage all that has to do with ht. access security parameters

Script embedded – php script integrator to include php code, fast

Communication

Agenda – complete time management suite for users, events and groups

Planning – event management set for specific locations and uses

Contact form – simple email contact form

Contact group – simple group mailing list manager

Forum – basic forum publication and authoring tool

Meta forum – complex multi-thematic forum management tool

Mailbox – multi account webmail interface for pop, imap, and BolinOS mail messages

Mail access – interface to mail functionalities

Workflow

Atlas – complex image collection publication tool, with key imaging, multimedia linking and zone definition

Bulletin – bulletin creation tool

Document workflow – set of tools to follow document workflow online

Form – easy web form creator

Multiple-choice questionnaire – simple set for multiple choice questionnaire making

SyncPad – multimedia file authoring and publication system for the web, palm, pocket pc and smartphones

Tests on line – online evaluation tool

Users vacancies – tool for employee vacation management

Page construction

Background – easy page background manager

Banners – banner management set of tools

Full screen – adds full-screen capabilities to any BolinOS webpage

Page footer – management of page footers

Page skin – complete set to manage locally graphical skin parameters

Page formatter – tools to set page format

Contents collections / manager

Blog – simple blog like displayer

Conditional displayer – adds complex filters for content publication

Contents collection – displays multimedia contents in diverse collection looks

Contents selector – enables multimedia collection display under diverse looks

Embedded contents – integrates any content into a page

Emdedded HTML – integrates HTML as well as parses it into other standard BolinOS contents

Files collection – displayer for binary file collections

Images collection – image displayer for large image collections, includes diverse pop-up viewers and image manipulators

Photo collection – complete photo album displayer and manager

Texts collection – displayer of text collections

XML displayer – parser for XML code

Games

Battleship – get the computer's ships before he gets yours

Find number – find the right number

Mine Sweeper – find where all the mines are without exploding one

Tic tac toe – a simple game of tic tac toe against the computer

Navigation

Customisable Links Collection – simple tool to manage links' collection

Groups navigation – tool to enable navigation between users' data and personal pages

Links collection – complete links collection manager

Navigation – creates basic navigation menus between pages

Navigation menu – creates complex navigation menus between pages

Navigation restriction – plug-in that restricts access to certain pages

Previous / Next – plug-in that displays back and forth navigation through complex get and post environments

Site plan – display plug-in for definable parts of a website

Search

Search engine – plug-in to enable search into a website's contents

Search user – plug-in to easily search into the user database

Google search engine – plug-in for google search interface insertion and management

Miscellaneous

DICOM Digital Imaging and Communications in Medicine – plug-in to enable DICOM format images to be used by all plug-ins and for web transformation

ImageJ – integration of the open source Java application for image manipulation

Viper Visual Information Processing for Enhanced Retrieval – complete tool for interfacing searches compatible with VIPER analysis software

HUG

HUG directories – plug-in to connect and interact with the centralised user database

HUG user profiles – plug-in to enable unified logging, tracking and user rights' management in our hospital

IntRad quiz – complete and powerful online radiology examination tool

References

- 1 Tschopp M, Geissbuhler A. Use of handheld computers as bedside information providers. Medinfo Division of Medical Informatics, Geneva University Hospital) 2001;10(Pt 1):764-7.
- 2 Zand T, Billet J, Spadola L, Girard C, Geissbühler A, et al. BolinOS, Multimedia Authoring Platform and Web Operating System for Internet / Radiology. Poster for the Swiss Radiological Society Congress 2003 (SGR – SSR), Lucerne.
- 3 Billet J, Zand T, Lovis C. BolinOS – Online radiological examination open-source tool for federal certification. Swiss Med Informatics 2005; n°55.
- 4 Apache Web Server: open source web server official home page. www.apache.org

Virtual Internet Patient Simulation: paving the way from sound pedagogical design to popularity

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VIPS: What, Why and When?

“Computers are useless. They can only give you answers.” (Pablo Picasso)

Virtual Internet Patient Simulation (VIPS) is a computer-based training system that allows medical educators (self-proclaimed or otherwise) to build virtual patients capable to take part in Web-based simulated consultations that challenge the learner’s clinical reasoning and decision-making skills. Recognising the primary importance of managing the context of uncertainty inherent to ambulatory medicine, VIPS focuses on *the questions* one may ask and *the decisions* one has to make during a consultation, rather than on *the answers* that describe symptoms, conditions and treatments [1].

In other words, VIPS neglects the descriptive paradigm (ie systematic medical history, physical examination and investigations) in favour of the operational paradigm (ie what information is useful in the present context to make the right decisions). Few medical educators would argue against such an approach. In fact, with regards to clinical reasoning, the theoretical and practical foundations of VIPS are similar to those underlying live standardised patient (SP) programs, whose benefits are well documented [2]. Moreover, initial studies have indeed shown that VIPS holds the promise of effective learning [3] and high learner satisfaction [4].

The VIPS prototype was initially released as a combined Internet/stand alone application in 1999, using the best software technologies available at that time (Java Applet and Visual Basic) [5]. Over the next four years, the prototype underwent numerous evaluations, tests and revisions, culminating in the release of the current industry-grade version. As of today, some 50 VIPS cases have been created, both for continuing medical education (CME) and undergraduate formal education, catering to different target learners, in four different languages, operating in different contexts, often within the framework of pilot projects each with its own specific features.

This paper briefly presents the main original features of VIPS and the first lessons learned

from our attempts to render the system popular among different users.

Anatomy of a VIPS consultation

“Anatomy is destiny” – Sigmund Freud

To the uninitiated that expect a virtual patient with convincing multimedia-rich, three-dimensional features that simulate a real human being, the first encounter with a VIPS patient will certainly be a disappointment. A VIPS patient is merely represented by a small photograph and a few sentences describing the chief complaint. As for the VIPS consultation itself, it consists of a user-defined series of inputs (questions or decisions) and software-generated outputs (patient answers or outcomes).

However, working up a VIPS case is much more realistic than what meets the eye. Just like in a real consultation, the learner must actively seek answers from the patient: no unsolicited information is ever communicated to the learner. The absence of any type of hints is probably the single most important feature of VIPS that sets it apart from most case-based educational resources on the Web. This feature is also essential to elicit unbiased clinical reasoning, which is (at least) a two-stage process: the first stage is the choice of the appropriate questions that need to be asked and the second stage is the correct interpretation of the answers that are obtained [1].

History taking

The requirement for VIPS to provide information only in response to user inquiries posed a specific technical problem when the software was initially developed; during the history taking phase of the consultation, the program had to recognise all reasonable questions that the user would formulate in free text format. A priori, this problem could have been solved by implementing a (never identified) sophisticated mechanism relying on some medical “knowledge” transferred to the program or by finding a simpler solution.

This second option was chosen and successfully implemented. It relies on developing a set of keywords, or more precisely key strings of char-

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Figure 1. The left-sided panel of the VIPS consultation window which illustrates a typical result of the matching mechanism between user input (free text format) and items available in the case database.

acters linked by Boolean operators that are used to match the user's input to the available questions in the case database.

Consider the following question one may ask a patient: "Have you had this problem before?". There are a number of ways to ask this question and thus several corresponding matching strings of characters: *probl, before, past, prior, first time, recur, repetiti*, etc. Finding the right combination of strings may appear complex at first. However, because the vocabulary is relatively controlled and perfect specificity and sensitivity are not absolutely necessary, an acceptable combination is reached in a reasonable period of time through several cycles of testing (figure 1). Importantly, such type of indexing is only done once for every new question that is added during new case creation. Existing questions, along with their matching strings, are integrated into new cases automatically.

Physical examination and laboratory tests

Compared to oral questions, the physical examination phase is implemented in a much simpler manner. The patient's body is represented by a series of static two-dimensional drawings. Each drawing is implemented as an image map and each active image polygon has an associated set of examination tools or methods. For example a drawing representing the patient's face has two "eye" polygons with the appropriate examination methods (ophthalmoscope, visual acuity, palpation, etc.). The type and number of images, the active polygons and the examination tools are all specified in the case database and can thus be easily changed depending on case specifics.

Laboratory tests are implemented as a hierarchy of lists of individual tests, which take into account the actual time needed to obtain the result. For example, a white blood cell count is a quick test and the result is available immediately, while the result of a haemoculture will only become available during the next consultation. Such time dependency, while relatively unsophisticated, is an important feature of the simulator, because it forces the user to make decisions like in the real world, in the *context of uncertainty*, without necessarily having all the answers to his or her questions.

Decisions and performance evaluation

Decisions in VIPS are defined as either diagnostic actions (e.g. radiology) or therapeutic actions (treatment or referral) that can have immediate or delayed outcomes. Ending the consultation (without setting another appointment) is a special decision that leads to the evaluation phase: all items chosen by the learner are scored and the entire database of all possible user inputs/virtual patient outputs (approximately 1500 for internal medicine cases) is made available for exploration.

From a pedagogical point of view, the key feature in the VIPS evaluation is to establish an explicit link between a question or decision chosen by the learner during the consultation (*Reflection-in-action*) with validated, relevant knowledge from the literature (*Reflection-on-action*). This two stage process complies with Donald A. Schön's theory of the "Reflective Practitioner" [6], a canonical reference among educators in healthcare and other professional domains.

At the end of a VIPS session, the user may request a certificate of completion for any of the consultations that he or she has previously completed.

VIPS: what's under the hood?

Structure is more important than content in the transmission of information – Abbie Hoffman

As a software product, VIPS is comprised of four distinct components:

VIPS Virtual Patients

A single VIPS patient is defined by a database of author-rated physician questions and patient responses, diagnostic or therapeutic actions and patient outcomes. All pertinent items are linked to author comments and local or distant medical knowledge references in HTML format.

VIPS patient databases are built and maintained with Microsoft Access, but all data are serialised prior to the compilation of any given VIPS case and subsequent publication on the Internet. Such serialisation insures easy storage and transport across broad and narrow-band Internet connections and optimises overall performance.

The VIPS Simulator

The VIPS simulator is a 100% Java server application modelled with the Unified Modelling Language (UML), facilitating any type of customisation and upgrading. This component allows any user with an Internet connection and an Internet Browser to carry out virtual consultations. A stand-alone version for off-line use is currently under development.

The VIPS Web server

The current VIPS web server (Apache/Tomcat/MySQL) includes all the necessary utilities to publish and maintain VIPS cases, manage registered users, requests for certificates, statistics and other back-office functions.

The VIPS case editor

A case editor is available for potential authors interested in creating their own cases. Our experience has shown that the architecture and the methodology of the VIPS patient database allow rapid creation of new cases, providing that the learning objectives and the case scenario are well defined by the author. Very often, defining a quality learning objective proves to be the rate-limiting step.

VIPS: different uses and different opinions

People can have many different kinds of pleasure. The real one is that for which they will forsake the others. – Marcel Proust

Careful instructional design, proven didactic value, innovative technology, quality content and official accreditation are all futile accomplishments if in the end, the product is not adopted by the intended users. As many creators of e-learning products have discovered, the pathway to popularity is anything but a straight highway.

Because VIPS is ultimately only a tool for managing virtual consultations, it can operate in a number of different contexts. Our current experience with different VIPS implementations does provide two main clues as to what may render the system popular or not.

Synchronous, multiple user VIPS sessions in a live setting

Unsurprisingly, off all channels of delivery, a workshop-like context where several users carry out VIPS consultations in the presence of a moderator prove to be the most rewarding. With very few exceptions (individuals that simply dislike computers), the participants appear very enthusiastic about VIPS and the opportunity to use this tool in the future. VIPS software characteristics (user interface and ergonomics) in particular, are perfectly adequate.

Interestingly, workshops organized for potential VIPS authors are particularly well received. The principal learning objective of such workshops is to learn what it takes to become a VIPS author. Because the approach is patient-centric, it sheds a unifying, strongly pragmatic light on notions that are often taught as disparate topics: evidence-based medicine, intelligent use of PubMed and other medical search engines, critical appraisal of retrieved information, reflective practice in medicine, etc.

Asynchronous, individual, distant VIPS sessions

A small number of VIPS cases are freely accessible on the VIPS website upon rapid registration. The context is thus identical to that of any number of e-learning offerings found on the Internet that have no "push" component. The results are somewhat surprising: while new user registration is an ongoing, uninterrupted process, requests for CME certificates (offered free of charge) are

extremely rare. Moreover, the majority of users carry out one single test consultation and fail to return to the web site. At the same time limited feedback obtained from users is usually positive, although certain users complain about the complexity of the user interface and a feeling of being “left without any guidance” in the middle of a consultation.

Conclusion

The value of an idea lies in the using of it. – Thomas A. Edison

While VIPS can be used in a number of different settings (workshops, isolated online CME, bundling with other educational material, performance profiling, undergraduate education, etc.), we believe it is most useful in two situations:

- As a means to expose learners in a harmless and pedagogically stimulating manner to

errors known to have significant impact in medical practice.

- As a means to train and test clinical reasoning and decision making processes. It may in fact elegantly complement live SP encounters, which may then focus primarily on other crucial aspects of a medical consultation (communication and physical examination skills). The issue of popularity is of course critical. Based on our experience, we hypothesise that VIPS is a good illustration of how a quality educational product can fail to engage learners when it is offered as pure “e-learning”, and yet clearly satisfy users when used in a “blended learning” format.

At this stage of VIPS development it may be interesting to substantiate this hypothesis with real data. To this aim, we have created a short survey on our website for those readers who wish to discover VIPS for themselves and help us pave the way to popularity.

References

- 1 Nendaz MR, Raetzo MA, Vu NV, Junod AF. Teaching Diagnostic Skills: Clinical Vignettes or Chief Complaints?. *Adv Health Sci Educ Theory Pract.* 2000;5(1):3–10.
- 2 Howley LD. Performance assessment in medical education: where we’ve been and where we’re going. *Eval Health Prof* 2004;27:285–303.
- 3 Nendaz MR, Ponte B, Gut AM, Perrier A, Louis-Simonet M, Junod A, Vu NV. Live or computerised simulations of clinical encounters: do clinicians work up patient cases differently? A prospective study. Submitted.
- 4 Thivierge RL, Gagnon RJ, Raetzo MA. Virtual Internet Patient Simulation (VIPS). Validation d’un simulateur de consultations médicales: résultats d’une analyse qualitative. In preparation.
- 5 Raetzo MA, Loroche VA, Klioutchnikov G, Mironov D. VIPS (virtual internet patient simulation), un simulateur de consultations médicales sur internet. *Médecine et Hygiène* 1999;57:1032–8.
- 6 Schön D. *Educating the Reflective Practitioner*, San Francisco: Jossey-Bass; 1987.

The Federated Identity Management System AAI – a critical success factor for medical e-learning in Zurich

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Introduction

The faculty of medicine of the University of Zurich promotes the integration of ICT-supported learning environments into the curriculum. Since 2001, the virtual medical platform VAM (Virtuelle Ausbildungsplattform Medizin¹) is providing the medical students in Zurich with a growing number of highly interesting e-learning offers (figure 1). The e-learning projects on the VAM-platform presently cover approximately 7 % of the total curricular teaching / learning time. An analysis of the (anonymous) server-statistics shows that the VAM-platform is used extensively: every weekday one third of all medical students is online for 12 minutes on average (Data: 2003/2004).

The two main factors for its success are: (1) VAM only publishes e-learning offers anchored in the medical curriculum, and (2) the “keep it simple” strategy towards technology. The latter means that the learning management system used, is selected mainly on “ease of use” for end-users and authors. One crucial factor in this strategy is the login-procedure. With the introduction of the federated identity management system from SWITCH² the login procedure was considerably simplified for both end-users and platform administrators.

This paper gives an overview of the federated identity management system and its advantages, followed by its application for access to medical e-learning courses at the University and the University Hospital of Zurich.

The Federated Identity Management System AAI

The federated identity management solution run by SWITCH is called AAI, Authentication and Authorisation Infrastructure³. Participants eligible to take part in the SWITCH AAI federation are institutions of the Swiss higher education like universities and universities of applied sciences, university hospitals and research institutes. Apart from federation members, so called federation partners can offer services to federation members. Federation partners are for instance commercial e-journal providers.

A federation member can act as 1) a “Home Organization” by identifying persons, and 2) as a “Resource” that provides services to these persons (figure 2). Federation’s partners can act as Resources.

The AAI Home Organization

The “Home Organization” is typically a university that has a database for their staff members and students. It checks the identity of the persons in the database by means of an identification paper and keeps their records up to date. The Home Organization matches physical persons with a digital identity and vouches for the correctness of the data provided for this digital identity. The authentication of a user takes place at the Home Organization usually by means of username and password. Stronger authentication is possible, eg with certificates using smartcards.

The AAI Resource

The “Resource” is a web server, offering services over the internet, for example an e-learning program. A Resource relies on the user authentication provided by the Home Organization. If a user wants to access a service, he submits his credentials at the Home Organization’s server. The Resource then receives the information whether the user has been authenticated along with supplementary information (attributes) about the user. The user’s attributes are checked to make an authorisation decision: if the attributes satisfy the Resource’s access rules, access to the web server is granted.

Shibboleth

The servers of Home Organizations and Resources are connected to the internet like every other web server. However, to communicate together within a federation, there is some

1 Die Virtuelle Ausbildungsplattform Medizin (VAM). <http://www.vam.unizh.ch>

2 SWITCH, The Swiss Education and Research Network. <http://www.switch.ch>

3 Authentication and Authorisation Infrastructure (AAI) of the Swiss Education and Research Network (SWITCH). <http://www.switch.ch/aa>



Figure 1. The portal page of the e-learning platform VAM (Virtuelle Ausbildungsplattform Medizin).

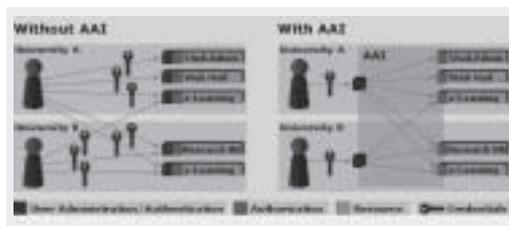


Figure 2. The AAI procedure: with AAI the user administration is organized by the Home Organization, in this example a university (see text for further details).



Figure 3. (a) The OLAT-AAI login screen. The user selects his Home Organization (eg University of Zurich) (b) Subsequently the user is authenticated (in the case of the University of Zurich by UniAccess).

special software needed: AAI uses the implementation of Shibboleth from Internet2 for its federation. Shibboleth⁴ is open source software and uses the Security Assertion Markup Language (SAML) standard⁵ for the exchange of authentication and authorisation information. Shibboleth is a widely deployed middleware in federations of higher education and can be seen as a counterpart to the commercial Federated Identity Management efforts like “Liberty Alliance Project”⁶

and “Web Services Federation”⁷. This does not mean that Shibboleth is going a way of its own: as the Liberty Alliance also uses the SAML standard, the basis is laid for interoperability.

The role of SWITCH is to run the federation as a service for its members and partners. Among other things, this service comprises the provision of a legal framework for the federation, which establishes the legal basis for the trust between the federation members. Trust is one of the basic elements, which makes it possible for a federation to function: its members are part of a “circle of trust”.

Implementation of AAI for Medical E-Learning Resources

In 2004 the faculty of medicine decided to migrate their e-learning content VAM from a commercial learning management system to the OLAT platform. One of the main reasons was the possibility to organize the access to the VAM contents for students and staff from all Swiss universities with AAI. OLAT (Online Learning and Training) is an open source, Java-based learning management system, used in the public sector of Switzerland⁸. The AAI login procedure has been implemented in OLAT since September 2004. The AAI authentication functions are executed by the previously mentioned Shibboleth interface. For the integration of AAI-attributes, the OLAT group was supported by SWITCH.

The main advantage of the implementation of AAI is, that all 8000 registered OLAT users (status: May 2005) are authenticated and authorised by one single system. This means that (1) for authentication the user needs his digital identity from the Home Organization, and (2) for authorisation the e-learning courses running on OLAT only have to define a rule, specifying which user-attributes are needed to get access to the course or course node.

⁴ The Shibboleth project.

<http://shibboleth.internet2.edu>

⁵ Security Assertion Markup Language (SAML) from OASIS Standards. <http://www.oasis-open.org/specs>

⁶ Liberty Alliance Project. <http://www.projectliberty.org>

⁷ Web Services Federation Language. <http://www-128.ibm.com/developerworks/library/ws-fed>

Web Services Trust Language. <http://www-106.ibm.com/developerworks/library/specification/ws-trust>

⁸ Online Learning and Training (OLAT).

<http://www.olat.org>

VAM users on OLAT coming from the University of Zurich Home Organization are handled by the UniAccess system⁹. Since a number of VAM users does not belong to an AAI Home Organization (eg guest lecturers), SWITCH decided to establish a Virtual Home Organization (VHO) for VAM. User accounts in the VAM-VHO are administrated by the Resource, in this case the e-learning coordinator of the faculty of medicine.

The SWITCH AAI has been in use since mid 2003. The first web server connected with the AAI was the dermatology e-learning resource for medical education DOIT¹⁰. This Swiss Virtual Campus project is developed and hosted in Zurich and is used by all medical schools in Switzerland. The login procedure is controlled by AAI, so that students are authenticated at their own Home Organization. In this specific case, the access is restricted to Swiss medical students in the clinical stage of their curriculum¹¹.

The University Hospital of Zurich as AAI Home Organization

Many employees of the University Hospital of Zurich need to access the e-learning contents of VAM. To facilitate the OLAT-login, the university hospital decided to become an AAI Home Organization. The university hospital has over 4000 employees and is a complex organization. The IT-infrastructure is Windows-based, various Unix systems are running for critical applications. The Active Directory Service (ADS) from Microsoft is used for user identification and authentication. The structure of the in-house ADS is rather flat; the employee's data are stored in a separate database.

The AAI logon server is linked to the ADS using Kerberos¹². The ADS data is transformed to an open form by an export into an LDAP-database. The shallow structure of the ADS data does not allow a distinction between employee, professor, technical staff etc. Rather than merging the LDAP-database with the employee database, the ADS schema got enhanced by specific groups. Access to VAM services will be given depending on the group-membership of the employee.

The University Hospital AAI-logon-server can be accessed from anywhere in the internet. Since the secure socket layer does not protect from key-logging programs, the potential danger exist, that the ADS username of employees is logged. Since the ADS account is the key to the com-

puter resources of the University Hospital, giving users a different login name for AAI circumvents this security problem.

One problem still to be solved is that the AAI-logon-server sees the un-NAT-ed IP of the computer in the intranet (NAT: Network Address Translation). This address is interlaced into the AAI-ticket. The address verification by the OLAT-server fails, because the OLAT-server sees the address of the USZ firewall and it cannot pass over the NAT.

The integration of the AAI-server is planned to be operative from autumn 2005. With the AAI infrastructure more web services can be made available over the internet, like access to the hospital phonebook, currently only available from the intranet. Other specific intranet contents may follow.

Conclusions

The introduction of AAI has been a success for e-learning in Zurich. Since September 2004 the access to the VAM-content on the OLAT server is organized by AAI and therefore the users can access the medical e-learning content with a single login and password that is authenticated at their Home Organization. The advantage for the user is that the amount of digital identities is reduced; the advantage for the Resource is that the user administration is reduced to implementing an access rule for each e-learning course, since the authentication is organized and administrated by the Home Organization. The implementation of the AAI in a Resource or Home Organization is illustrated by the examples of the learning management system OLAT and the University Hospital respectively. With the help of SWITCH the technical implementation of the AAI is rather uncomplicated. However, the consequences of coupling the login system of the Home Organization to the AAI system and the resulting possibilities of access internet resources from anywhere, forces organizations to reconsider their security strategy, as shown by the example of the University Hospital of Zurich.

⁹ UniAccess of the University of Zurich.

<http://www.access.unizh.ch>

¹⁰ DOIT. <http://aai.cyberderm.net>

¹¹ "AAI, just do it" SWITCH Journal 2/2004: 28–29.

<http://www.switch.ch/about/switch-journal.html>

¹² Kerberos, *The Network Authentication Protocol*.

<http://www.mit.edu/kerberos>

**nächste Ausgabe:
Dezember 2005**

**prochaine édition:
décembre 2005**

Die nächste Ausgabe des Swiss Medical Informatics erscheint im Dezember 2005 und behandelt folgendes Thema:

**Schweizer Beiträge
zur MIE 2005**

La prochaine édition du Swiss Medical Informatics paraîtra en décembre 2005 et traitera le sujet suivant:

**Contributions suisses
au MIE 2005**

In eigener Sache

Die neue SGMI-Website

Zum zweiten Mal innerhalb eines Jahres hat sich das Layout der SGMI-Webseite geändert. Nach intensiver Evaluation des Content-Management-Systems sind wir schliesslich auf das Open-Source-Produkt "typo3" (<http://www.typo3.com>) gekommen. Dieses basiert auf der bewährten und kostengünstig betreibbaren Linux-Apache-MySQL-PHP (sog. LAMP) Technologie. Typo3 ermöglicht die Integration von sogenannten Extensions, welche erweiterte Funktionalitäten integrieren, so dass sehr viele Features genutzt werden können. Einige dieser Features, z.B. ein Forum für Verbesserungsvorschläge, wurden bereits integriert. Ebenso wurde ein Memberbereich geschaffen, welcher jedem SGMI-Mitglied den Zugang zu einem sich im Aufbau befindenden Bereich gewährt. Dort kann jedes Mitglied interessante fachbezogene Events eintragen. Alle Mitglieder werden diesen Zugang nächstens erhalten.

Wer Fragen oder Inputs hat, kann diese im Forum stellen oder direkt an den Administrator richten.

Wir hoffen, damit einen Beitrag zu interessanten Angeboten zu leisten, und freuen uns auf viele interessante Inputs.

*Dr. med. U. Woermann, Chefredaktor
des «Swiss Medical Informatics»*

Ausserordentliche Generalversammlung der SGMI in Bern

Programm:

- 14.00 Integrierte kantonale Gesundheitsversorgung: Wunschtraum oder Wirklichkeit?
- 15.00 Kaffeepause
- 15.30 Generalversammlung
- 17.00 Apéro

Detaillierte Informationen werden per Post oder E-Mail versandt.

Assemblée générale extraordinaire de la SSIM à Berne

Programme

- 14.00 Réseau de soins cantonal et intégré: rêve ou réalité?
- 15.00 Pause de café
- 15.30 Assemblée générale
- 17.00 Apéro

Des informations précises seront envoyées par courrier postal ou électronique.

Events

Switzerland

ENI 2005 – European Nursing Informatics

Date: 4.–5.11.2005

Location: Zürich

Contact:

<http://www.printernet.info/eni.asp>

Slice of Life 2006

Date: 4.–8.7.2006

Location: Lausanne

Contact: <http://www.slice.utah.edu>

Europe

Mednet 2005 – the 10th Annual World Congress on the Internet in Medicine

Date: 4.-7.12-2005

Location: Prague

Contact: <http://www.medinfo.cz/>

[MedNet2005/](http://www.MedNet2005/)

World

AMIA 2005 – American Medical Informatics Association

Date: 22.–26.10.2005

Location: Washington DC

Contact:

<http://www.amia.org/meetings/annual/current/>

NI2006 – 9th International Congress in Nursing Informatics

Date: 11.-14.06.2006

Location: Seoul, Korea

Contact:

<http://www.ni2006.org/main.html>