

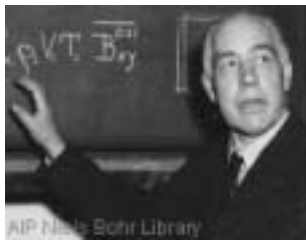
Teaching and Learning of Medical Basic Sciences Using New Media

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Introduction

I'm invited to have a keynote about the use of computers in the learning of medical basic sciences. I'm somewhat surprised about this invitation - since computer based medical education has seen better times. However, I think that the time is good to give it another try since there are now some experts available in this field. Niels Bohr explained what makes an expert with the following words:



Show Next Slide: "An expert is someone who made all the mistakes that can be made - in a very narrow field"¹ (Niels Bohr).

Therefore, my goal today is to share with you some of the mistakes I've made - as well as some of the strategies and techniques that I found helpful for my work.

And here is how I will structure my talk:

1. Tell the story how I became a multimedia doctor and the individuals who guided me

¹ <http://www.quoteworld.org/author.php?thetext=Niels%20Bohr>

Another nice quote of Niels Bohr that can be found at that site is:
"Never express yourself more clearly than you are able to think."

2. Illustrate my ideas and beliefs with examples of my own work
3. Present what I learned from the literature
4. Show good examples of new media for medical basic sciences education

But first, I would like to acknowledge the individuals who most influenced my work. These are Joe Henderson with whom I have the pleasure to work with, Howard S. Barrows and Geoff Norman from McMaster, George Bordage from the Department for Medical Education in Chicago, Rolf Schulmeister from the interdisciplinary center for didactics in Hamburg and not to forget my dear friends Marco Mumenthaler, Suzanne Stensaas and Raphael Bonvin.

1. The story how I became a multimedia doctor

I'm a medical doctor who started in 1994 with the creation of learning programs in a moment when computers became capable to handle multimedia content. What I was doing was more or less an attempt to use my experience as having graduated from medical school to develop computer-supported aids for learning that I would have enjoyed to have available as a student.

I was lucky to have found a field of work where I could bring in most of my knowledge, skills and attitude. I have a long lasting interest in design and art besides a love for medicine and some computer skills. That's why I attended a year at the school of fine arts in Zurich before going to the medical school, and while studying medicine I earned part of my living with the development of databases.

I consider myself more as a man of action than grounded in research and theories; my portfolio therefore shows far more successfully completed projects than papers.

Show Next Slide: Projects

See <http://iml.dartmouth.edu/cda/projects/> for a list of my projects

However, during the last 10 years I tried to get an overview of the body of knowledge

that was produced in the field of media assisted medical education. In this talk, I'll try to convey what I consider important. I will do this using story telling combined with showing "life" examples.

First story: How I found out that the information given in the programs must be relevant

I remember very well how offended I personally was when I looked through the log files of the computer stations in the learning lab at the University of Berne Medical School in Switzerland. There we had installed the most wonderful learning programs – and the students instead of beleaguering the learning stations ignored them almost completely.

I came up with a simple theory to explain this: In order to create good learning programs you have to work together with good teachers – but where you have good teachers, you won't have the need to use learning programs. So you can only produce where you won't need what you produce – and worse: because of the "not invented here"² syndrome, it also won't be used at any other place.

However, my theory was not right since a very important part was completely missing, the relevance. Students will use the programs if they are addressing their needs. And Medical Students have very clear goals: to become good doctors and to pass the exam. The students know exactly that they will have to digest a lot of information into learned, applicable knowledge and skills in order to reach their goal. They are also very aware of

² I am not sure what exactly are the reasons for the "not invented here" syndrome.

I was considering the fact that a not-as-good teacher won't be compared with a really good one, even if this one is not actually here but as part of a learning program – and so tries to find a weakness – which is always to find somewhere – and then takes this as a reason to condemn the whole program.

An other explanation of the "not invented here" syndrome would be that if somebody starts working on something, this person does not want to know that somebody is doing something similar that could be more advanced already. If you don't look around you won't see anything that you don't want to see. In such a case it's kind of a reflex to say something other can't be good – just to protect you from becoming aware of the real world.

the fact that they have hardly enough time to achieve this, and therefore they have to be very careful how and where to invest their study time.

Sadly, there is no such thing as a wonderful learning program that is widely used by students because it's fun to work with.

I had to take this insight as an order to invest 70% of my energy into the development of programs that served the students needs – but was still allowed to invest 30% of my time with the exploration of how the then very new technologies like CD-ROM and Internet could support learning.

2. Illustration of my ideas and believes with examples of my own work

And so I had to develop a computer based multimedia program to serve the needs of the curriculum and the students for self paced learning in ophthalmology. I made use of what the new technologies allowed me like pattern recognition and explorative learning. I was lucky that the program was recognized as useful – and since it addressed an existing need it was declared mandatory for the medical students at the University of Berne Medical School, so all the students had to learn with it, and it's now in its 2nd edition still being used that way.

Let me at this place show you a glimpse of the program, so you understand what I'm talking about



Show Next Slide: DEMO of AUGENFUNDUS

<http://medweb.dartmouth.edu/ocularfund/>

5 Minutes, showing pattern recognition, explorative learning and emotional involvement by establishing a link to a real patient

Personal emotional involvement is an often-neglected factor in learning. In case of medical students, the presented knowledge should reflect its connection to the ultimate goal of medical education, which is the artful application of medical care towards patients.

That's why each photo of an ocular fundus – and there are more than 60 in that program - is first related to the human it has been taken of. So when the student gets to a slide, one is at example reminded the “this is the right eye of a 54 year old teacher, suffering of diabetes.”

If I would start today with the development of a similar program, I would go further into that direction and have a short video statement of each patient included, where the patient would tell us what the problem is of being affected by this medical condition. “It was as if a dark curtain covered my view” could be the statement of a patient suffering of a retinal ablation. “I could not open my eye, it was so hurtful when I even tried it that I closed my eyes as strong as I could” might would be a description of a patient suffering of an inflammation. I personally think that such links between pathology and what patients experience would lead to young doctors being more empathetic and understanding with their patients.

That's what we tried in our next program, “Neurology Interactive.”

There we chose a patient-centered, case based approach to the topic.

I will give you here a short presentation of the English Version of that program that was awarded in 1998 with the European Academic Software Award.



Show Slide: DEMO of NEUROLOGY INTERACTIVE

http://www.aum.iawf.unibe.ch/prod/cd/Neuro_Projekt.htm

5 Minutes, showing case based learning, explorative learning and emotional involvement.

A specialty of this program is the demonstration how a caring physician interacts with

patients.

Marco Mumenthaler, distinguished professor emeritus of Neurology, ex-provost of the University of Berne, author of many textbooks in neurology that have been translated into 11 languages, was co-authoring this program with me. He is a very good role model of a caring, knowledgeable, and skilled physician. I think that the success of the program is based on how we managed to make his persona available to the learner.

The core part of the program “Neurology interactive” is the simulated physical examination, which can be performed on 10 simulated patients using 11 different tools. Besides that, also further examinations like X-rays, CT, Lab, Liquor and more can be performed. The technique used to present the result of these exams to the students is similar to the one used in the program about the ocular fundus. It’s a technique to foster explorative learning in providing the student in a first step with the uncommented results of an examination – e.g. the picture of a chest X-ray. The student can then choose to see an interpretation the results. In doing so, the student will have an idea what the interpretation will be. When the interpretation is finally discovered, the student’s expectation will be met or disapproved.

As mentioned above, this program received the European Academic Software Award 1998 in Oxford, UK. That was a big deal for me, of course. At that time, I ran the media-learning center at the University of Berne Medical School. I installed the program on all learning stations. I expected the students to enjoy my wonderful program so much that they all would use it for their learning and buy it afterwards when they discovered how many layers of medical knowledge it covered... and some of the students really seemed to enjoy it, but far not as many as I expected it to be. Neurology was not part of the Swiss medical board exams, why should then the students bother? However, the company that was publishing it in German speaking Europe sold more than 2000 copies – mainly in Germany where Neurology is part of the medical board exams.

It took Marco Mumenthaler and me about 4 years to complete “Neurology interactive.” During that time, we became friends – and when it was done we had to find another

project to continue our working friendship.



Show Next Slide: Marco Mumenthaler

When we were working on “Neurology interactive,” we did not succeed in finding an interactive way to teach history taking skills. However, soon after its completion, we had a promising idea about a way in which this could be done. We decided to prove our concept and to develop a computer program for the learning of history taking skills. We chose “Headache” as the topic since the diagnosis of the different forms of headache is mainly based on a complete medical history, and Marco Mumenthaler is known as a headache-expert. Even better, he could bring in the necessary funding to make it happen.

We were lucky that our concept was right. “Headache interactive” received the European Academic Software Award 2000 and the Award of the Medikinale International 2000 in Munich. I would like to show you in the next 5 minute how we accomplished the task to help the student in the learning of history taking skills:



Show Slide: DEMO of HEADACHE INTERACTIVE

5 Minutes, showing learning by watching someone doing something, meta-layers of specialist’s knowledge, emotional involvement, enabling self-assessment

You may wonder why I show you programs that run from CD-ROM and not from the Internet. The explanation is simple: we don’t have Internet access in this room, so I can’t

give you a demonstration of Internet programs. But that's only part of the truth. The other part is that the Internet is still often too slow to be used for bandwidth demanding applications.

That's it for showing you excerpts of my works. I'll go on now with the presentation of some thoughts, ideas and facts about medical learning that are somewhat related to how technology can empower learning best.

3. What I learned about how new media can empower teaching/learning

The environment in Berne: Master of Medical Education

Show Next Slide: Berne

When I was working at the University of Berne Medical School, I was lucky to be in the right place at the right time: when Juerg Steiger initiated in the Department form Medical Education – where I was working in the section for educational media - the first “Master of Medical Education” in the German speaking part of Europe. That's where I came to a more comprehensive understanding of medical education. I learned that new media are not the centerpiece of a medical curriculum but one of many assets. I also began to understand that the best way to build a meaningful curriculum is to start with a definition what the final product has to look like - as is done at example in the Swiss Catalogue of Learning Objectives for Undergraduate Medical Education³ – and then to find existing and create new instruments that would allow the students to get there.

How does learning work – sequence of content

I heard Geoff Norman's talk at last year's AMEE (Association for Medical Education in Europe) conference in Berne, where he impressed me with the following statement:

³ <http://www.smifk.ch/>



Show Next Slide: Geoff Norman

“The acquisition of expertise in an area can be characterized by the development of idiosyncratic memory structures called semantic networks, which are meaningful sets of connections among abstract concepts and/or specific experiences. Information is retrieved through the activation of these networks. Thus, when teaching, new information must be embedded meaningfully in relevant, previously existing knowledge to ensure that it will be retrievable when necessary.” (Regehr G, Norman GR, 1996)

This said, Professors with a lot of knowledge (exception: facilitators in problem based learning settings) in their domain are in charge of educating the students. For their own learning, pre-existing knowledge allows them to incorporate new facts easily, since the semantic networks and schemes are already in place. For these specialists it is important to understand how students can be helped first in the building up of such semantic networks which then can hold new information and transform them into knowledge. Novice students are learning best when the information is didactically presented in small bits as I will explain further.

Allow me to put here a personal remark about the recent research by Geoff Norman as he describes in the “International Handbook of Research in Medical Education”. Norman found that the promise given by Problem Based Learning to help the student in the development of unspecific problem solving skills is not kept. More so, that there is no such thing than domain unspecific problem solving skills.

Show Next Slide: Fishing



We have to ask if the analogy outlined in “traditional learning is like giving a fish to a starving man whereas problem based learning is about teaching how to catch fish” is still true. However, there are many different ways how to catch fish – in New Hampshire it’s fly fishing in streams, on the ocean its fishing with nets and if it’s about fishing for whales let’s ask captain Ahab. My point is that also fishing is content specific and a fly fisher won’t succeed in fishing for a whale.

How does learning work - media & sensory input

From my colleague Sissel Guttormsen who is specialized in cognitive ergonomics and leads the laboratory for man-machine interaction at the Swiss Federal Institute of Technology in Zurich, Switzerland, I learned about research how information is perceived and processed. I would like to share two main messages that I take out of this with you.

The first one is, that if the auditory and the visual system are addressed simultaneously – as is the case in showing a picture or movie and explaining it verbally – is a very efficient way to transmit information that than can be incorporated into the working memory and be transformed into knowledge. (Paivio’s dual coding theory, Mayer’s Cognitive Theory of Multimedia Learning)

The second one is that there are clear limitations how much new information can be processed at once. Learning happens in small steps of 7 (+-2) chunks of information, which have to be “digested” before the working memory becomes ready for new input

(Sweller's Cognitive Load Theory). This research strongly suggests not giving unnecessary information to avoid overload.

*Next Slide: SHOW EXCERPT of the movie
PAPILLON*

OutSight™ and a
Photo-JPEG decompressor
are needed to see this picture.

Where Steve McQueen explains that waves come in groups of seven, and that the seventh wave is what all is about...

Active learning and media presentation

Since learning happens when information in the working memory is processed and meaningfully integrated into preexisting knowledge, the brain has to work to make this happen. There is a pitfall for multimedia learning to be avoided: seeing is not understanding. I remember how George Bordage from the University of Illinois Medical School Department of Medical Education in Chicago explained once a study in which students had to learn the anatomy of the skull using either high quality 3 D animations or simple sketches. The group who learned with the simple sketches outperformed the 3 D group. My interpretation of this is that information to be learned should be presented in a form that leaves the final processing up to the student's brain.

Explorative learning

My own works deal with explorative and case based learning for students in clinical medicine. I already made my points when I was showing you excerpts of my programs.

4. How new media can empower education

Repositories of Learning Objects for Medical Education

Other than in the first round of software development for medical education, it's no longer about the creation of self-contained learning programs that you hand over to the students, you are in charge of the curriculum, you stay in charge of the curriculum but you include computer learning objects into your teaching where appropriate.

When Suzanne Stensaas told me how happy she is that in my programs the patient movies are easy to find and to identify so she can easily pull them out and incorporate them into PowerPoint slides for her teaching, I realized that complex self-containing programs are not what the teachers are asking for, but collections of high quality multimedia learning objects.

Next Slide: MedWeb

see <http://medweb.dartmouth.edu>

I came up in 1998 with one of the first editable database to serve as a repository of such learning objects: <http://MEDWEB.dartmouth.edu/>. This database was build to hold descriptive links to case based web resources for medical education and to resources that teach medical skills. It was - and still is - open to the public, and it allows users to add new links to other resources and to describe them. When the MedWeb database became available, I made it public with a note I sent using the Ed-Med list-server. The response was overwhelmingly positive, however not many links have been added from the "outside."

Next Slide: HEAL

See <http://www.healcentral.org>

In 2000, the **HE**alth **A**ssets **L**ibrary **HEAL** www.HEALCENTRAL.org came to life, a collection of high quality multimedia learning objects that originated from a 1998 UCLA project. It was endorsed by the AAMC and in September 2002, the National Science Foundation awarded \$780,000 to HEAL for its continuing development.... now there are more than 37,000 resources available through HEAL!

HEAL's mission is to provide free digital materials of the highest quality that meet the needs of today's health sciences educators. HEAL promotes the preservation and exchange of useful educational assets while respecting ownership and privacy. By using state-of-the-art Internet technologies, HEAL enables educators across the country to efficiently search and retrieve teaching materials from a variety of sources. (from the healcentral webpage)

This sounds like an advertisement for a used car. However, in this case the big and shiny words are no lie: HEAL holds its promise to be a major achievement for technology enhanced medical education. It really does offer a whole bunch of high-quality learning objects ready to be integrated into teaching courses – so faculty can enhance teaching with having to spend less resources and money on the development of such learning objects.

That's why I will give up the MedWeb repository and endorse HEAL in the very near future. And here is why it's still online and being used.

Literature, Movies, Arts, and Medicine

One of the things that are available on MedWeb but not on HEAL is a repository of Movies that have something to do with medical conditions. Why I put such a repository online has several reasons.

One personal reason is that I like movies.

A not as personal reason is the fact that our concept of the world is partly made up by movies, by the stories they tell and the rules it's protagonists follow. This is the case as well with literature and the arts – but the influence of movies has gained strength since the average time of exposure has increased over the last 50 years enormously.

Next Slide: SHOW EXCERPT of FANTASTIC VOYAGE

Trailer from the movie “Fantastic Voyage” that was a reason for more than one of my colleagues to consider becoming a physician

See <http://medweb.dartmouth.edu/movies/>

QuickTime™ and a
Photo-JPEG decompressor
are needed to see this picture.

I have to commit that my concept of the medical condition “autism” is based partly on the movie “Rain Man”, where Dustin Hoffman plays an autistic individual.

And when Keanu Reeves in the “MATRIX” takes the red pill and so becomes aware that the whole world as he knows it is a fake and he is the chosen one. This illustrates a schizophrenic mindset at its best!

And if I had seen a movie about a manic depressive patient before I went to the board exams in psychiatry, I may had a better idea about the danger these patients are in because they think that they are indestructible, so when they cross a highway they can't be hit or hurt by a car. I would have understood why it is sometimes to a patient's best benefit to be kept in a safe place.

Of course I was not the first who came up with the idea to collect medical links to movies, literature and art. When I published the MedMovies repository in the MedEd-List, I was pointed to the Hippocrates Project at NYU, where since 1993 resources in medical humanities are collected:

The Literature, Arts, & Medicine Database is an annotated bibliography of prose, poetry, film, video and art which was developed to be a dynamic, accessible, comprehensive resource in MEDICAL HUMANITIES, for use in health/pre-health and liberal arts settings. It is a multi-institutional project (see Editorial Board), which was initiated, by Drs. Felice Aull, Martin Nachbar, Karen Brewer, Roy Smith and Irene Chen '96 of the New York University School of Medicine in

the summer of 1993. This Web site is produced and maintained by the Hippocrates Project, the multi-disciplinary development laboratory for application of information technologies to medical education at New York University School of Medicine. (<http://endeavor.med.nyu.edu/lit-med/lit-med-db/about.html> and <http://endeavor.med.nyu.edu/lit-med/lit-med-db/webdocs/webkeywords/>)

A footnote to this is that I met Marty Nachbar at a meeting about simulated patients at the AAMC in Washington and subsequently he invited me to give a presentation at his Lab at NYU... and that he never mentioned the Hippocrates project to me, nevertheless we had a very interesting discussion about medicine and the humanities. That's how things go..

Self-contained learning materials

I met Joe Henderson for the first time in Karlsruhe, Germany, when he was giving a presentation about the HIV/AIDS virtual clinic program. I was fascinated by his approach of showing many aspects of a medical condition including the psychosocial and personal dimension where the disease is a dramatic event in the patients live – and where medicine is not only applied science but also an art.



Next Slide: Joe Henderson's Credo

"For the most part...practice is viewed as technically rational and mechanistic, addressable by the application of theory-based facts and rules. This restricted model of health care largely ignores the psychosocial dimensions of health and illness. It does not prepare students to deal effectively with the real swamp of professional practice, particularly in the majority of cases where the variability of human behavior and human situations plays a role." (Joe Henderson)

When I met Joe for the second time – this happened at the Slice of Life conference in Philadelphia in 1999 – he came to my booth and had a close look at my programs. He liked them so much that he offered me a job as Assistant Professor at his lab. That’s how I got to work with him for the last three years. Since my term at the Interactive Media Lab will end in only little more than a month, I can tell from experience that the work with Joe was very rewarding in the personal and in the professional dimension. I enjoyed especially to work on the project “Smoking Cessation in Pregnant Women and Beyond” that I would like to explain a bit further here.



Show Next Slide: DEMO

***Smoking Cessation for Pregnancy and Beyond:
Learn Proven Strategies to Help Your Patients
Quit***

<http://iml.dartmouth.edu/education/cme/Smoking/>

Show the Virtual Practicum Model

Joe had developed the “Virtual Practicum” model for computer assisted medical education. This model combines different learning experiences like simulated cases with reflective case discussions, lectures interviews with real patients, so the personal dimension becomes understandable. In short: Joe makes the point that the way his programs are crafted reflects the best practice and is sometimes even superior to other ways of learning. And his arguments are strong: the first step in the development of such a “virtual clinic” is the nation wide search for “best” content experts with whom an advisory panel is build. The panel then outlines the final learning content and comes up with the naming of leading individuals who are willing to contribute with lectures or reviewing cases or doing case discussions. This process is more or less the same as if a group of dedicated educators has unlimited resources to come up with an optimized teaching, only that the virtual clinic programs are crafted to be used with computers.

Automated learning materials

While Joe Henderson combines different learning experiences artfully, an actual trend goes towards attaching SCORM meta-data to learning objects. This with the declared purpose, that a system when fed with a learning request could retrieve the appropriate learning objects and present them in meaningful sequence to the learner. The dream of automated learning is a nightmare to me, since I see no need to dismissed the human out of one of his dearest activities: teaching – and I'm sure that automated systems will never become able to do it's job artfully.

From Computer Based Instruction to Computer Mediated Communication

Besides the delivery of learning materials, computers can be used to connect and coordinate individuals in different locations into learning groups – which is especially interesting in case of project-based learning.

Greg Kearsley, author of some books about education and technology, states the following:



Next Slide: Greg Kearsley about Computer Mediated Communication

“There is a big difference between the earlier and current forms of online learning. The earlier type, called Computer Based Instruction (CBI), focused on the interaction between the student and computer drills, tutorials or simulations. Today, the prevailing paradigm form of interaction is Computer Mediated Communication (CMC), where the primary form of interaction is between students and instructors, mediated by the computer.” (Kearsley G, 2000)

Blackboard and WebCT are examples of available software that have the potential to assist collaborative learning.

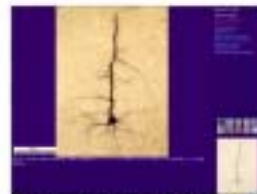
5. Examples of special interest for the study of medical basic sciences:

In the following, I present as time allows some of the programs that I consider good examples for computer assisted teaching and learning for the basic medical sciences.

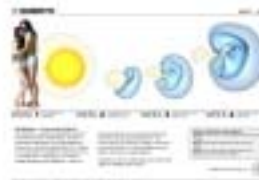
Some Programs for you...



An@tomedia



Histology Explorer



3D Embryo



HyperHeart

Next Slide: Medical Basic Sciences Learning Programs

Thank you!

Christof Daetwyler, July 8, 2004