RadioWeb

The Design, Development and Formative Evaluation of Web-Based Learning Material for Radiology

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Thesis

submitted in partial fulfilment

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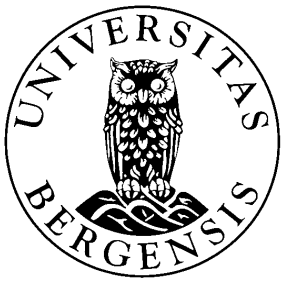
Candidata Rerum Politicarum



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ABSTRACT

This dissertation describes the RadioWeb project. The scope of this project was to plan, design, develop and evaluate a prototype for delivering web-based learning material in radiology at the University of Bergen. The learning material includes an online web lecture, lecture notes, exercises and a discussion group. The dissertation consists of two parts: the first part describes the different stages in the development of RadioWeb, while the second part focuses on the formative evaluation of RadioWeb. This evaluation was carried out as a field test with students from the target user group and the intention was to discover potential improvements regarding the design of RadioWeb.

The research question asked was: “What new design issues arise from a formative evaluation of RadioWeb?” and the answer turned out to be: “Quite a few”.

ACKNOWLEDGEMENTS

Several people have contributed to the RadioWeb project. First of all, I would like to thank my supervisor Barbara Wasson for involving me in this project, for supervising it, for encouragement, and for very valuable proofreading.

I would like to thank Jarle Rørvik, assistant professor at the Section of Radiology at the University of Bergen, who first initiated the project and who has spent much of his valuable time on it during the entire process. His time, expertise and encouragement have been invaluable!

I am extremely grateful to the staff at the University Media Center, especially Xavier Bonète, for contributing to the production of the material included in RadioWeb.

I would also like to thank Helge Opedal for assisting with any technical problems along the way, my good friend Asbjørn Hornnes for sharing his medical expertise with me, Stig Frode Samnøy for assistance during the development and Weiqin Chen for being my co-supervisor early in the project.

On the personal level I would like to thank my parents for financial and emotional support and my friends, especially The Fab Four, for encouragement and support.

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Figures and Tables

1. INTRODUCING THE PROJECT

The RadioWeb project set out to develop a prototype for providing web-based learning material for the introductory course in radiology at the University of Bergen. The learning material is meant to supplement the traditional instruction by allowing the teachers to use their limited amount of classroom time for discussions and elaboration, rather than information presentation. The developed learning material should serve the role of presenting the material to the learners, and the idea was to make the learning material more accessible by delivering it online. The scope of the project was to plan, design, develop and evaluate a prototype for learning material equivalent to the content of one lecture. This dissertation describes this process of development and evaluation of the online learning material for radiology, henceforth referred to as RadioWeb.

1.1 Background

The background for the project was the pedagogical foundation for instruction in radiology, which states that one of the focus areas should be to develop computer-based learning material (Rørvik, 1999). Jarle Rørvik, assistant professor at the Section of Radiology, was in charge of developing a strategy for increasing the use of ICT in the radiology education, and he decided that he wanted a web lecture prototype. He contacted InterMedia at the University of Bergen asking for collaboration, and I became involved in the project. I had attended the research seminar "Research Methodologies in Pedagogical Information Science" in the autumn 2001, and was interested in finding a project that would allow me to combine knowledge from this course with my interest in media and information studies. In addition, I wanted to do some hands-on development as part of my thesis.

From a funding programme for ICT and learning at the University of Bergen, the project received funding in the form of 50.000 NOK worth of services from The University Media Centre (UMS). These funds were used to buy the production of two flash animations, the production, editing and compressing of one video, and the recording, digitally capturing, editing and compressing of all the narration audio.

1.2 Participants and Division of Work

The team involved in the project consisted of:

1. Jarle Rørvik, assistant professor at the Section of Radiology, and the subject matter expert in the RadioWeb project. He is the faculty member who teaches the course on-campus and the one who initiated the project. His major responsibility was to supply the course materials.
2. UMS – represented by Xavier Bonète, a designer specialist from UMS. Worked with the SME to produce the more complex animation and to record video and audio.
3. Kristine Sevik, author of this dissertation. Responsible for creating the pages, producing the online material, communicate with faculty and UMS, coordinate work and evaluate the prototype. When referring to my work conducted in relation to this thesis, the personal 'I' form will be used; when referring to my role as one of the team members, I will refer to my role as 'the designer'.
4. Helge Opedal, engineer at the Faculty of Medicine. Hosted the server where the RadioWeb pages were located and assisted with any technical problems.
5. Asbjørn Hornnes, at the time a medical student, now a doctor. He produced manuscript for, and read the narration audio for, an animation produced by UMS.

1.3 Teaching of Radiology

The Section of Radiology is part of the Institute of Surgical Sciences at the University of Bergen. Students are welcome to observe the activities performed at the radiology unit as long as they use a white coat and bring their ID card. Leader of the section, and responsible for the instruction, is assistant professor Jarle Rørvik. A focus area for the section is increased use of ICT in the education.

Radiology refers to medical imaging techniques. Simply put, radiology is the study of images of the human body. It used to deal with radiation and radioactive substances and their use in diagnosis and treatment. Today the radiologist has a variety of tools for 'taking pictures' of patients. Many of these newer tools use a computer to create images and some do not use radiation of any kind[1].

All students in the medical school have to complete a mandatory course in radiology. This course consists of four modules which are taught in the 3rd to 6th year of medical studies. This project has focused on the introductory course in radiology. Today this instruction takes the form of lectures and tutoring in small groups.

Table 1.1. The radiology instruction offered at the University of Bergen

Course	Form of Instruction	Duration	Year
Basic Course	Guided tour of the radiology unit	2 hours per student	3rd
Introductory Course	*a) Classroom lectures*	*10 hours*	*3rd*
	b) Group Tuition	12 hours	3rd
Decentred part	Practicing radiology at hospitals	10 hours	4th or 5th
Examination preparation	Group tuition. Solving cases. Problem oriented	18 hours	6th

[1] An example of such technique is Ultrasound which involves the sending of sound waves through the body. Those sound waves are reflected (echoed) off the internal organs. The echoing waves can be used to identify how far away the object is, how large it is, and how uniform it is.

The introductory course is held in the third year in medical school and consists of 10 one hour lectures and 12 hours of group teaching. This course is meant to give the students an understanding of the methods, procedures, and basic principles for diagnostic imaging, and knowledge of indications and algorithms used in radiology. The group teaching involves a great deal of interaction where radiological images are the starting point for a discussion between the instructor and the students. Approximately 70 students take the introductory course each semester.

1.4 The Challenge

It has been a challenge to make the classroom lectures engaging since the students lack the necessary clinical expertise to see the overall purpose of the subject. Most of the lectures are based on PowerPoint presentations (Microsoft, 1987-2001) with text, radiographic images and simple animations. Rørvik's idea was to build a prototype that addressed the material usually presented in the first lecture of the introductory course. This lecture introduces the different techniques used in radiology.

The web-based learning material, consisting of a web lecture, as well as lecture notes, exercises and discussion group, should be available to the students via the Web and is intended to be used in addition to regular face-to-face lectures.
This dissertation describes both the development and the evaluation of RadioWeb. Because of this, the dissertation contains two parts:

- The first part describes the design process and the development of the RadioWeb prototype.
- The second part focuses on the formative evaluation conducted on RadioWeb with students from the target user group.

The scope of the end user evaluation was to discover improvements that should be made to the program before initiating a full-scale development of the product. Data was collected to answer the following research question:

What new design issues arise from a formative evaluation of RadioWeb?

This evaluation took place in May 2002 at the Faculty of Medicine at the University of Bergen. The respondents were members of the target user group, that is 3rd year students of medicine.

1.5 Outline of Content

The next chapter, Chapter 2, presents relevant literature concerning delivery of instruction on the Web, development of software systems, development of instructional material (instructional design), and formative evaluation. A model for development and formative evaluation of educational programs is presented towards the end of Chapter 2. This model serves as a starting point for Chapter 3 which describes the phases of planning, designing and developing RadioWeb and the corresponding phases of evaluation performed during program development. Chapter 4 presents RadioWeb with its key features at the time it was ready to be evaluated by real end-users. Chapter 5 describes the data gathering techniques used to collect the data for the purpose of answering the above-mentioned research question, while chapter 6 presents the findings from the end user evaluation. Chapter 7 discusses the results from the evaluation of RadioWeb. This final chapter also seeks to sum up the project, and to discuss the project's success in achieving its goals.

2. LITERATURE REVIEW

This chapter gives an introduction to topics relevant for the rest of the thesis. The purpose of this chapter is to account for the different theories that governed the development of RadioWeb, described in chapter 3, and the formative evaluation undertaken, described in chapters 5 and 6. Part one of this chapter describes different approaches to the delivery of instruction, especially the delivering of instruction on the World Wide Web. Part two of this chapter describes different models of system development together with instructional design models for developing learning material. A model for developing and formatively evaluating educational programs is presented towards the end of the chapter, and this model serves as a starting point for the rest of the thesis.

PART 1: LEARNING AND INSTRUCTION ON THE WEB

Learning is a lifelong process that occurs both intentionally in formal settings, such as in schools, and in informal settings, such as at work, in interaction between people, etc. Different theories of learning make different assumptions on how people learn and remember. Instruction can be viewed as efforts to facilitate learning (Alessi & Trollip, 2001; Dillon & Zhu, 1997; Driscoll, 1994; Gagné, Wager, & Briggs, 1992), thus the design of instruction should be influenced by some assumptions about how people learn, i.e**.** a learning theory. Broadly speaking, we can identify three fundamentally different schools concerned with how learning occurs. These three approaches, or learning theories, are referred to as behaviourism, cognitive theories, and constructivism (Driscoll, 1994; Hergenhahn & Olson, 1997).

When instruction is delivered via the World Wide Web it is often referred to as *web-based learning* or *web-based instruction.*

2.1 Web-Based Learning and Instruction

> "Web-Based Instruction can be viewed as an innovative approach for delivering instruction to a remote audience using the Web as the medium" (Khan, 1997b, p. 5).

The terms 'the Internet' and 'the World Wide Web' (WWW, the Web) are often used interchangeably, even though they do not refer to the same thing. The internet is a system of networks that connects computers around the world via the TCP/IP protocol. The WWW, on the other hand, is the set of documents residing on all Internet servers that use the HTTP protocol. It is a collection of internet sites that can include text, sound, video, graphics, and animation resources. The Web is accessed through a browser such as Internet Explorer (Microsoft, 1995-2001) and Netscape Navigator (Netscape, 2000-2002).

The Web can be a powerful medium for learning and instruction. The delivery of instruction and the facilitating of learning via the Web can take different forms, and can involve different degrees of online activities. Barron (1998) distinguishes between e-mail correspondence instruction, web-enhanced instruction, web-managed instruction, and web-delivered instruction, depending on the degree of web-activities in the course. Web-enhanced instruction is usually designed to supplement on-campus instruction and can simply consist of a web page displaying relevant links for the course. Web-managed instruction uses a tool to provide an environment for managing instructional resources. These tools are generally not designed to provide instruction in itself, but to provide means of managing course information and materials. Web-delivered instruction, on the other hand, includes courseware in which instruction is delivered, and interactions and feedback are enabled, via the Web. Web-delivered instruction can also be referred to as web-based instruction (WBI), web-based training (WBT), web-based learning (WBL), internet-based training (IBT), online learning, e-learning, etc. According to Barron (1998), WBT seems to be emerging as the preferred acronym in the industrial area

while the academic arena prefers WBI or WBL. These two terms, *web-based learning* and *web-based instruction*, will be used somewhat interchangeably in the following sections.

Khan (1997b) defines web-based instruction (WBI) as:

> "… a hypermedia-based instructional program which utilizes the attributes and resources of the World Wide Web to create a meaningful and supportive learning environment where learning is fostered and supported." (p. 6)

Hypermedia is a nonlinear, non sequential way of presenting material. Buttons and hyperlinks allow you to click on them in order to be taken to another site page or site location. Most web pages provide some form of informal learning environment in the sense that people use the Web to access different kinds of information, but this does not necessarily make them *instructional* web sites. To qualify as WBI, the site has to contain instructional elements intentionally designed to facilitate learning (Dillon & Zhu, 1997; Khan, 1997b).

The Web offers a multitude of ways to present information, and WBI can make use of these in order to support learning and instruction. Kahn (1997b) distinguishes between to categories of WBI features: (1) key features and (2) additional features. The key features are features that are provided by the Web and can be incorporated into a WBI program. Examples of such features are: interactivity, multimedia, online search, global accessibility, online resources, etc. Additional features, on the other hand, are related to specific WBI programs. This means that the developers of the WBI program are responsible for providing these features if they are to be included in the program. Such features include: ease of use, course security, online support, support for collaborative learning, online evaluations, and many more.

Interactive Multimedia as a tool to support learning

Educational technology is sometimes referred to as interactive multimedia (Sims, 1997). Multimedia can refer to any application that includes two or more media types, such as text, colour, images, animation, audio, and video. Multimedia can help people learn when the media support dual coding of information, and when the different media support one another (Alessi & Trollip, 2001; Najjar, 1996; Rieber, 1994). Dual coding

theory (Paivio, 1986) is a theory about how information is stored in the memory. It states that the memory consists of two separate and distinct representations, or codes, one verbal and one nonverbal. One channel processes verbal information, such as text and audio, and the other processes visual information. When information is processed through both channels, such as a combination of complementary pictures and narration, learning is enhanced (Rieber, 1994).

2.2 A Model of Instruction

Alessi and Trollip (2001) present a general model for providing instruction. According to this model, four phases of instruction should occur in order for learning to be effective and efficient:

- *Presenting information*, verbal or pictorial, through different methods such as rules and examples. The information can be presented through any media such as an instructor, a textbook, or a computer. This phase focuses on the instructor or the media which presents the information.
- *Guiding the learners* in their performance after viewing the information presentation. During this phase the learners can answer questions about the information presented in the former phase, they may apply rules and principles in problem solving activities, or practice skills. This phase is more interactive than the former, and includes both the learner and the medium.
- *Practicing what has been learned.* Learning is not complete when a learner can do something once; repeated practice is often required to retain information and to be familiar with it.
- *Assessing learning* in order to provide information about the level of learning, the quality of teaching, and future instructional needs. According to Alessi and Trollip (2001), too much emphasis is placed on assessment as a means of assigning grades, instead of assessment as a means of guiding instructional decisions.

This model is developed for classroom instruction, but it can also be applied to instructional technology and interactive multimedia. Computers may be used in one or

more of the four phases of instruction: presenting information, guiding the learner, practicing and assessing learning. When the computer is intended to cover the total instruction, it is important that all four phases of instruction is provided by the programs (Alessi & Trollip, 2001). In RadioWeb, the online learning material is intended to be used mainly to present information, but also to provide some guidance, to the learners. The intended use of RadioWeb is described in section 3.1.3.

2.3 Methodologies for Learning with Technology

Alessi and Trollip (2001) also discuss eight methodologies for facilitating learning with technology, or more specifically, with interactive multimedia. The eight methodologies are tutorials, hypermedia, drills, simulations, games, tools and open-ended learning environments, tests and web-based learning. These methodologies can serve as a starting point for understanding and developing interactive multimedia.

These methodologies are not exclusive categories; a program can, and usually will, include elements from two or more methodologies. As we shall see in a later section, RadioWeb has characteristics from both tutorials and the web-based learning environments. The following section presents the eight methodologies based on Alessi and Trollip (2001).

Tutorials

Tutorials are programs that usually support the first two phases of instruction. Tutorials present the learners with information, and guide them through the first attempts to reproduce the information. A learner typically goes forward through a series of pages or frames that have a predetermined order, and periodically encounter interactions such as questions to be answered. This methodology is more thoroughly described in section 2.4 since the Web lecture in RadioWeb follows the structure of a tutorial.

Hypermedia programs

Hypermedia programs are also used for presenting information, but they are designed for more constructivist[2] and open-ended learning. They are less structured than tutorials in that they allow the learners to take their own path through the material. The hypermedia methodology is often used in combination with the web-based learning methodology. The essential features of hypermedia are a database of information elements, such as text, images, video, and multiple methods of navigating between them.

Drills

Drills are used primarily to provide the learners with practice, that is, as support for the third phase of instruction. These are particularly useful if repetition is essential in order to learn. An example of a drill would be a program training students in touch-typing.

Simulations

Simulations are a bit more complicated to define. Simulations can be used for any or several of the phases of instruction. Simulations, or any other methodology for that matter, are rarely used to provide all four phases of instruction. Simulations are useful to illustrate either a phenomenon, such as the orbit of the planets, or an activity, such as flying a spaceship. The great advantage of this methodology is that it is very flexible. It can support any phase of the learning process, and can be applied to different educational philosophies. The Java applet included in RadioWeb is a simulation of how radiologists can use radiological images in order to make a diagnosis[3].

Games

Educational games can be very motivating ways of learning, especially when younger children are the target users. Games may be combined with drills or with simulations, and they usually support the third phase of instruction, practice. Games may also be used for guidance or assessment when combined with the simulation methodology.

[2] Constructivists view learning as the result of mental construction. Students learn by fitting new information together with what they already know. Simply put, the constructivist school view learning as a change in meaning constructed from experience. (What is Constructivism?, 2000)

[3] The java applet is described in section 4.4.2.

Tools and open-ended learning environments

Tools are software that learners use in combination with other media or activities for achieving some educational goal. An example on such a tool may be a statistical program to support the learning of quantitative data analysis. Open ended learning environments, on the other hand, provide an environment to support learner exploration. These environments usually include some form of tools.

Tests

Tests usually represent the last phase of instruction, the assessment of what has been learned. An exception is practice tests or quizzes which can be used to support the learner in the practice phase of instruction.

Web-based learning

The Web can support learning both as support for traditional on-site learning, which is the case with RadioWeb, and as support for distance education (Alessi & Trollip, 2001). Most web sites are designed using the hypermedia methodology since the Web relies on hypertext for navigation. Alessi and Trollip (2001) place web-based learning among software methodologies for learning, although they do not seem to think that it belongs in the same category as the other methodologies. An instructional web site can include programs built on the other software methodologies for learning, such as tutorials, drills, games etc. (ibid.). Khan (1997a; 2001), on the other hand, seem to support the view that the Web represents something new within the field of instructional technologies. Perhaps it is more correct to view the Web as a way of delivering instruction, rather than a methodology in itself.

In designing WBI, the designer can apply general principles of Human Computer Interaction (HCI), a field concerned with how users interact with computer systems. According to Preece (1994, p. 1), HCI "is about designing computer systems that support people so that they can carry out their activities productively and safely". Applying the principles of HCI to the design of web-based instruction will not ensure that learning will take place, but it will reduce the risk of learning being hindered due to a poor interface (Dillon & Zhu, 1997). Dillon and Zhu (1997) state that: "Beyond this, HCI turns to instructional design for insights on how to take the well-designed or usable

technology and apply instructional theory to its pedagogic use" (p. 223). Theories of instructional design will be presented in section 2.7.

2.4 RadioWeb - a Web-Based Tutorial

The goal of the RadioWeb project was to develop a web site in order to deliver learning material on the Web, and to present this material to the learners with the use of multimedia. RadioWeb meets the requirements of web-based instruction, but at the same time it possesses many of the features that characterize a tutorial. A tutorial program aims to support the first two phases of instruction described by Alessi and Trollip (2001), the presentation of information and guiding the learners through the information. RadioWeb is intended to present information that is usually presented during a face-to-face lecture.

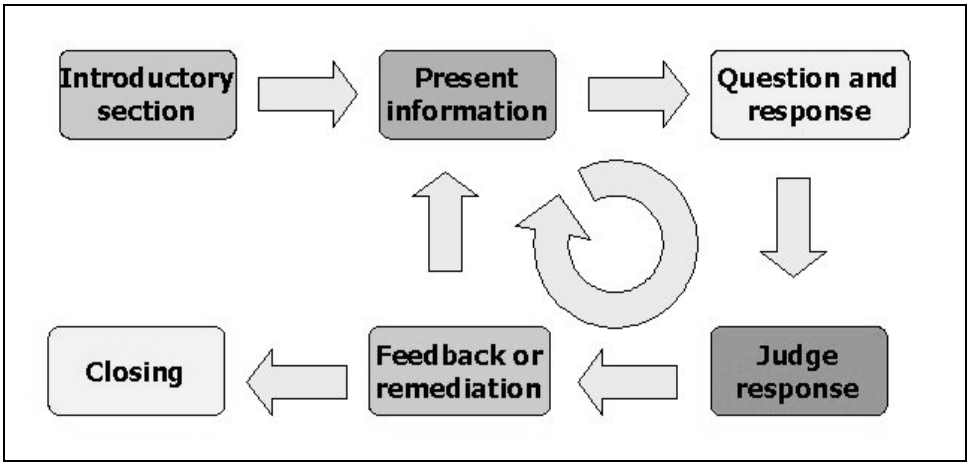


Figure 2.1. The general structure of a tutorial program (Alessi & Trollip, 2001)

The web lecture embedded in RadioWeb follows the same structure and sequence as a typical tutorial described by Alessi and Trollip (2001), see Figure 2.1. A typical tutorial starts with an introductory section which presents the learner with the purpose and nature of the program, i.e. the instructional objectives of the program. Next a cycle begins where information is presented, questions are answered by the learners, their response is judged by the program, and feedback on their achievements is given. This

cycle is repeated until the program is terminated. The sequencing of content in RadioWeb will be more thoroughly described in chapter 4.

PART 2: MODELS FOR DESIGN AND DEVELOPMENT

This section describes different models for the design and development of information systems, and models for the design and development of instruction (Instructional design models).

2.5 Life Cycle Models

The overall process of developing systems from requirements through analysis, design, implementation and maintenance is often described using a *life cycle model of system development*. There are many different life cycle models and methodologies, but each generally consists of a series of defined steps or stages. Examples of such life cycle models are *the waterfall model*, *the spiral model*, and the *star life cycle model* of system design. Because the life cycle steps are described in very general terms, the models are very adaptable and their implementation details will vary.

2.5.1 The waterfall model

The most common model of system design is the waterfall model, see Figure 2.2. The waterfall model is a linear model where the output of each process is used as input to the next (Preece, 1994).

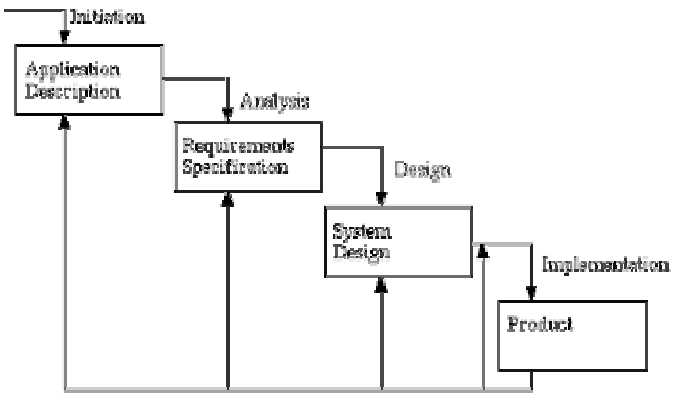


Figure 2.2. The traditional waterfall model of system development (Preece 1994)

The process in a waterfall model is essentially sequential, but testing is performed at different stages in the process. Results of the testing are used as feedback to previous activities, allowing the product to be refined. This approach to system development can also be referred to as the ADDIE model of system design, where each letter represents a stage in the process: analysis, design, development, implementation and evaluation.

2.5.2 The spiral model

In real life, development of complex systems is rarely performed sequentially from beginning to end. Boehm (1988, cited in Preece 1994) offers an alternate model of software development, the spiral model, see Figure 2.3. This model recognizes the need to iterate during software development.

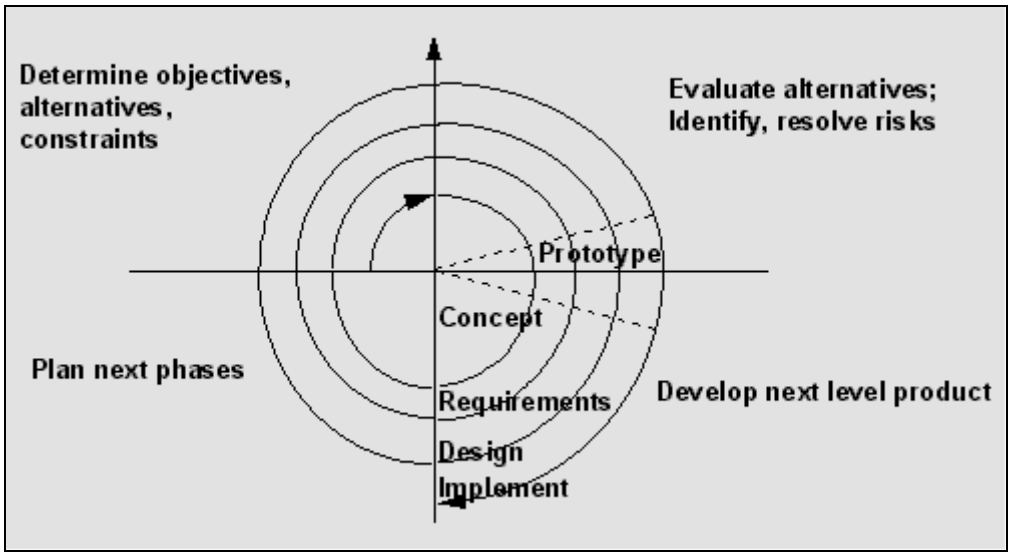


Figure 2.3. The spiral model (Boehm, 1988)

The spiral approach involves moving through the stages of development several times, each time with a broader focus. Each of the phases ends with a risk assessment and prototyping. At the end of each phase a prototype is evaluated and decisions are made concerning the progress of the project. The spiral model is more iterative than the waterfall model in that each phase is repeated several times, but is still linear in its nature because each iteration only addresses one of the aspects of the development; either concept, requirements, design or implementation.

2.5.3 The star model

An even more iterative approach to system design is offered by Hix and Hartson (1993), known as the star life cycle model. The central point of this model is evaluation, which is important in all the other stages represented in the model.

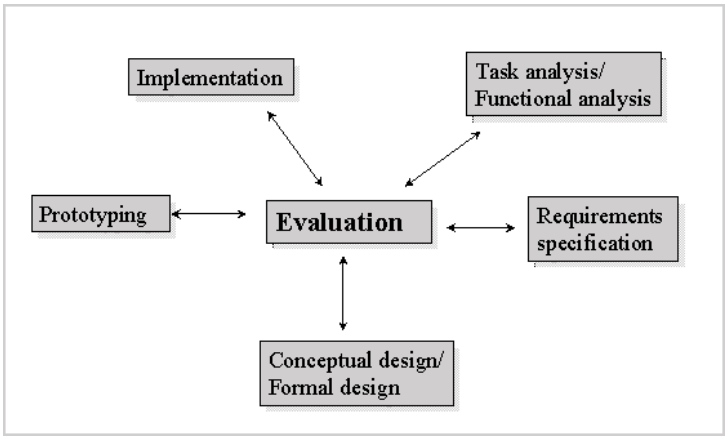


Figure 2.4. The star life cycle model (Hix & Hartson, 1993)

The star model approach is very flexible because it has no predetermined order. Developers of software systems are allowed to start and finish the development process at any point, and development can proceed to the next stage before finishing the previous. The model is more iterative than the spiral model because every stage can be repeated an infinite number of times, and it supports smaller loops of iteration than the spiral model because it does not require the designer to repeat the entire sequence every time. All the stages of software development are connected through an evaluation process. The strength of such a flexible model can also be its weakness. The development can potentially go on forever, it can be difficult to determine where to start the development and where and when to end it.

2.6 Prototyping

Both the spiral model and the star model involve prototyping. The process of prototyping is yet another way for designers to escape the linear approach to design presented in the waterfall model. Building a prototype helps designers make decisions concerning the desired functionality and the look-and-feel of the interface (Preece, 1994). A prototype usually contains the key features of the intended system.

Preece (1994) mentions four different prototyping techniques; requirements animation, rapid prototyping, evolutionary prototyping and incremental prototyping. Requirements animation implies that possible demands to the system are demonstrated to, and assessed by, users. When rapid prototyping is employed, the prototype is thrown away after evaluation, in the sense that it will not evolve into a final product. Incremental prototyping, on the other hand, allows for the development of the product in phases to avoid delays. Finally, evolutionary prototyping involves that the prototype is produced, evaluated and evolved into a final product. Table 2.1 gives a more detailed description of these techniques.

Table 2.1. Prototyping methods and tools (from Preece, 1994)

Prototype method	Description	Useful tools
Requirements animation	Allows possible requirements to be demonstrated in a software prototype which can be assessed by users	Purpose-built animation packages and screen painters are suitable for animating the representational aspects. Data manipulation languages and other high level languages are suitable for animating the functional aspects. Authoring languages, menu builders and active images tool prototype operational aspects.
Rapid (throw-it-away) prototyping	Aims to collect information on requirements and the adequacy of possible designs. Recognizes that requirements are likely to be inaccurate when first specified. The emphasis is on evaluating the prototype before discarding it in favour of some other implementation	Representational requirements and designs can be created quickly using animators, screen painters, forms systems, report generators and menu systems. Hypermedia and very high level language systems are also particularly suitable.
Evolutionary prototyping	Compromise between production and prototyping. The system can cope with change during and after development. Helps overcome the traditional gap between specification and implementation.	It is important to prototype using the facilities that will eventually be used to implement the final system. Additions and amendments made to the model following evaluation and the system is regenerated.
Incremental prototyping	The system is build incrementally, one section at a time. Incremental prototyping is based on one overall design.	Reusable software and highly modular packages can be useful as more pieces are 'bolted on' to produce the final system gradually.

Prototypes may be shallow or narrow (Preece, 1994; Wilson, Jonassen, & Cole, 1993). A shallow, or horizontal, prototype shows the entire look of a program minus some functionality, while a narrow, or vertical, prototype is completely functional in a small

segment of the program and the rest is undeveloped.

The evolutionary prototyping approach is the approach most suitable for the RadioWeb project because it should have most of the features implemented, but also allow for the prototype to evolve into a final product. In RadioWeb, most of the interface will be developed, but some of the desired functionality will be lacking. A framework for the delivery of web lectures will be created, but only one lecture will be implemented into the framework.

2.7 Instructional Design

> "An instructional-design theory is a theory that offers explicit guidance on how to better help people learn and develop." (Reigeluth, 1999, p. 5)

Designing and delivering web-based instruction requires thoughtful consideration of how to use the Web's potential in relation to instructional design principles (Ritchie & Hoffman, 1997). It is difficult to give a precise definition of what instructional design is, and according to Rieber (1994), there are as many characterizations of instructional design as there are instructional designers. Though there are many different theories of instructional design (ID), and several models for applying them, most of them aim to make instructional materials support learning. Most models of instructional design view ID as a process including stages similar to those of the ADDIE model of system design. Instructional design is concerned with the analysis, design, development, implementation and evaluation of learning material and instruction. Reigeluth (1999) states that instructional design theories are often confused with learning theories, but that one important difference is that instructional design theories describe specific events outside the learner that facilitate learning, while learning theories describe what goes on inside a learner's head when learning occurs (p. 13).

Kemp defines ID as "the process for designing instruction based on sound practices" (Kemp, Ross, & Morrison, 1998, p. 3). It is a systematic approach to planning and producing instructional materials and activities (Gagné et al., 1992; Kemp et al., 1998; Reigeluth, 1983; Reigeluth, 1999; Smith & Ragan, 1993). ID is an iterative process that

requires ongoing evaluation and feedback, much the same as in the development of software systems. Many models for instructional design and development exist (e.g. Dick & Carey, 1978; Gagné et al., 1992), one comprehensive model is proposed by Kemp (1998). This model, presented in Figure 2.5, consists of nine stages, starting with the identification of the "instructional problems". The stages are completed in a clockwise sequence. As each stage is carried out, other processes occur simultaneously, including evaluation, revision, project management, and planning. Kemp chooses not to use arrows or lines connecting the stages to each other, thus showing that the ID process is not a linear process. This model takes a holistic approach to instructional design and considers a variety of factors in the learning environment, such as learner characteristics, task analysis, instructional problems and objectives, method for delivering instruction, available resources (computers, books, etc.), and evaluation.

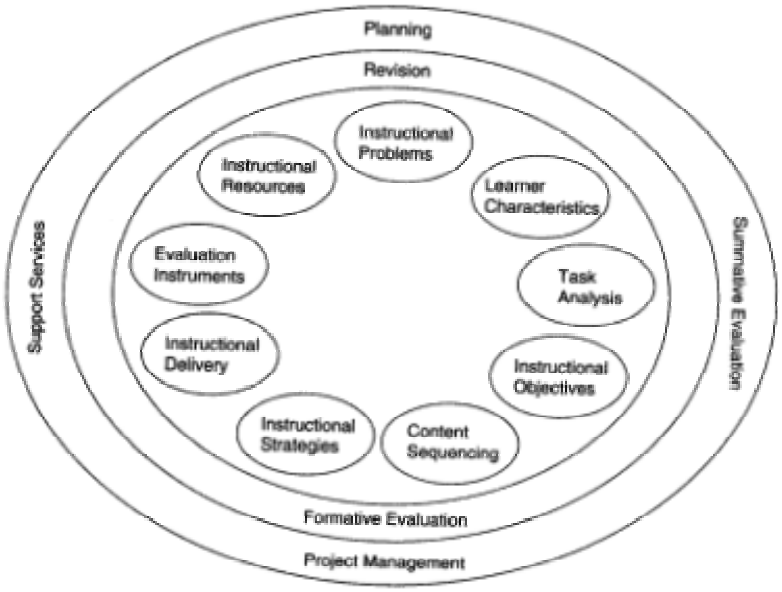


Figure 2.5. Elements of the instructional design plan

Most models of the instructional design process include stages similar to those described in this model. The process is iterative, and revision and evaluation are performed during all stages.

Evaluation in instructional design is often referred to as *formative evaluation* (Flagg, 1990; Gagné et al., 1992; George & Cowan, 1999; Hix & Hartson, 1993; Kemp et al.,

1998; Nichols, 1997; Preece, 1994; Reigeluth, 1983; Rieber, 1994; Tessmer, 1993, 1995). Formative evaluation is described in more detail below.

2.8 Formative Evaluation

> "When the cook tastes the soup, that's formative evaluation; when the guest tastes it, that's summative evaluation" [4]

Scriven (1967) introduced the term 'formative evaluation' as one of two major categories of evaluation: formative and summative evaluation. Formative evaluation is conducted during development, while summative evaluation is conducted on a final product. The term originally referred to "outcome evaluation of an intermediate state in the development of the teaching instrument" (Scriven, 1967, p. 51). According to Flagg (1990), the term now covers "any kind of feedback from target student or professional experts that is intended to improve the product during design, production, and initial implementation" (p. 5). She defines formative evaluation as "the systematic collection of information for the purpose of informing decisions to design and improve the product" (pp. 1-2). Formative evaluation can be performed during any stage of the development of an instructional program and is done in order to improve it. According to Tessmer (1993), formative evaluation is not conducted in order to find out whether instruction is effective, but to discover its problems during design and development. Formative evaluation is not done in order to test the instructional design; it is part of the instructional design itself. Tessmer (1993) recognizes four types of formative evaluation:

- **Expert review**: Experts review the instruction with or without the evaluator.
- **One-to-one**: One learner at a time reviews the instruction with the evaluator and comments upon it.
- **Small-group**: the evaluator tries out the instruction with a group of learners and records their performances and comments.
- **Field test**: the evaluator observes the instruction being tried out in a realistic situation with a group of learners.

[4] Quote attributed to Robert Stake by Scriven (1991, p. 19)

These four types of evaluation should be performed at different stages of the product development. First, the expert review and one-to-one evaluations should be conducted. Next, the program should be refined before conducting a small-group evaluation. After the small-group evaluation, the program should be further refined. The final step is to field test the product in its intended learning environment. A different approach to ongoing formative evaluations at different stages in a development process is described by Flagg (1990). This model is presented below.

2.9 A Model for Formative Evaluations

When the RadioWeb project first evolved, both the initiators and the designer were too inexperienced in this type of development to select an overall strategy for the process of program development. The requirements and expectations to the finished product changed several times during the process as new possibilities or limitations were discovered by the team members. The process of developing RadioWeb was indeed an iterative process. However, the development process was influenced by literature concerning general software development and instructional design. It followed the general stages of the ADDIE model, it was an iterative process, and the product was reviewed and changed several times along the way.

The nature of formative evaluation implies that it can, and should, be performed during the entire development process. Flagg (1990) describes a general model for developing educational programs. This model consists of four phases of development and four parallel phases of evaluation, illustrated in Table 2.2. The phases in the development RadioWeb correspond with these phases of program development and evaluation.

Table 2.2. Phases of program development and evaluation

Phases of program	Activity	Phases of evaluation
Phase 1	Planning	Needs Assessment
Phase 2	Design	Pre-production formative evaluation
Phase 3	Production	Production formative evaluation
Phase 4	Implementation	Implementation formative evaluation
		(Summative evaluation)

Planning and Needs Assessment.

The first phase of program development involves planning the product. During this phase, assessment is performed in order to determine the need for the program in order to make decisions concerning the planned product. Flagg (1990) considers needs assessment to be the first phase of formative evaluation, but it is not evaluation in the sense that the word is usually used, so the real formative evaluation can be said to begin with the design phase (ibid.).

Design and Pre-production Formative Evaluation

During the design phase of program development, a number of decisions about the product are made. These decisions are used to guide the developers in the production phase. During this stage, the product can take the form of documents describing the lesson goals, storyboards, manuscripts and sample screens. These various documents can be reviewed by subject matter experts, designers, developers or representatives from the user group. Flagg (1990) refers to the collection of information to guide decisions during this phase as pre-production formative evaluation.

Production and Production Formative Evaluation

During this stage, the program is produced. This involves writing the code, recording sound, creating animations, building the web pages and so on. Before the product is finished, preliminary versions can be tested with representatives from the target group and experts for user friendliness, appeal and learning. Information gathered during such testing is considered by the developers in order to make decisions about the finished product. Production phase results in an operational program.

Implementation and Implementation Formative Evaluation

Implementing the program involves placing it in the context where it is to be used by the target group. Evaluation during this stage involves testing the program with its target users in the real setting. The intention is still to improve the program, and results from this evaluation are used as feedback to the produced program and to guide the design

and development of future programs. This type of formative evaluation is often referred to as field testing.

2.10 Evaluations of RadioWeb

The process of designing and developing the RadioWeb prototype followed the same general stages of program development as described above, and the product was constantly reviewed during the process. The different forms of evaluation performed on RadioWeb during the design, development and implementation phases are illustrated in Figure 2.6.

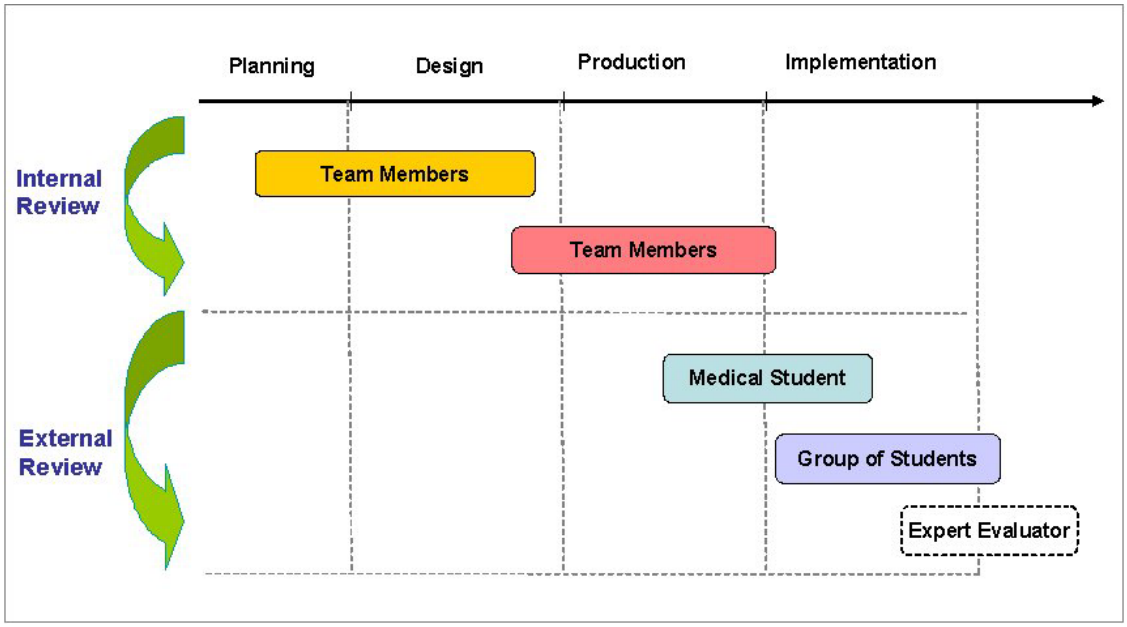


Figure 2.6. Evaluations of RadioWeb (Adapted from Kennedy, 1999)

During the design and production phases, the program was constantly reviewed internally by the team members, and adjustments were constantly made to the product. When the program was almost finished, that is towards the end of the production phase, it was reviewed by one 4th year student of medicine, and results from this one-to-one evaluation was used to make the last changes to the program before the field test. The field test was carried out in May 2002 at the Faculty of Medicine with students from the target user group, that is 3rd year students of medicine. A few months later, during a

presentation of RadioWeb to the radiology faculty, RadioWeb was reviewed by a university expert on ICT & learning. These different evaluations will be described in the succeeding chapters[5].

2.11 Chapter Summary

In the first part of this chapter, the field of web-based instruction was described. WBI can include different degrees of web-activities, and can be used to support both on-campus instruction and distance education. A general model of instruction and different methodologies for learning with technology were also presented. This part of the chapter also aimed at placing RadioWeb within the context of using the Web to support learning and present the learners with information.

The second part of this chapter focused on system development in general and educational system development in particular. The field of designing instructional programs is often referred to as instructional design, and an important part of instructional design is the formative evaluation of the product. Finally, a model for developing educational programs with a focus on formative evaluation was described.

Flagg's formative evaluation model serves as a starting point for the succeeding chapters. The next chapter will describe the phases of planning, designing and developing RadioWeb, and the corresponding phases of evaluation performed on the program.

[5] The expert evaluation was not originally a part of the RadioWeb project. Comments made by the expert are cited in chapter 3.

3. DEVELOPMENT OF RADIOWEB

The process of developing the RadioWeb prototype will be documented in this chapter. Based on the formative evaluation model presented in the previous chapter, the phases of planning, designing and developing RadioWeb are described together with the ongoing evaluation performed on the prototype.

3.1 Planning and Needs Assessment

Prior to the development of instructional material, we should identify the instructional problems by asking why new instruction is needed (Kemp et al., 1998). In other words; what is the problem with the existing instruction, and what do we hope to achieve by the developing new instructional material? In order to answer these questions, we should perform a *needs assessment* (Flagg, 1990; Gagné et al., 1992; Kemp et al., 1998; Schauble, 1990) to determine the gap between the existing instruction and the desired instruction. A needs assessment seeks to describe the learner, the context of the learning, and the goals of an instructional intervention (Flagg, 1990). With RadioWeb, the decision to provide online learning material was already made when the project started. The assumption was that this would allow the lecturer to use the classroom lectures to something else than information presentation. One might say that the desired instruction was to be delivered via the Web, while the existing instruction was delivered in the classroom. During this stage, the audience was identified, the content outlined and the goals and usage context described.

3.1.1 Learner characteristics

Before initiating an instructional development, one should consider the characteristics, motivations, and capabilities of the students that constitute the target users. RadioWeb's target audience consists of 3rd year students of medicine, attending the mandatory introductory course in radiology. We already know that the target users for RadioWeb have the same level of education, namely at least three years in medicine school, and that most of them have the same prerequisite knowledge of the subject matter. We also know that all medical students have access to the Internet from the student computer lab at the Faculty of Medicine. In addition, data collected by Haagensen (2003) on 6th year students of medicine, suggests[6] that medical students at the University of Bergen have a fairly high motivation for using computers in education, and that many have access to the Internet from home.

3.1.2 Initial goals of the project

The objective for the RadioWeb project was to make the learning material more available and attractive to the students. There was a desire at the Section of Radiology to use the classroom time more efficiently. The traditional lectures consisted mainly of one-way communication from the lecturer to the students. One hoped that by giving the students the opportunity to view the content of these lectures online in advance, the available classroom time could be used for discussions of the topic of the lecture instead of mere information presentation. In order to achieve these objectives, it was decided to develop online lectures.

Rørvik was inspired by online video-lectures at Stanford University (Stanford Online), and the initial idea was to develop something similar for radiology. After several meetings it was agreed to develop a solution that included more interactive elements, and hopefully a more challenging way of presenting the material. It was decided to use different types of media such as video, audio, text, animation and Java applet to present the learning material on the Web.

[6] These data are not necessarily applicable to 3rd year students.

Only one lecture was to be included in the prototype, both because of the time available, and to make it easier to change elements in the prototype after the evaluation. As it turned out, developing one lecture was challenging enough, and involved more work than perhaps any of the team members first anticipated. At first, the intention was to create a course web site, but as more and more features were added to the site, RadioWeb turned out to be more like a portal than a web page. It became a starting point for radiology at the University of Bergen.

3.1.3 The intended use of the program

The project's goal was to develop web-based learning material for instruction in radiology. Early conversations with project initiator Jarle Rørvik revealed that, in his opinion, the students played a very passive role during the classroom lectures, and he wished for more communication and interaction between the instructor and the students. One wanted to allow the students to work with the material prior to the classroom lectures, hoping that this would provide them with a broader understanding of the problem areas. The face-to-face aspect of the instruction should be preserved by offering so-called post-lectures during which the instructor answer questions and elaborate on any topics that the students find hard to comprehend. The pedagogical assumptions governing the project are illustrated in Figure 3.1.

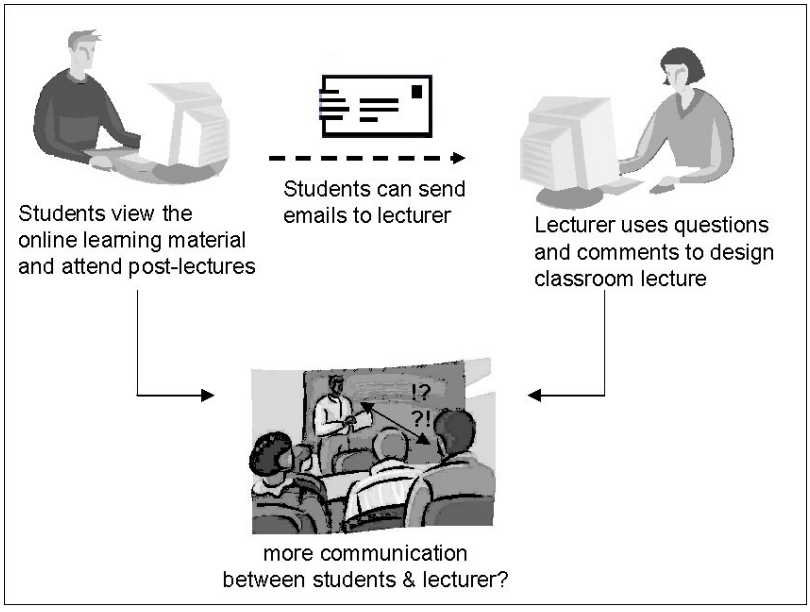


Figure 3.1. The pedagogical design of the RadioWeb project

Questions and difficulties were to be sent by e-mail to the instructor from the students after they had viewed the web lecture. By offering the students the opportunity to view the lecture material on the Web in their own time, one hoped to achieve more active students during the classroom sessions.

As described earlier, Alessi and Trollip (2001) present a model for instruction consisting of four phases, that is presenting information, guiding the learner, practicing and assessing learning. The RadioWeb project set out to develop learning material to support the learners in the two first phases of this process. The main purpose is to present the learners with information that was previously presented in the classroom, thus allowing the lecturer and the students to use the classroom time for discussion rather than information presentation. By including questions and exercises in the program, the learners will also be encouraged to recall some of the material presented in the web lecture. Further guidance will take place during the post-lectures and the group teaching. The group teaching will also allow the students to practice their knowledge, thus supporting the third phase of the process of instruction. Formal assessment in radiology is not carried out until the 6th year of the medical education, when the students have their final exams. Considering that it takes three years from the introductory lectures in radiology are given till the final exams are held, chances are that students forget much of what is taught in their 3rd year. By making the material available on the Web, you also provide the students with an opportunity to review these lectures before their final exams. RadioWeb can thus also serve as a tool for the students to repeat the basics of the course before the final assessment takes place.

3.1.4 Timeline

Planning of the RadioWeb project began in spring 2001 and the prototype was tested with real end users a year later. Table 3.1 shows the timeline for the RadioWeb project. Originally, the goal was to test the web lecture prototype with target users in December 2001 but this deadline was not met. Instead, the web lecture was finished early 2002, and RadioWeb was ready to be tested in a one-to-one setting in February, and in a field test setting in May 2002. There are different reasons for this delay, but the most

prominent is probably the fact that both the subject matter expert and the designer had little experience in this kind of development and underestimated the amount of work that was required.

Table 3.1. Milestones in the RadioWeb project

	2001								*2002*				
Activity	May	June	July	Aug	Sept	Oct	Nov	Des	Jan.	Feb	Mar	Apr	May
Planning													
Design & Development													
One-to-One evaluation													
Field Test (planned and actual)													

The phases of designing and developing RadioWeb are described in the succeeding sections, and the different evaluations of RadioWeb are described towards the end of this chapter.

3.1.5 Requirements

Through a series of meetings during this initial stage in the development process, a number of demands were made to the prototype that was going to be developed:

- The lecture was going to be delivered on the Web and be accessible anywhere.
- It should be easy to add more lectures to the prototype later. This calls for an evolutionary approach to the development.[7]
- One wanted to include some degree of interactivity. This can be done by asking the students to do some exercises after the lecture. The students' knowledge within the subject area is very limited, so the exercises should not be too difficult. Assessment and feedback should be given immediately after the exercises.

[7] See chapter 2 for more about prototyping techniques.

- ❖ It should be easy to send e-mails to the instructor while going through the online lecture.
- ❖ Students should be able to access other radiology pages from the lecture such as timetables, information about faculty members, external resources, etc.

3.2 The Design Phase

The goal of the design stage was to decide what kind of information that should be included in the product, and to develop a blueprint of how the finished product should look. In order to achieve this, paper storyboards and manuscripts describing the lecture were produced.[8] This was done to visualize the intended look-and-feel and to serve as a tool for communication between the different persons involved in the project. The subject matter expert (SME) played a crucial role during this stage, as he was the only one with the qualifications to determine what the delivered instruction should include. Results of this phase were a number of specifications of what information needed to be included in the product, how the information should be organized in different pages and how the navigational items should look. This is described in more detail below.

3.2.1 Defining the instructional objectives

A needs assessment seeks to describe the learner, the context of the learning, and the goals of an instructional intervention (e.g. Flagg, 1990). A task analysis, on the other hand, determines what needs to be learned in order to achieve those goals given the particular context and learner (e.g. Kemp et al., 1998).

Before developing instruction, one should formulate clear statements about what the students are expected to learn, in other words, one should define the *instructional objectives*. According to Kemp (1998), defining the instructional objectives serves three important purposes. First, they offer a means for designing the appropriate instruction. Second, they serve as guide for evaluating the instruction. And third, they guide the learners in identifying the knowledge they should master. The instructional objectives for the prototype web lecture were formulated by the SME as six statements on what

[8] An excerpt from the produced manuscript is presented on page 46

skills the students should master after completing the lecture. These objectives are listed in Table 3.2

Table 3.2. Instructional Objectives for RadioWeb

After completing the lecture, the learner should:
1. Know about the different techniques used in radiology
2. Know the main principles for each technique
3. Know how different radiological images are created
4. Know which factors decide the quality of radiological images
5. Know the areas of application for the different techniques
6. Know the advantages and disadvantages of the techniques

These objectives were presented early in the introductory section of the web lecture, since evidence supports that presenting the learner with the objectives, enhances learning (Alessi & Trollip, 2001).

3.2.2 Content design

The actual learning material, i.e. the content of the system, was produced in close cooperation with both the SME from the Section of Radiology and the University Media Centre (UMS). Based on the existing material used in the classroom lecture, PowerPoint-files and radiological images, the SME produced storyboards and a manuscript describing the content of the lecture, and the sequence of which the content should be delivered. Storyboarding is a technique often used by software designers to illustrate on paper how the computer screen will look like in a program (Newby, 1996). A great advantage with this technique is that it is low-cost and easy to carry out. Because both the SME and the designer were inexperienced with this type of development, there were some difficulties communicating what these storyboards should include. Only the SME had the necessary knowledge of the subject area, so the designers[9] had to rely entirely on his ability to produce the content. A lot of time was spent in meetings discussing details concerning radiological techniques and images, and

[9] 'Designers' refers to both the author and the graphical designer from UMS

to produce storyboards that could serve as a starting point for the development. These storyboards contained both pictures and manuscript for the text that was to be written or read (audio), together with suggestions for aspects of the pictures that could be animated (for example highlighting an area of the picture). Figure 3.2 shows an excerpt from the storyboard[10].

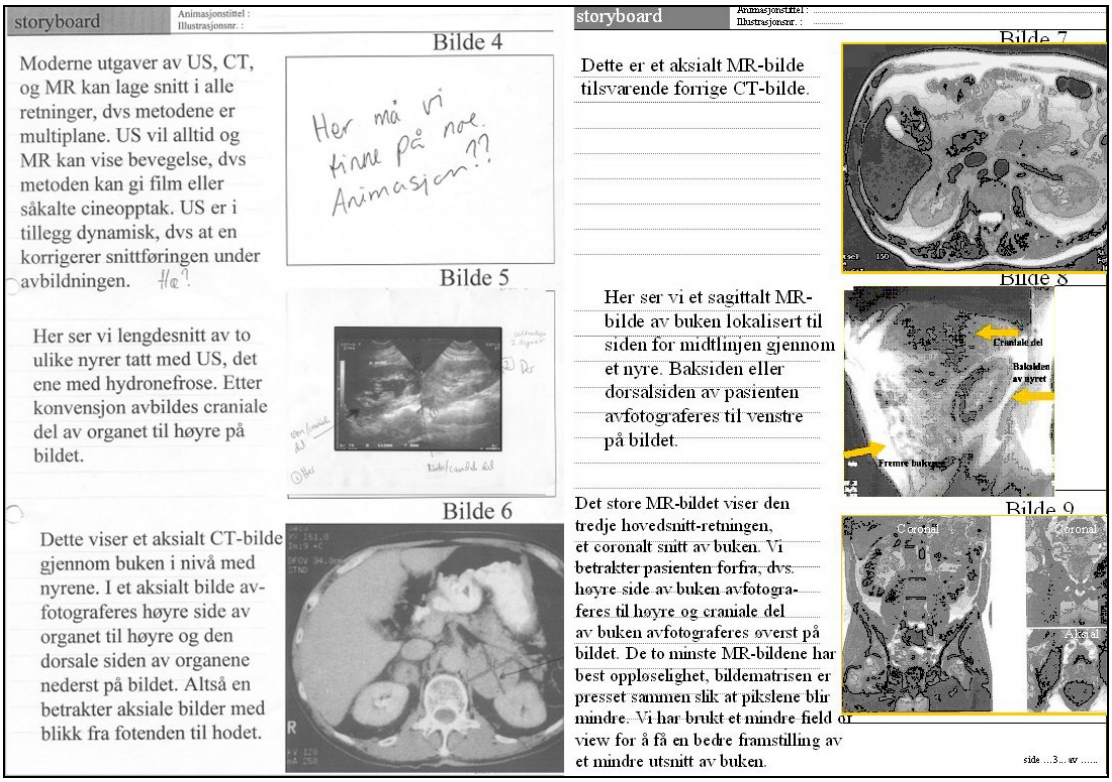


Figure 3.2. Excerpt from the produced manuscript

These storyboards were discussed at the team meetings and this helped to clarify the amount of information that was to be included in the product, and to make decisions on how this information could be organized in different web pages.

3.2.3 Interface design

Paper storyboards were drawn by the designer in order to illustrate suggestions to how buttons and menus could look like, and to get feedback on these suggestions. It turned out to be some difficulties in communicating the intended look-and-feel based on these

[10] The storyboard template was provided by UMS.

drawings, so mock-up websites with little functionality implemented were created instead. Figure 3.3 shows an example of a storyboard and a mock-up web site that were created to illustrate navigational items of the planned product[11].

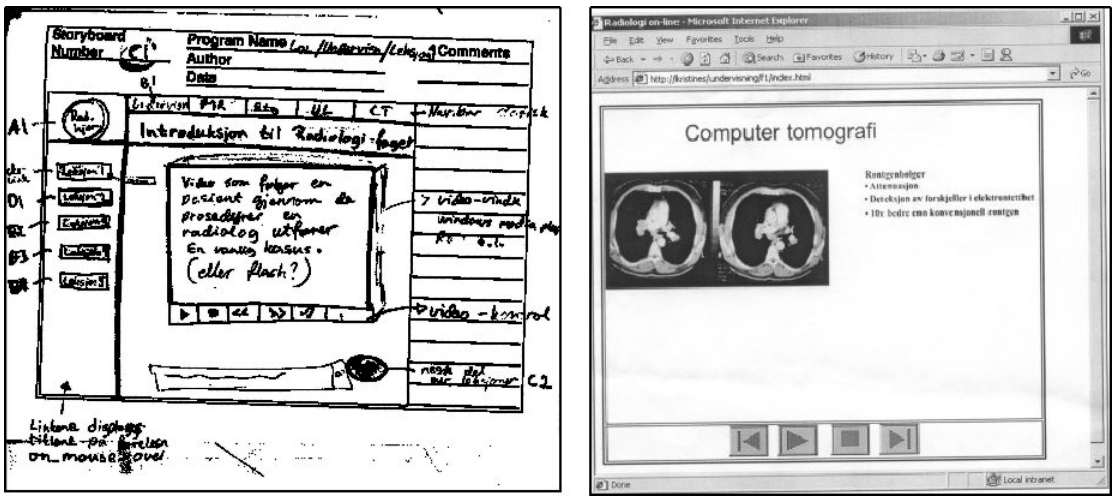


Figure 3.3. Storyboard and mock-up web site

These web sites were used to illustrate how the final pages could look. This made it easier for non-technologists to give feedback and communicate their views on design and functionality. These mock-ups were reviewed by the designer, the subject matter expert and a graphical designer from UMS.

Colours

It was decided to use a blue colour for the menus, white for the background and black for the fonts in RadioWeb. There was no particular reason for this choice of colours, except that blue and black foreground colours are known to provide a good contrast to a white background. It is generally recommended to minimize the amount of colours on one screen and to be consistent in the use of colours (Alessi & Trollip, 2001; Macaulay, 1995; Shneiderman, 1998). The colour schema was changed after the production formative evaluation described in section 3.4.2.

[11] More examples of storyboards, manuscripts and mock-ups are available in Appendix B.

Fonts

The designer first decided to use the *Verdana* font for the RadioWeb pages. This font has been developed for screen viewing and is easy to read. It turned out that the Section of Radiology had a standard font they use for instruction, the *Comic Sans MS*. After internal reviewing and feedback from the faculty member, the font was changed for the content of the lecture, while the rest of the pages continued to use Verdana. This inconsistency might have been a bit disturbing.

3.3 The Development Phase

The development phase focuses on the actual production of the prototype. In this phase, the web pages were created and the necessary text, images, animations, and sounds were produced. The outcome of this phase was a fully functional prototype.

3.3.1 Content production

Once the nature of the interface had been decided, during the design phase, production of the content began. Existing images and videos were collected, and animations produced based on the storyboards and manuscripts provided during the design phase. For the more complex animation that were to be produced by UMS, more detailed storyboards were needed, as the UMS did not have the same close contact with the subject matter expert as the designer had. The manuscript and drawings for this animation were provided by a 6th year medical student writing a dissertation on the subject. An excerpt from this storyboard and a screenshot of the corresponding animation are illustrated in Figure 3.4.

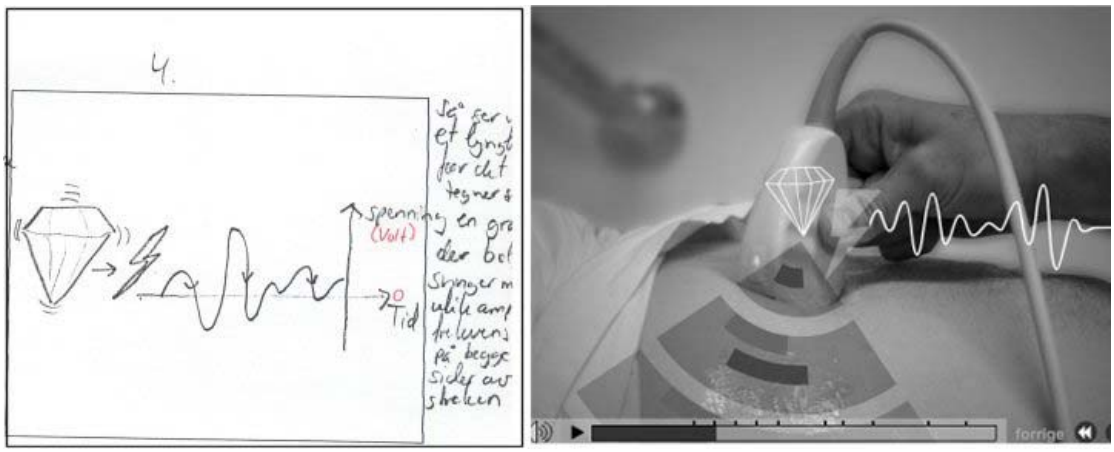


Figure 3.4. From storyboard to animation

3.3.2 Production of videos and audio

There was also expressed a desire to include videos in the prototype. One introduction video was produced by UMS, one video already existed and could be included in the lecture as it was, and one existing video needed audio. The introduction video was recorded in the studio at UMS and they also edited and compressed the video till mpeg format. In addition, narration audio was recorded, digitally captured, edited and compressed by the UMS. The narrators were the subject matter expert and the medical student. The recording of audio and video was done in November 2001 at the UMS studio.

3.3.3 Production of animations

Once the narration audio had been recorded, the work with synchronizing the audio, pictures, text, and animations began. This was done by importing everything into Flash (Macromedia 2001c). Flash was used to produce the animations[12] that constitute the actual content. Most of the narration explained what you could see on a particular radiological image, thus it was important to direct the learners' attention to the right area of the images. This was done by highlighting different areas in the image. For instance, when the narration read "in the left kidney, you see a tumour", a yellow circle appeared around the tumour[13]. Because the narration sound was 45 minutes long, we did

[12] Animations in this instance refer to the Flash movies. This means that the entire content of the lecture (except the three videos) consists of animations.
[13] Examples of the lecture content are available in Appendix C.

not manage to produce interesting animations covering all topics. In addition, some of the topics were so specialized that not even the SME had any suggestions as to how it could be illustrated visually. In those cases the screen displayed keywords or images relevant to the narration audio. The result was 47 animations, each with narration audio, which together with the 3 videos constituted a web lecture lasting approximately 45 minutes.

3.3.4 Implementing interactivity

The initial manuscripts and storyboards did not include any suggestions for interactive elements that could be included. A mini quiz was created by the designer, but the quality of these interactions was limited by her lack of expertise in the subject area. It was difficult for the SME to find time to make suggestions concerning such exercises, and the complexity of the subject area made it difficult to create meaningful interactions. A few exercises were included after the one-to-one evaluation of the web lecture, this evaluation is described in section 3.4.2.

3.4 Ongoing Evaluation

Different forms of evaluation were performed on RadioWeb during the development process. During the design phase the prototype was reviewed internally by the team members, during the production phase it was reviewed both internally by the team and externally by a 4th year medical student, and during the implementation phase it was reviewed externally by members of the target user group and by an expert evaluator. Using the terms from Flagg's formative evaluation model, described in Chapter 2, we can refer to these evaluations as pre-production-, production-, and implementation formative evaluations. Figure 3.5 shows an extended version of the model of evaluations of RadioWeb. This model integrates aspects from Flagg's general model for developing educational programs (Table 2.2), and the different evaluations of RadioWeb during the development process (Figure 2.6).

3.4.1 Pre-production formative evaluation

During the design phase, the storyboards, manuscripts, and mock-up web sites were reviewed by the SME and the designers. Evaluation in this phase was done internally by the team members. It was informal, verbal or written, feedback and discussions concerning the overall design, the interface, the graphic design, and the technical solutions. These reviews were done at a series of meetings or via e-mail. Decisions made during the design phase were constantly changed during the entire development process as problems or new ideas arose.

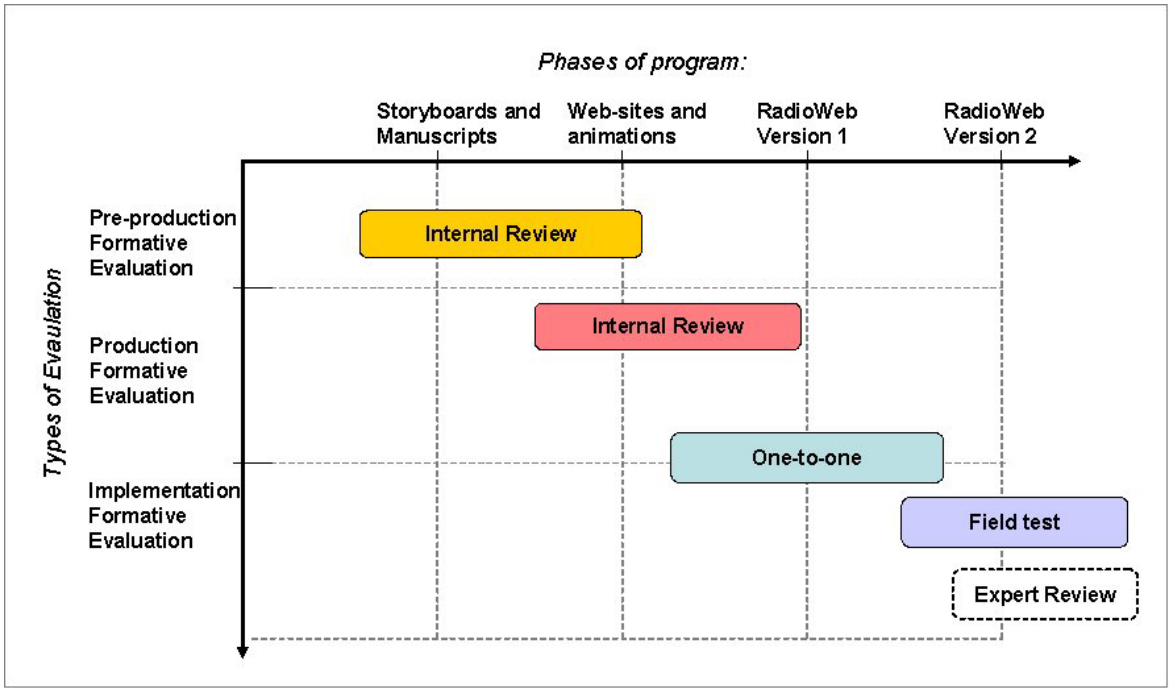


Figure 3.5. Evaluations conducted on RadioWeb

3.4.2 Production formative evaluation

During the production phase, two kinds of evaluations were performed. RadioWeb was reviewed both internally by the team members and externally by a representative from the target user group. The internal review was done much the same way as during the design phase, as informal feedback given during meetings or via e-mail. This feedback could vary from comments concerning minor details, such as dissatisfaction with a font colour, to more serious problems, such as a video not displaying properly. The internal review was performed continuously from the first web page was created until the product was ready to be tested with real end-users, that is from August 2001 to May 2002.

One-to-one-evaluation

Before introducing the product to the end-users, a third evaluation was conducted. This evaluation was performed as a one-to-one evaluation with a 4th year student of medicine in an informal setting. He was asked to try the almost finished prototype and to comment on the colours, navigation, content, or anything else for that matter, while I was sitting next to him taking notes. The main purpose with this session was to identify problems, such as typographical errors, unclear sentences, poor or missing directions, etc. Table 3.3 shows the problems and solutions that arose from the one-to-one evaluation.

Table 3.3. Results from the one-to-one evaluation session

Problem:	Action taken:
One of the videos was playing over and over again in a loop	Corrected
One of the links led to the wrong page	Corrected
Would like to have the menu on the left, not the right, side of the screen	None taken due to lack of time
Would like more exercises	More exercises were provided
Thinks the colours are boring. Would like warmer colours	Colour schema was changed

This one-to-one evaluation was performed shortly before the field test was to be carried out, so only a limited amount of changes could be made to the product. At this point, RadioWeb did not offer the students any exercises during the online lecture, only a mini quiz was available outside the lecture pages. Because the respondent asked for more exercises, five sets of questions were created to break up the lecture and make it less monotonous. Another result of this evaluation session was that the colour schema was changed from white and blue to yellow and orange. The designer did not necessary think this was an improvement, but the client liked the new colours, so it was decided to keep them.

One possible explanation as to why this evaluation session revealed so few problems is the physical setting of the session. The testing was done using the same computer that had been used during the development. Looking back, this was probably not a very

good idea considering that the material had been continuously tested on this computer during development, but never thoroughly tested on other computers. As we shall see in chapter 6, problems were discovered during the field test that could (and should) have been discovered during this earlier evaluation.

3.4.3 Implementation formative evaluation

The last type of evaluation performed on RadioWeb, the *implementation formative evaluation*, was carried out as a field test in May 2002 with respondents from the target user group. The goal of this evaluation was to discover potential improvements to the design of RadioWeb. The execution of, and results from, this end user evaluation are described in detail in chapters 5 and 6. In addition, an expert evaluator reviewed RadioWeb in September 2002. The main point made by this expert was that he thought it was too much information presented on each of the web lecture pages and that this made it difficult to focus on the actual lecture content. He also noted that the screen looked a bit 'untidy.' The result of this evaluation was agreement in that the lecture should open in a separate window. This expert review was not initially planned to be part of the project evaluation, so the rest of this thesis focuses on RadioWeb as it appeared at the time it was evaluated by students.

3.5 Chapter Summary

This chapter described the process of developing the RadioWeb prototype from the initial ideas till the product was ready to be tested with students from the target user group. The planning phase began in late spring 2001, and design and development of the prototype began in August that year. RadioWeb was evaluated continuously during the development, both internally by the team members, and externally by a 4th year medical student in a one-to-one setting, by representatives from the target user group in a field test setting and by an expert evaluator. The review of the development process presented in this chapter, serves as a background for the presentation of RadioWeb given in the next chapter. The next chapter describes the RadioWeb application as it appeared at the time it was ready to be tested with end users in May 2002.

4. THE RADIOWEB APPLICATION

This chapter presents the RadioWeb application as it appeared at the time it was evaluated by students from the target user group[14]. As mentioned before, RadioWeb became more than just a web lecture; it became a starting point for radiology at the University of Bergen. This chapter starts by describing the organization of the pages stored at RadioWeb. Next, some of the web pages available in RadioWeb are described, especially those pages related to the actual web lecture. Aspects concerning the layout, content, navigation and interactivity of the web lecture pages are described. The chapter concludes with a presentation of the tools used in the development of RadioWeb.

4.1 Structure

McCormack and Jones (1997) describe a web site as a combination of two structures, the presentation structure and the storage structure. The presentation structure provides the look-and-feel of the web pages including the navigation paths, while the storage structure is the hierarchy of files and folders used on the web server to store the pages and other data. Both structures can be organized in two different ways; as a narrow but deep structure or as a broad but shallow structure (ibid.), see Figure 4.1.

[14] The current version of RadioWeb can be found at http://www.med.uib.no/radioweb

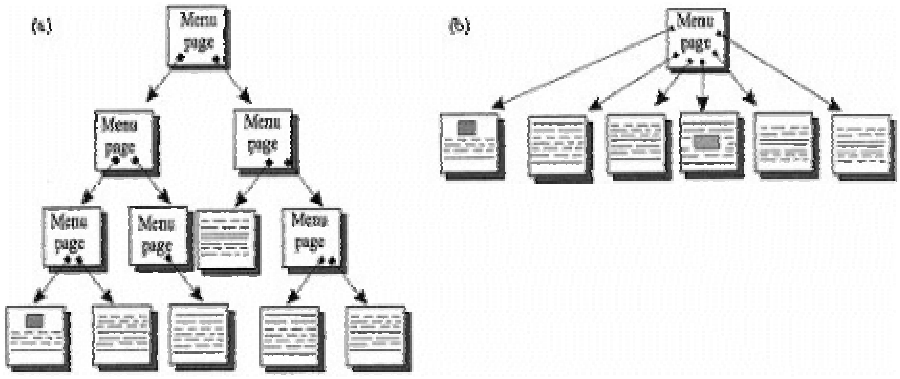


Figure 4.1. A deep structure and a shallow structure

RadioWeb is for the most part organized as a broad but shallow hierarchy of web pages where most of the pages are available from the main page. The presentation structure and the storage structure are practically identical, with the exception of the discussion forum which is physically stored one level above RadioWeb, but appears to be part of the RadioWeb site. The web lecture sub hierarchy is deeper than the rest since the larger amount of information is stored here. The hierarchical structure of RadioWeb is shown in Figure 4.2, and the pages illustrated as grey boxes in this figure will be more thoroughly described in the succeeding sections.

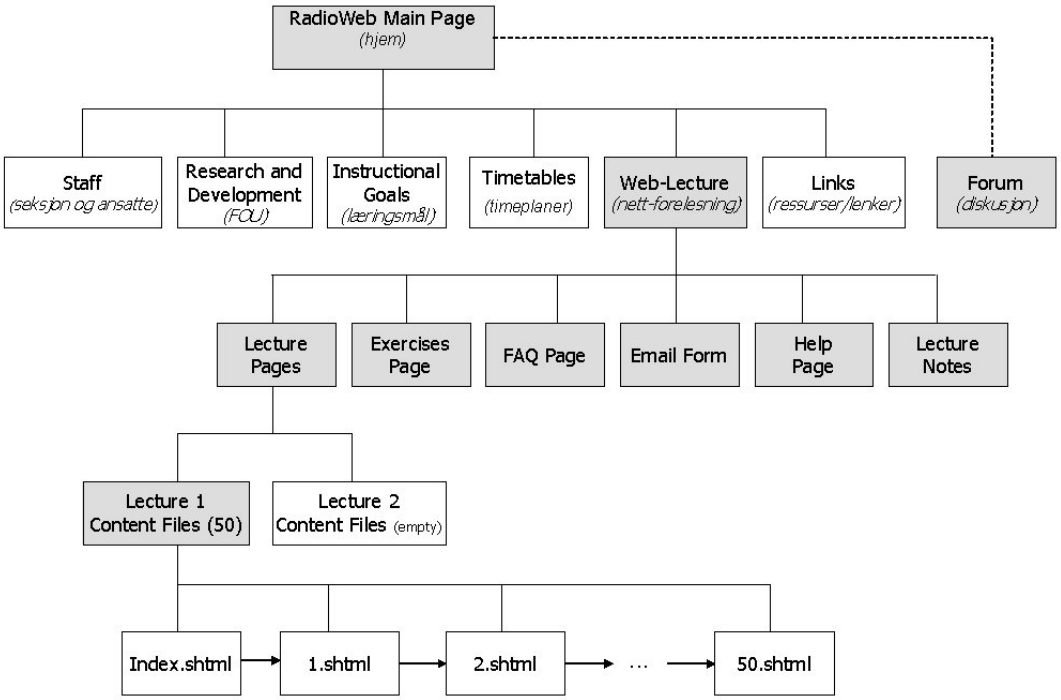


Figure 4.2. Structure of RadioWeb files

4.2 The Main Page

When first entering RadioWeb, the main page is presented, see Figure 4.3. At the top of the page is a menu bar, containing links to the different categories of information found at RadioWeb. Navigation on a web page should be clear, consistent and intuitive, and a well-tested approach (e.g. Hannum, 2001; Mann, 2000) is to insert a navigation bar on every page in exactly the same position on the page. The top menu will always be available for the users, providing a consistent view and a sense of whole in that all pages that belong to RadioWeb look the same. Using the top menu you can access a number of pages including information on the staff, research and development, time schedules and so on. One of these sub-categories is the actual web lecture.

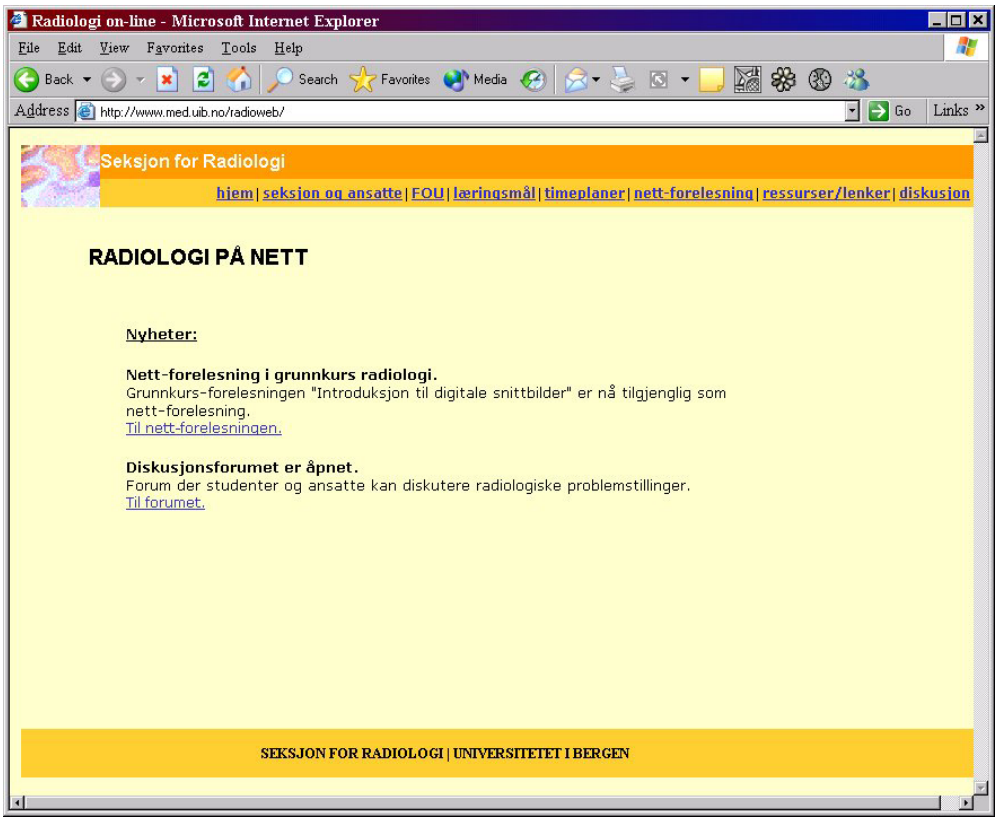


Figure 4.3. Screenshot of the main page

4.3 The Web Lecture Page

When clicking the web lecture link (‘nett-forelesning’), you get access to the different web lectures available. At this time, only one lecture is available. The lecture pages layout, illustrated in Figure 4.4, consists of three main elements:

1) Content area for playing and navigating the animation or video

2) Content menu displaying the different chapters in the lecture, and

3) Button bar with links to other pages related to the web lecture.

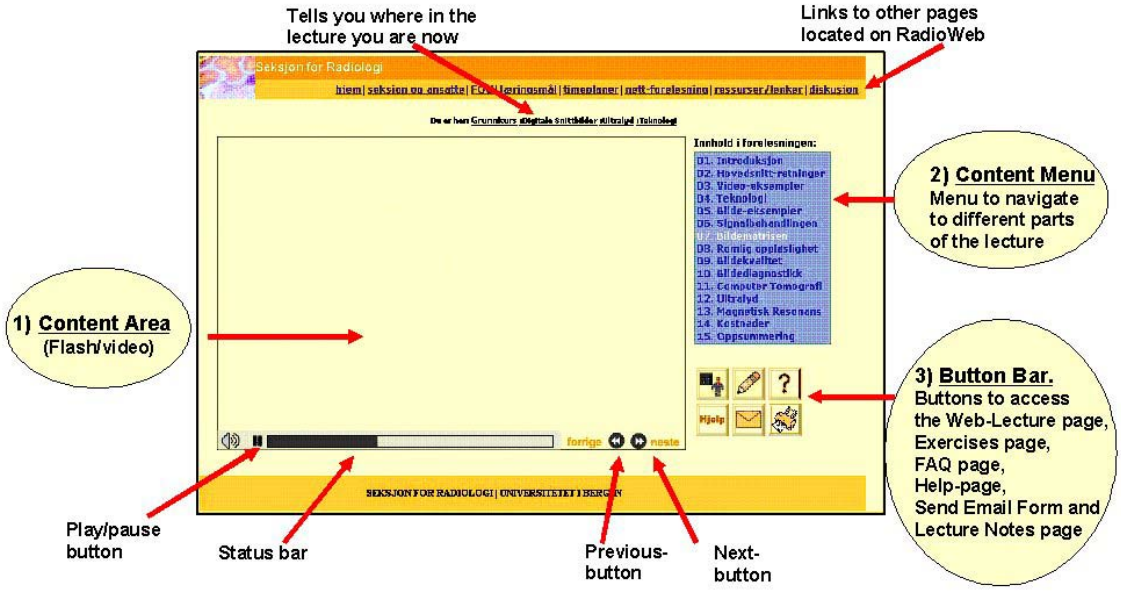


Figure 4.4. Elements in the page layout of the web lecture pages

The following sections describe these main elements of the web lecture pages; the content and navigation of the web lecture pages, the sequencing of the lecture content and also some of the other pages related to the web lecture. Figure 4.4 serves as a starting point for this presentation.

4.3.1 Content and navigation of the Web lecture

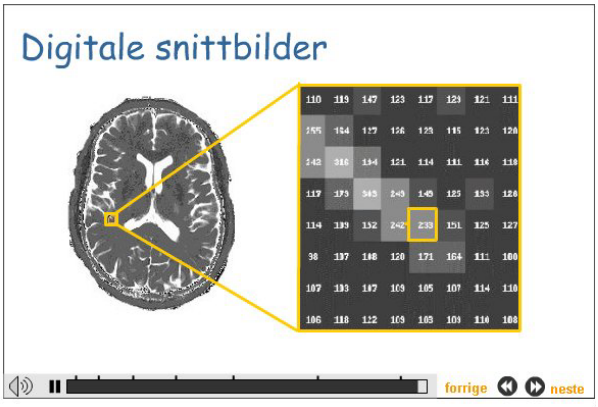
The larger amount of space in the web lecture pages is occupied by the *content area*. This area displays the content that constitutes the actual web lecture together with navigational items. Table 4.1 shows some examples of the lecture content in RadioWeb[15]. The first page of the program consists of an introductory section in the form of a video, where the instructor welcomes the learners to the program. Next, the instructional objectives of the lecture are presented. At regular intervals the users are prompted if they would like to do some exercises, and they can choose whether to open a new window displaying the exercises, or to continue viewing the lecture, see section 4.4.2 for more about the exercises. The final lecture page encourages the learners to send e-mail to the lecturer if they have any questions or comment to the content of the lecture. The closing page also directs the learners' attention to the discussion forum, the exercises page and the lecture notes page.

[15] More examples from the lecture content are available in Appendix C.

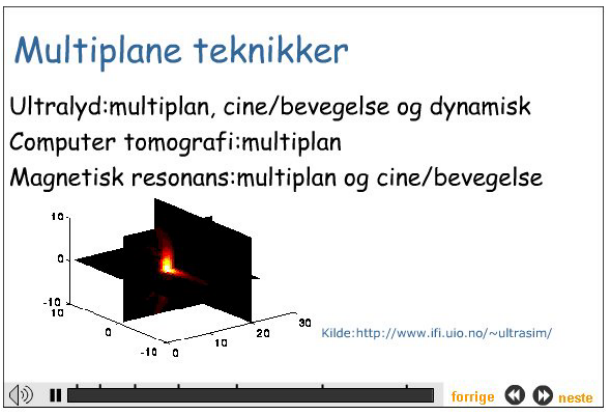
Table 4.1. Sample pages from the lecture content.

Screenshot 1. The video introduction.

Screenshot 2. Stating the instructional objectives.



Screenshot 3. The 3rd content page.



Screenshot 4. The 4th content page.

Screenshot 5. Prompting the user to do exercises.

Screenshot 6. Closing program.

Navigation and learner control in the web lecture

The most important aspect of navigation and user control, is to provide the learners with control of the sequence and pace of the content (Alessi & Trollip, 2001). Because of the narration audio in RadioWeb, the learners cannot control the speed of the playback, but they can decide when to move to the next section, and to pause and resume the playback at any time.

The entire lecture consists of a series of relatively short animations and videos, and the user navigates through the lecture content by using the next- and previous buttons at the lower right corner of the content area. These buttons, displayed in Figure 4.5, are standard flash buttons. The learner can control the sequence of the lesson, that is moving forward, backward or jumping directly to a section of the lesson.

Figure 4.5. Navigational items

To pause and resume the animation, you use the play/pause button. As long as the animation plays, the button displays a ‘pause’ icon. If this ‘pause’ button is pushed, the animation will stop playing immediately and the play/pause button will change to display a ‘play’ icon, see Figure 4.5. When the animation is finished playing, the button changes from ‘pause’ to ‘play’. If the button is clicked at this point, the animation will start playing from the beginning of the animation again. The metaphor used for this button is the same as for standard VCR controls and should be familiar to most users.

Next to the play/pause button there is a timeline that indicates how much of the current animation is left to play. This timeline starts whenever a new page is loaded.

4.3.2 Lesson flow

The RadioWeb lecture should be viewed in a given sequence in order to fully understand the content. Sequencing of the content was done by the subject matter expert, based on the PowerPoint presentation he normally used in the classroom lecture. Hannafin and Peck (1988) argue that “Lesson flow is critical to the ease with which

learning will occur. Lessons that move logically and smoothly from frame to frame and from section to section will likely maintain learner attention effectively" (p. 303). The sequence of the information presentation in RadioWeb corresponds with the general structure and sequence of a tutorial, presented in chapter 2. Figure 4.6 shows the ideal sequence of the web lecture.

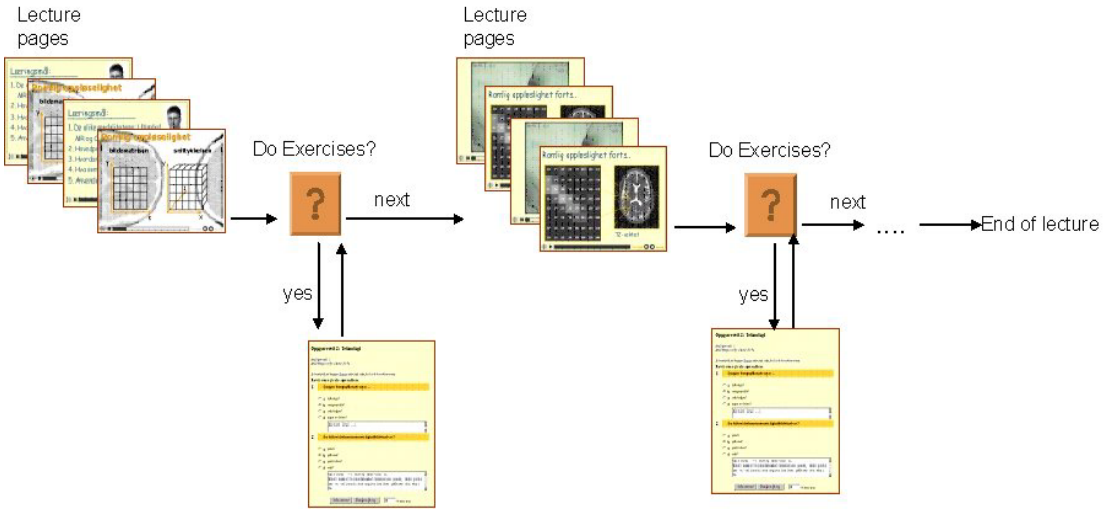


Figure 4.6. The ideal sequence of the lecture

For first time viewers it is recommended to access the lecture in the pre-determined order from start to end, moving through the lecture content and exercises using the next-button, but it is not mandatory to do so. Returning users, on the other hand, can jump directly to the subject they would like to review. This is done by using the *second* main component in the web lecture page layout, the *content menu* which is located to the right of the content area, see Figure 4.7. The lecture is broken into fifteen chapters with a different number of sub-chapters, constituting a total of 50 (flash or video) movies. When the user's mouse pointer passes over one of the chapters, its sub-chapters are displayed.

Figure 4.7. The content menu

4.3.3 Supplementary pages

The *third* main element in the web lecture pages' layout is the *button bar* located at the lower right corner of the page, shown in Figure 4.8. These buttons take the user to pages related to the web lecture, that is to the web lectures index page, the exercises page, the FAQ-page, the help page, the send e-mail page, and the lecture notes page. The web lecture page has already been described, and the other pages are described below.

Exercises page

The exercises page displays links to the questions related to the lectures. Such questions are also given during the lecture, but this collection of exercises can be useful as a repetition for the students in order to see how well they remember the content of the lecture. There is also a mini quiz available at this page. Section 4.4.2 describes the exercises in RadioWeb in more detail.

FAQ-page

The FAQ-page does not contain any information at the time, but it is intended to display questions sent to the lecturer per e-mail and answers given to these questions. The intention is to avoid that the lecturer has to answer the same questions more than once. Students who have questions concerning the lecture, can first check the FAQ page to

see if anyone has asked the same questions before. If this is not the case, students can submit their questions to the lecturer using the send e-mail button.

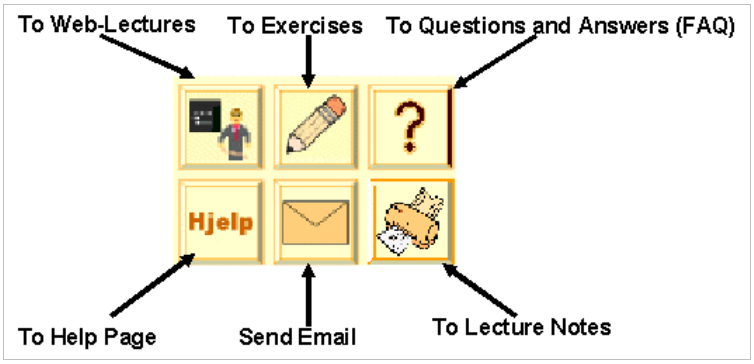


Figure 4.8. The button bar

Help page

There are generally two ways in which a program can provide help; it can help the user operate the program, or help the user in relation to the content of the program (Alessi & Trollip, 2001). RadioWeb only provides the first type of help, the help page provides information on problems concerning viewing the flash animations, hearing the sound, viewing video, viewing the pages correctly, navigating the pages and which browsers that are supported.

E-mail form

The ‘send e-mail button’ opens a new window containing a form that allows the user to send an e-mail to the lecturer with questions or comments to the lecture. This provides the students with an opportunity to ask questions about, or to comment on, the web lecture. Such questions and comments will be used as a starting point for classroom discussion and elaboration of topics during the post-lectures.

Lecture notes

Lecture notes to the web lecture are currently available in PowerPoint format and can be viewed, downloaded or printed from the lecture notes page.

4.4 Interactive Elements

According to Alessi and Trollip, one of the great disappointments with educational web sites is their lack of interactivity. Three types of interactions were identified by Moore (1989; cited in Rovai, 2002); learner-instructor interactions, learner-learner interactions, and learner-content interactions. In RadioWeb, the students can interact with the lecturer via e-mail, with other students via the RadioWeb forum, and with the program through different kinds of exercises.

4.4.1 The RadioWeb forum

The students can discuss the content of the lecture, or anything else for that matter, with each other or with members of the radiology faculty using the RadioWeb forum (see Figure 4.9). The students are encouraged to discuss radiological topics and ask questions in the forum.

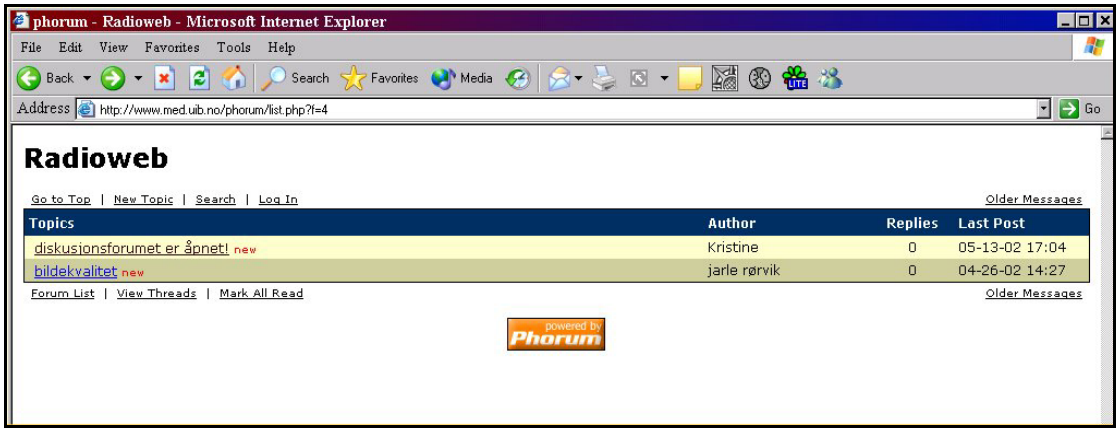


Figure 4.9. Screenshot of the RadioWeb forum

The discussion group is powered by Phorum (Phorum, 2002) which is an open source web-based discussion software application written in PHP (PHP, 2002). Phorum was already in use at the Faculty of Medicine so the system administrator simply created a new forum called RadioWeb and added it to the list of existing forums at the faculty. Anyone can participate in the discussions or start a new discussion in the forum.

4.4.2 Exercises

Three different types of exercises are provided in RadioWeb; sets of multiple choice questions, a Java applet exercise and a mini quiz[16]. These are presented below.

Multiple Choice Questions

At regular intervals during the lecture, the students can choose whether or not to open a set of questions regarding the current topic, or to continue viewing the lecture content. Alessi and Trollip (2001) recognize two types of questions, alternate-response questions in which the users can choose the right response from a list of alternatives, and constructed-response questions in which the learner must produce the answers. The questions provided in RadioWeb belong to the first type of questions, and they are implemented as multiple choice questions. After completing the questions, the user clicks the 'submit-button' to see the correct answers and get feedback on her performance.

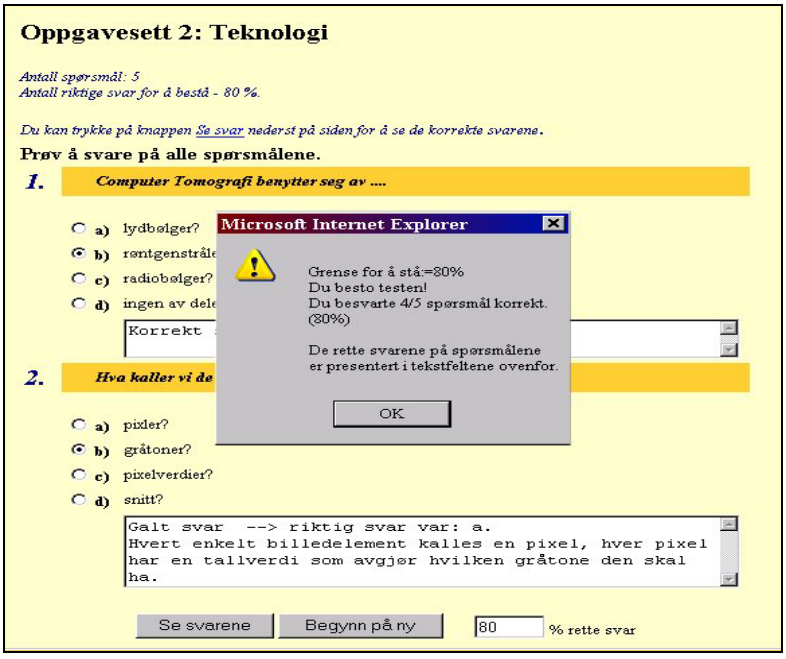


Figure 4.10. Multiple choice questions page with feedback window

Figure 4.10 shows the multiple choice questions page and the feedback given to the user. Providing the learners with feedback is essential in educational technology

[16] More screen shots from the different exercises are available in Appendix C.

(e.g. Alessi & Trollip, 2001). The most common function of feedback is of course to tell the learner whether or not the answer is correct. In addition, feedback should be corrective and provide information in order to improve future performance (Alessi & Trollip, 2001). Feedback on the multiple choice questions is given as a percentage of correct answers and the number of correct answers. An attempt to provide corrective feedback is done by displaying the correct answers together with explanations to why the answer is correct.

The Java applet

A Java applet developed at the Haukeland hospital was also embedded in RadioWeb, see Figure 4.11. The users are prompted if they would like to do the exercise in the same way as with the multiple choice questions, and the applet also opens in a new window.

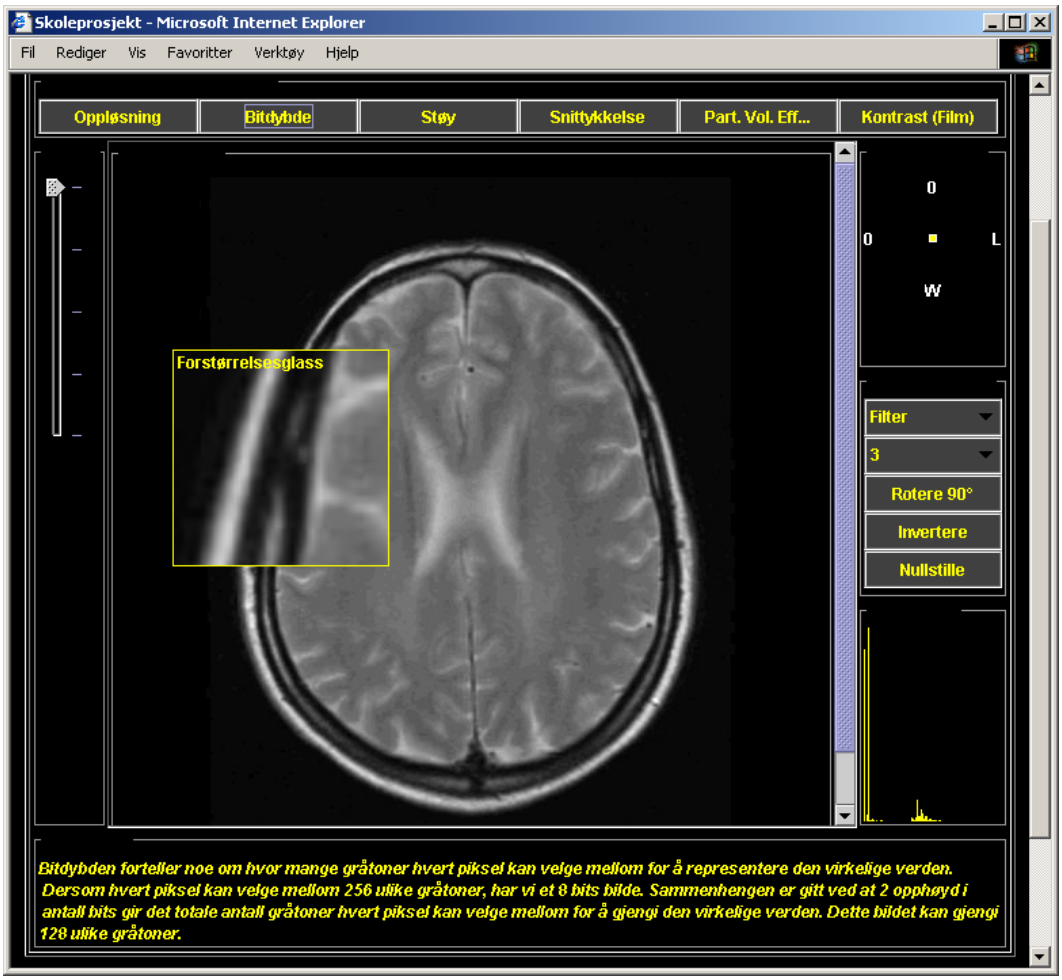


Figure 4.11. Screenshot from the Java applet

This applet allows the users to manipulate different aspects of a radiological image, and displays the effect of such manipulation. This is a practical exercise that allows the students to see for themselves how changing the information displayed in a radiological image, can make it easier to interpret the information stored in the image. This is important tools for radiologists when analyzing an image to look for any irregularities in order to make a diagnosis[17].

Mini quiz

A small quiz is available from the exercises page. It opens in a new window and consists of four questions; two multiple choice questions with only one correct answer each, one drag-and-drop question and one multiple choice question with several correct answers. All questions have a limited amount of time to answer the question, see Figure 4.12. After completing the quiz, you get a summary of your performance, both number of correct answers and time spent on each question.

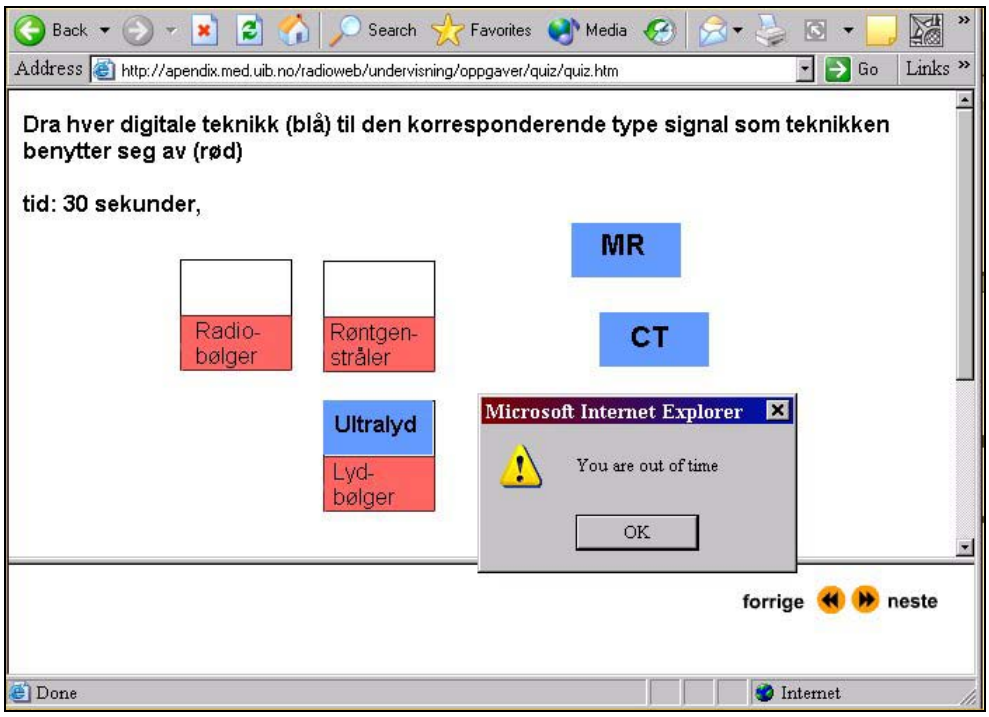


Figure 4.12. Drag-and-drop question with out-of-time notice

[17] For example, a radiologist can choose only to see structures with a certain density, thus manipulating the image to display the bone structure, but not the intestines.

4.5 Development Tools

Several tools are available to help developers design multimedia applications for learning. Tools used in development of RadioWeb include Macromedia's products Flash, DreamWeaver and CourseBuilder (Macromedia, 2001a, 2001b, 2001c). JavaScript and PHP were also used to implement interactivity.

Macromedia Flash 5.0

Macromedia Flash is a tool that is well suited for building animations on the web, because it enables you to create animations that require a relatively small amount of bandwidth. Flash offers a script-language that enables the making of interactive animation. Animations created with Flash can be viewed on the Web using the free Macromedia Flash Player. Flash was used to create the animations that constitute the course material. The web page must contain tags that reference the Flash movie file to be opened, and the flash animations are included into the web page using the OBJECT and EMBED tags. The OBJECT tag is used by Internet Explorer on Windows, and the EMBED is used by Netscape and Internet Explorer on Macintosh in order to direct the browser to load the Macromedia Flash Player (Macromedia Flash Support Center).

Macromedia DreamWeaver 4.0. / CourseBuilder Extension

Macromedia's DreamWeaver editor was used to create the actual web pages. CourseBuilder is an extension of DreamWeaver that can be used to create interactive pages for learning. All the questions were first created using CourseBuilder, but these did not function properly when viewed in Netscape's browsers, so JavaScript was used instead. Only the mini quiz remained a CourseBuilder interaction and this was due to lack of time.

JavaScript

JavaScript is a scripting language for developing Internet applications. JavaScript statements can be embedded directly in an HTML page to create client-side interactions, which means that it runs on the user's computer and not on the web server. The browsers interpret the JavaScript statements embedded in an HTML page. JavaScript was used to create the exercises included in the lecture.

PHP

The send e-mail form is implemented using PHP. According to the official PHP web site, PHP is a server-side, cross-platform, HTML embedded scripting language (PHP, 2002). When a form is submitted to a PHP script, the information from that form is automatically made available to the script. The code included in the form was:

```
<FORM method="post" action="send.php">
```

The form action looks for the file ‘send.php’ which contains the necessary code for allowing a user to send e-mail from a web page to a specified e-mail address. In RadioWeb this will be the lecturer’s e-mail address.

CSS Style sheets

Cascading Style Sheets (CSS) are external text files containing styles and formatting specifications. When you edit an external CSS file, all documents linked to that file are updated to reflect those edits. If you decide to change the font used on your pages, you only have to make the change in the style sheet, and all web pages using this sheet will be changed. CSS style sheets were used in order to secure consistent use of font types, font sizes and font colours throughout the web pages.

Server-side includes

Since both the top and the bottom menus were the same on every page, server-side includes (SSI) was used to implement these menus. SSI are special variables in a HTML page that the server will replace with actual data before sending out to the requesting browser. By the time the web page gets to its destination it looks just like any other regular web page (Webmaster Resources & Tips: What is SSI?). SSI allows you to include one web page into another. This means that you can use the same menu on several pages, but you only need to update one file in order to change all the pages using this menu.

4.6 Chapter Summary

This chapter gave an introduction to RadioWeb. RadioWeb grew into a portal for radiology at the University of Bergen, and a lot of information is available from the web site. Nevertheless, the main focus for this project was the delivering of the web lecture. This chapter focused on describing the elements related to the web lecture, such as the layout of the web lecture pages, including the navigation and sequencing of the lecture contents. The interactive elements, the e-mail function, the discussion forum and the exercises, were also described. Development began in the autumn of 2001 and RadioWeb is still being developed at the time this is written. In order to achieve as much continuity as possible in this dissertation, this chapter described RadioWeb as it appeared at the time it was tested by students in May 2002. This evaluation is described in the succeeding chapters.

5. RESEARCH DESIGN AND METHODS

This chapter discusses the research design and data collection methods used in the end user evaluation of RadioWeb. At the time of the evaluation, the product was nearly finished, so a field test seemed to be the best way of getting feedback from the users. A field test, as described by Tessmer (1993), is an evaluation where the evaluator observes the instruction being tried out in a realistic situation with a group of learners. A field test is most suitable for situations where the product is near completion, and can be used to generate final revision suggestions. The purpose of the evaluation was to find room for improvement in the prototype, with a special focus on design elements. As stated in chapter 1, the research question asked for this evaluation was:

What new design issues arise from a formative evaluation of RadioWeb?

Both quantitative and qualitative research methods were used to collect data from the target users, for the purpose of discovering such new design issues.

5.1 Methodology

Methodology refers to how researchers approach problems and seek answers to their research questions (Taylor & Bogdan, 1984). Researchers can choose to conduct a study using a quantitative or a qualitative methodology, or a combination of both. The key difference between these two strategies can be expressed as two statements. Quantitative research is empirical research where the data are in the form of numbers, and qualitative research is empirical research where the data are not in the form of numbers (Punch, 1998, p. 4). Quantitative studies are generally more structured than qualitative studies and collect data from more respondents. The quantitative researcher

expresses the data as numbers and seeks to discover any patterns in the numbers (Hellevik, 1999). Qualitative studies, on the other hand, focus more on understanding, interpreting and explaining human behaviour. Savenye and Robinson (1996) define qualitative research as "research devoted to developing an understanding of human systems, be they small, such as a technology-using teacher and his or her students and classroom, or large, such as a cultural system" (p. 1171). These two strategies are not mutual exclusive, researchers often use a combination of quantitative and qualitative methods for collecting data. In fact, Ross and Morrison (1996) argue that "both provide unique perspectives, which, when combined, are likely to yield a richer and more valid understanding" (p. 1166). Using a combination of two or more methods is often referred to as triangulation (Frankfort-Nachmias & Nachmias, 1996). In the evaluation of RadioWeb, a combination of questionnaires, observation, interviews and online user tracking was used to collect data.

5.2 Carrying out the field test

5.2.1 Participants

Students from the target user group, that is 3rd year students of medicine, evaluated the system. The students were encouraged by the lecturer to show up for the evaluation. They were informed that the content of the web lecture would replace the content usually presented during the classroom lecture, and that the classroom post-lecture would be related to the web lecture. The students signed up for the time they wanted to attend, since only 16 computers were available.

5.2.2 Setting of the case

The field test took place in a PC lab available for the students at the Faculty of Medicine on the 15th of May 2002. The lab has 16 computers and is open 24 hours a day. The lab was booked in advance to ensure that there would be enough PCs available for the students to use. The computers were placed in 4 rows, each with 4 computers each, facing the whiteboard. The URL to the web page containing the web lecture was written

on the whiteboard. So was a request to the students to note in their questionnaire if they encountered any problems during the session.

Each student had their own computer and was allowed to access the learning material at their own pace and to leave the lab when finished. Each group of students had 90 minutes in the lab to test the program, which should be sufficient considering that viewing the material takes approximately 40 minutes. As problems were discovered, they were written on the whiteboard alongside instructions on how to solve them.

5.3 Data Collection Methods

The data collection methods used in the evaluation of RadioWeb included questionnaires, observation, interviews and user tracking, see Table 5.1. Questionnaires were administered and student interviews conducted in a face-to-face evaluation setting. The interview with the instructor was conducted 2 weeks later, after the post-lecture.

Table 5.1. Methods used to collect data from users

Data gathering technique	Notes	Type of Data
Questionnaires	Structured with predetermined categories except for a commentary field	Paper questionnaires and dataset in SPSS[18].
Observations	Informal, limited interaction. Both individual and groups	Observation Notes
Student Interviews	Semi-structured, open-ended. Both individual and groups	Recordings and transcripts
Instructor Interview	Semi-structured, open-ended	Recording and paper summary of interview
User tracking	Internet tracker	Computer-generated statistics

[18] Statistical Package for the Social Sciences (SPSS 2002)

5.3.1 Questionnaires

The students were asked to fill out a questionnaire after completing the program. A total of 41 questionnaires were handed out, filled out, and returned after the sessions. The questionnaire consisted of different types of questions, both structured and open-ended items. Several questions were Likert scale questions. The Likert scale is a rating scale that measures the strength of a subject's agreement with a given statement (Preece, 1994). The students should rate their opinion as 'strongly agree', 'agree', 'neutral', 'disagree' or 'strongly disagree'. The other questions were formulated as multiple statements were the student could check all the alternatives that applied. At the bottom of the questionnaire, the students could write their own comments. The questions in the questionnaire were grouped into categories concerning the users' opinions about[19]:

- The look-and-feel, or the user interface, of the program
- The navigation within the program
- The usefulness of the help page provided in RadioWeb
- The presentation of the lecture content
- The content of the web lecture
- Possible use of the program, motivation for future use
- The exercises provided in the program

5.3.2 Observations

Watching students work with a program is an effective way of producing formative evaluation data. Whether they have problems navigating the program, with the sequencing of the program, or any other problem that they may encounter, it can be judged by observing how they interact with the program. Hopefully, this will give the evaluator valuable information about how to refine the program in question. During three of the sessions, sessions 1, 3 and 5, I was present in the lab, observing students and assisting with problems. A formative review log[20] was used as a tool during the observation. This log has three columns, the first for recording the screen or item in question, the second for writing down observations, e.g., errors, confusing points, or

[19] The original questionnaire in Norwegian is presented in Appendix D.
[20] The review log is also presented in Appendix D.

ideas, concerning this screen or item, and the third for recording improvements that can be made as a result of this problem[21].

In addition to the observations of students using RadioWeb, I attended the post-lecture as an observer. The post-lecture was scheduled two weeks after the field test. The intention was to get an impression of the student-lecturer communication in the classroom. Whether or not there was any difference in student activity before and after the web lecture had been introduced in the course, could not be measured, since only the post-lecture was observed. In order to get information concerning any such change in student activity, the instructor who normally teaches the course, and who was in charge of the post-lecture, was interviewed after the post-lecture.

5.3.3 Interviews

Interviews yield rich insights into people's experiences, opinions, aspirations, attitudes and feelings (May, 1997). Thus it is a good method for capturing the user's opinions of what they think of using a program such as RadioWeb. Interviews can be characterized along a quantitative / qualitative dimension varying from structured to unstructured interviews (ibid). Semi-structured interviews utilize techniques from both in that questions are usually specified in advance, but the interviewer can ask the interviewee to elaborate and clarify his or her answers. The advantage of semi-structured or unstructured interviews is that it can capture opinions that were not anticipated by the evaluator in the questionnaire. You can also distinguish between interviews conducted individually and interviews conducted in groups.

In the evaluation of RadioWeb, four semi-structured interviews were conducted, three with students and one with the course instructor. All the interviews were conducted using an interview guide[22]. The interviews were recorded using a mini-disc and were later transcribed. Since my primary interest was the subjects' opinions, the interviews were not transcribed in detail.

[21] This column was not used. Figure 6.8 on page 92 shows an excerpt of the formative review log
[22] Both interview guides are presented in Appendix D.

Student interviews

The interviewees were selected by asking for volunteers at the day of the field test. The original idea was to conduct two interviews with individual students and one group interview with four students. But after one individual interview and one group interview, I decided that the data from the group interview seemed to be richer than the data collected from the individual interview. As a result of this, I decided to try yet another combination for my last interview. The result was one individual interview, one interview with a group of four students, and one interview with two students.

The student interview guide was designed to capture the subjects' immediate opinions concerning:

- Navigation and user control in the program
- Help function
- Colours and fonts
- Presentation
- Content
- Interactions
- Motivation for using the program

Interview with Instructor

An interview with subject matter expert and course instructor, Jarle Rørvik, was conducted immediately after the post-lecture had been given[23]. The purpose of this interview was to sum up the RadioWeb project so far, and to discuss whether or not the initial goals had been achieved. Whether or not he noticed any difference in the student activity before and after the introduction of RadioWeb was of special interest. This interview took place in his office at Haukeland hospital. The interview guide for this interview was designed in order to capture the instructor's response to questions concerning:

- Intentions with the project.
- Accomplishments of the project.
- Future work with the project.

[23] A summary of this interview is presented in Appendix F

5.3.4 User tracking

Data were also collected through user tracking. Using the free tracker from eXTReMe (1998-2003), data[24] was collected concerning:

- Number of unique visitors (per day, week, month, hours of the day, days of the week)
- Geographical location of the visitors (domain, country, continent)
- System used by visitors (browsers, operating systems, screen resolutions, etc).

5.4 Chapter Summary

This chapter described the methodology for the formative evaluation of RadioWeb. A combination of quantitative and qualitative methods was used to collect data about the program. The original intention was to conduct the field trial as a mainly qualitative study, but in order to get responses from a larger number of students; a questionnaire was also included in the study. As we shall see in the next chapter, the questionnaires turned out to be a rich source of data, much due to the fact that the respondents used the commentary field in the questionnaires to a great extent.

This chapter has presented the context for the evaluation of RadioWeb and the methods used to collect data in order to answer the research question, that is, in order to discover potential improvements to the design of RadioWeb. The next chapters present the findings from the formative evaluation of RadioWeb. Chapter 6 presents findings from the end user evaluation with students, while chapter 7 presents findings from the post-lecture observation and the instructor interview, and sums up the project's success in achieving its initial goals.

[24] Data collected using this tracker is presented in Appendix G

6. FINDINGS

This chapter presents the findings from the field test evaluation conducted with students from the target user group. The formative evaluation was conducted for the purpose of discovering improvements that should be done to the design of RadioWeb before further development of online learning material was initiated. A combination of questionnaires, observations and interviews was used in order to capture the students' immediate opinions concerning the program.

6.1 Findings from the Questionnaire

A questionnaire was distributed to all the students who participated in the evaluation. The main intention with the questionnaires was to get the general impressions and opinions of a larger group of students. As stated in chapter 5, the questionnaire was designed to capture the users' opinions of the *user interface, navigation, the help page, the presentation, the content, possible use of web lectures and the exercises* provided in RadioWeb. The following sections describe the students' response to these questions. The questionnaire was written in Norwegian so the questions and responses presented below have been translated by me[25].

6.1.1 Respondents' background

All the respondents were 3rd year students of medicine at the University of Bergen. A total of 41 students participated in the evaluation,, and answered the questionnaire (approximately half of the population). Demographic data collected about the students

[25] Data retrieved from the questionnaires are available in Appendix E.

was limited to gender and age. The 41 students who participated consisted of 20 male and 21 female students whose age varied from 21 to 31 with an average of 23 years.

6.1.2 Evaluation of the user interface

The majority of the students were positive to the user interface. Important aspects concerning the user interface include navigation, colours, fonts and the general look-and-feel of the program. When conducting a formative evaluation like this, the researcher takes a special interest in any negative feedback since the main objective is to improve the product. Table 6.1 shows the feedback given by the students concerning the user interface. The table shows that the responses from the questionnaire were generally very positive, the students liked the colours, fonts, buttons, navigation and the organization of pages.

Table 6.1. Opinions concerning the look-and-feel and the navigation

Statement	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
The colours are pleasing	16	24	0	1	0
The colours are disturbing	0	0	1	24	16
It was problem-free to read the fonts	23	16	0	1	1
The buttons were intuitive	7	26	8	0	0
Navigating inside the program was easy	11	26	2	2	0
It was difficult to determine where you were in the system	0	5	2	24	10
The pages were poorly organized	1	5	3	20	12
I am all in all pleased with how the pages looked and were organized	15	24	2	0	0

6.1.3 Navigation and user control

Almost all of the students (90%) answered affirmative to the statement "Navigating inside the program was easy", while two students had no opinion in this matter, and two students disagreed with the statement. In addition, only five students agreed to the statement "It was difficult to determine where I was in the system at all times". This indicates that navigation within RadioWeb was satisfactory. One of the students who disagreed to the statement, made a note in the comment field explaining his opinion[26]:

> Student 09: It would be an advantage if you could move back and forth in the videos (all of them) using mouse clicks. It will make it easier to go back and repeat what you missed without having to view the entire movie again.

Figure 6.1. Student comments in the questionnaire regarding winding

One student called for a pause-button, although such a button already existed (the play/pause button). This button can also be used to repeat the last played movie, and one student called for such a repeat function. The fact that two students overlooked this button does not necessarily constitute a problem, but three out of the six students who were interviewed did not find it either. This implies that the pause-button should be more noticeable.

> Student 03: Missed a stop-button to stop during playing.
>
> Student 33: Could have been a 'repeat button' between the 'previous' and the 'next' buttons.

Figure 6.2. Students commenting in the questionnaire regarding play/pause button

The reason why there seem to be some sort of ambiguity between the responses with regard to navigation, which were very positive, and the views expressed through the comments and interviews, can be the result of the design of the questions, especially the use of words like 'easy' and 'difficult'. Navigation was not necessarily difficult even if it could have been more pleasant, or more user friendly, if the system had provided the users with the opportunity to wind back and forth and if the play/pause button had been

[26] A complete list of comments in both Norwegian and English is provided in Appendix E

more noticeable. This becomes more evident when looking at the response given to the statement concerning user control, see Figure 6.3.

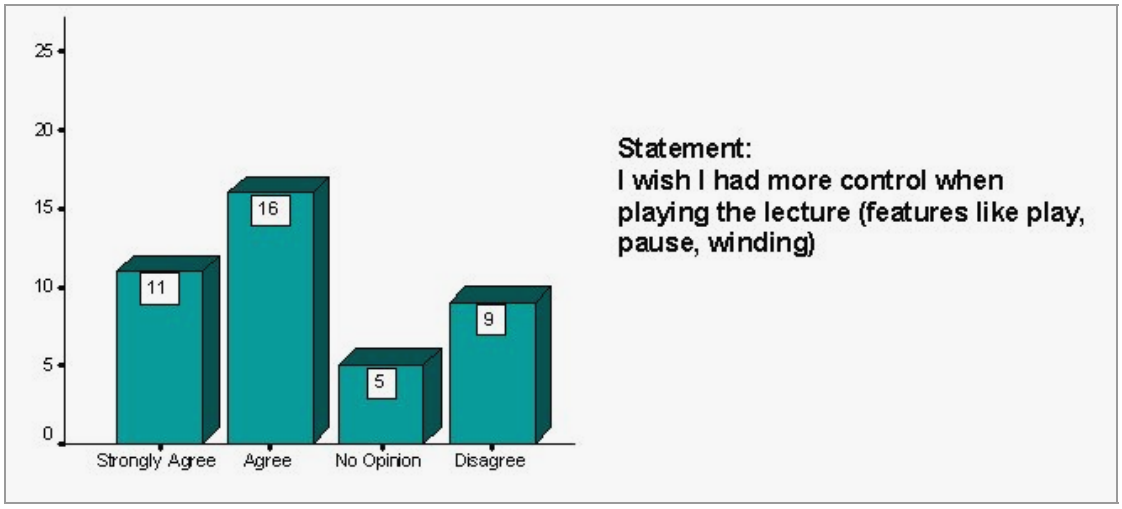


Figure 6.3. Evaluation of statement regarding user control

When asked whether they wished for more user control, more than half the students (27) answered affirmative. Six students noted in the questionnaire that they missed the opportunity to wind and this was also emphasized in all three interviews. Because so many of the students mention this as a desired feature, the lack of winding controls is a serious shortcoming in the system. This view is supported by Alessi and Trollip (2001) who state that:

> "Whenever there are movies, audio, or animations, allow the learner to pause, continue, repeat, or skip them. If the movie or other information is long (more than ten or twenty seconds), also provide fast-forward and rewind controls." (p. 53)

The students' responses support the view that the system should have provided them with the opportunity to fast-forward and rewind within the content. A total of 14 students commented in the questionnaire on aspects concerning navigation.

6.1.4 The help page

The help page offers solution to possible problems foreseen by the developer, but there is no guarantee that it will solve the problems encountered by real end-users. Table 6.2 shows responses to the question concerning the usefulness of the help page. This question was formulated as five statements where the respondents could check all that applied.

Table 6.2. Opinions concerning the usefulness of the help page

Statement:	Checked	Unchecked
I needed the help function	3	38
Help was easy to find when I needed it	14	27
Help solved my problem	3	38
Help did not solve my problem	4	37
I did not find help	1	40

Only 3 students answered that they had needed the program's help function. This does not necessarily mean that the program is flawless (most likely not). One possible explanation is the fact that I was present in the lab during three out of five sessions and that several students simply asked for help instead of searching for it themselves. Another possible explanation is that the design of the question was difficult to understand. Despite the fact that only 3 students said they needed the help function, a total of 7 students answered whether it had solved their problem or not. Besides, 14 students answered that the help function was easy to find when they needed it, but only 3 students claimed to need it in the first place. A possible explanation for this could be that the students looked for the help function while answering the questions in the questionnaire[27]. The fact that only 3 students answered that the help function provided the necessary information to solve their problem, while 4 students answered that it did not, suggests that the help function does not provide the necessary assistance to solve the problems encountered by real end users.

[27] Observation showed that this was the case with at least one student.

6.1.5 Presentation

One of the pitfalls in multimedia programs is the danger of presenting the user with too much information at the same time, but only 4 students seemed to think that was a problem with RadioWeb, see Figure 6.4.

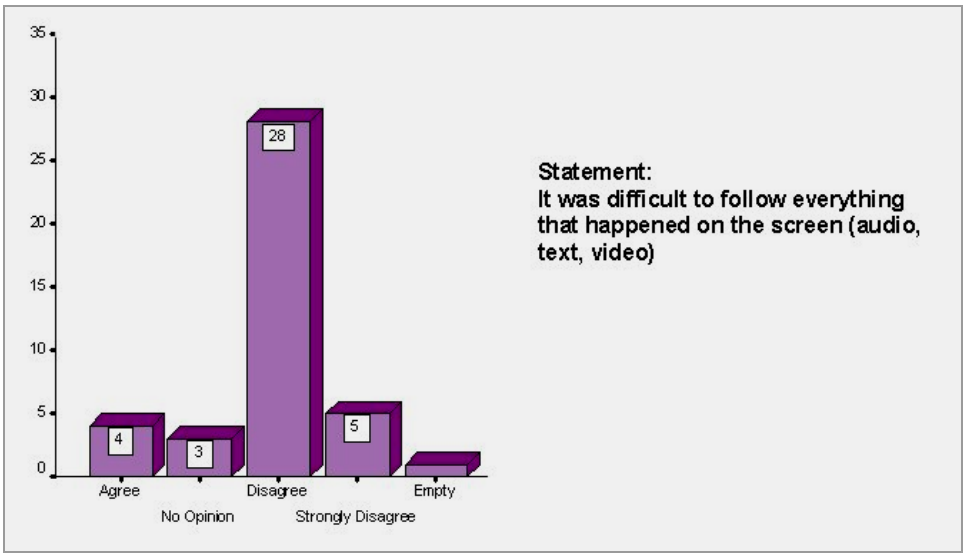


Figure 6.4. Information overload?

The questionnaire contained no questions regarding the quality of the narration, but several students noted in their questionnaire that the narration audio was a bit stuttering and that the lecturer had a boring or monotonous voice. One student noted that the web lectures should not be platform dependent.

Another important aspect of multimedia programs is the transitions between the different topics. According to Alessi and Trollip (2001), transitions from one topic to another are essential in multimedia programs. The frequent changing of pages makes it difficult to distinguish between the continuation of one topic and the beginning of the next one. Figure 6.5 shows that this was not a problem for the students who used RadioWeb. Only two students found it difficult to distinguish between the different topics. One student made a note in her questionnaire stating that it "would be nice if it was marked were you were, e.g. with colors in the menu".

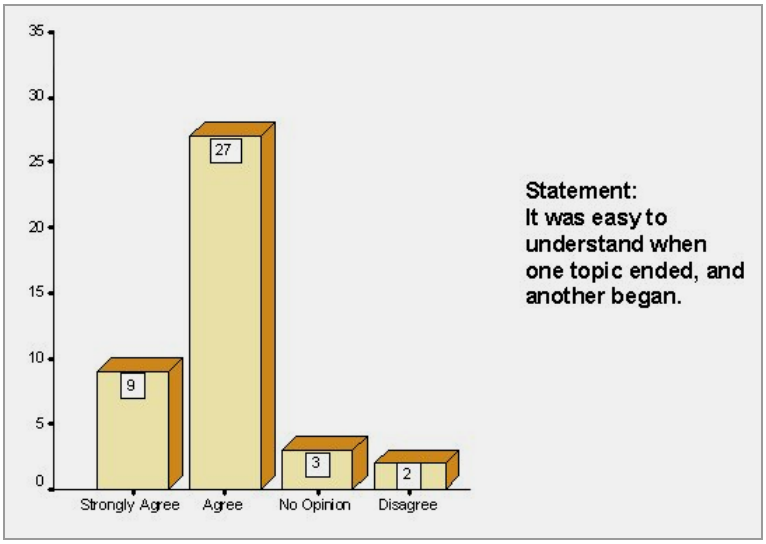


Figure 6.5. Transitions between topics

6.1.6 Content

Although the main objective with this end user evaluation was to discover potential improvement in the design, a few questions concerning the quality of the content of the program and the concept of web lectures felt necessary to ask. The intent with the evaluation was not to judge the quality of the material, but the students were nevertheless asked to give their subjective opinion as to whether or not this learning material increased their understanding of the subject taught.

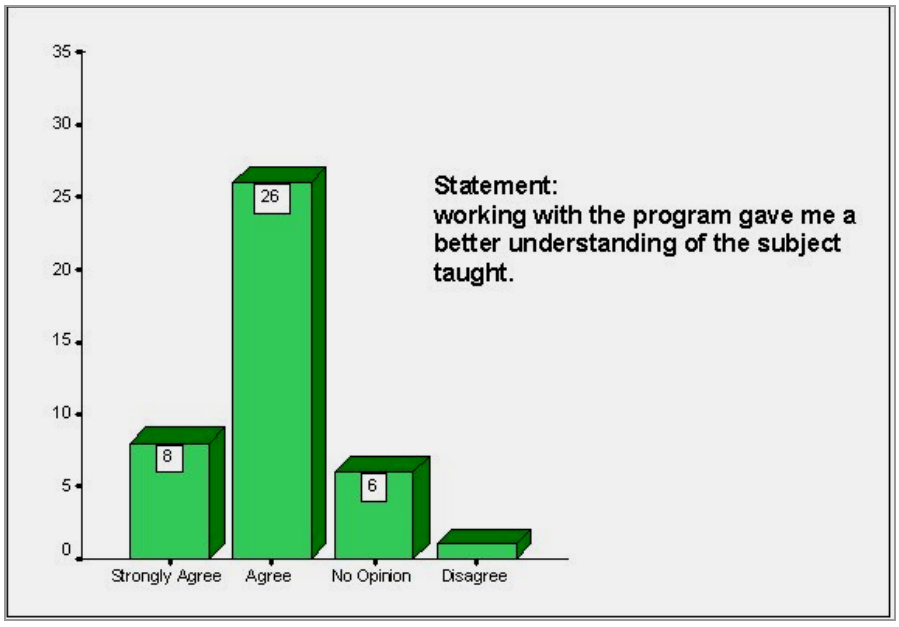


Figure 6.6. Usefulness of the web lecture

34 out of the 41 students answered affirmative to the statement, “working with the program gave me a better understanding of the subject taught”, while only one student disagreed to the statement, see Figure 6.6.

One student made a note in the questionnaire saying: “I got a better understanding of the subject taught, but I do not know for how long I will remember it.” Beyond that, only three students found the content difficult to understand, a majority of students found the content interesting and instructive, and only five students found the content boring, see Table 6.3. The question concerning the content was formulated as five statements where the respondents could check all that applied.

Table 6.3. Opinions concerning the content of the web lecture

Statement:	Checked	Unchecked
The content of the lecture was difficult to understand	3	38
The content of the lecture was easy to understand	18	23
The content of the lecture was interesting	34	7
The content of the lecture was instructive	29	12
The content of the lecture was boring	5	36

6.1.7 Motivation and possible use of the program

When asked for what purpose this kind of web lecture was suitable, see Table 6.4, a majority of the students agreed that it was suitable for learning new material, and a great majority think it suitable for repetition and supplement to the traditional lectures. But only 10 students think this kind of web lecture can replace the traditional classroom lectures.

Table 6.4. Opinions concerning possible use of the program

Statement:	Checked	Unchecked
This kind of web lecture is suitable for learning new material	25	16
This kind of web lecture is suitable for replacing traditional lectures	10	31
This kind of web lecture is suitable for repeating known material	33	8
This kind of web lecture is suitable as a supplement to traditional lectures	30	11
Other	2	39

Even though only 10 students thought that web lectures can replace traditional lectures, an overwhelming majority of the students would like to have more lectures available on the web. In fact, Figure 6.7 shows that only one student did not wish more lectures on the web.

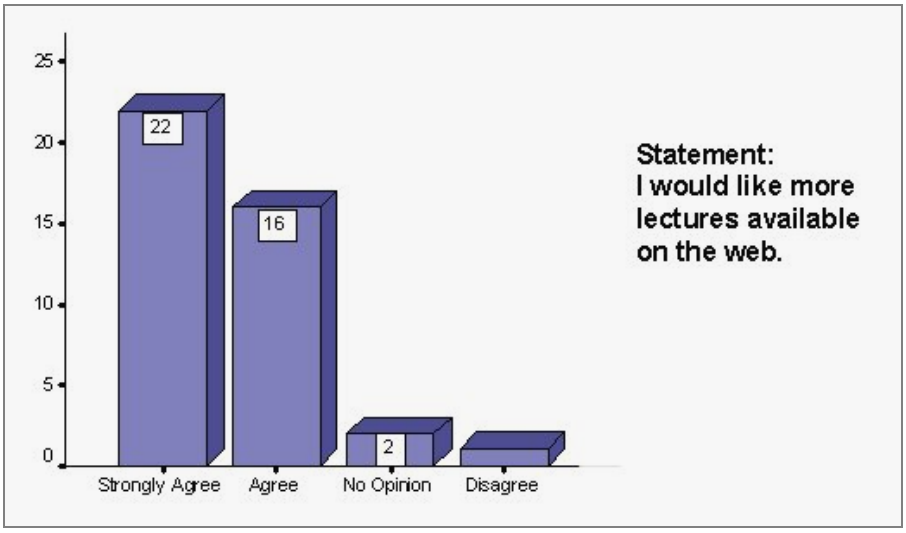


Figure 6.7. Motivation and future use

An important motivation for offering lectures on the web is that it allows the students to access such learning material at any time and from any place, provided there is a computer with Internet access available of course. The results from the questionnaire suggest that these aspects are important to the students from the target group: Nineteen students, approximately half of the respondents, answered affirmative to the statement

"Being able to work independent on time and place means a lot to me", 7 students had no opinion on this matter, while 5 students disagreed with the statement.

6.1.8 Exercises

The response to the question concerning the exercises provided in RadioWeb leaves little doubt that such exercises are welcomed by the students, see Table 6.5. None of the students thought there were too many questions and all but one agreed to the statement "the questions made the program more exciting". These responses support the view that students want exercises and indicate that there could have been more exercises in RadioWeb.

Table 6.5. Opinions concerning the exercises provided in the program

Statement:	Checked	Unchecked
The questions were too hard	1	40
The questions were too easy	7	34
There were too many questions	-	41
There could have been more exercises	26	15
I got satisfying feedback on my performance in the questions.	26	15
The questions made the program more exciting	40	1

6.1.9 Summary questionnaires

The questionnaires proved to be a valuable source of data, much more valuable than originally anticipated. Especially the comments proved to be very constructive with regards to suggestions on how to improve RadioWeb. The questionnaires gave the following results:

- Most of the respondents were satisfied with the look-and-feel of RadioWeb.
- Navigating the program was not difficult, but the program has some serious shortcomings with regards to navigation. First and foremost, the program should provide fast-forward and rewind controls. In addition, the play/pause/repeat-button should be more noticeable and its function should be more evident.
- Navigation may be made easier by highlighting the topic which the user is currently viewing.
- The next-button failed several times.
- The help function should provide better assistance to the users.
- Most of the respondents were satisfied with the presentation of the content.
- Most of the respondents thought the content was easily understood, interesting and instructive.
- Most of the respondents would like more web lectures, but do not think web lectures are suitable for replacing traditional lectures.
- Exercises make the program more interesting to use and there could be more exercises in RadioWeb.

6.2 Findings from the Observations

The observation sessions aimed at discovering any irregularities in the users' interaction with the program, and to discover whether the students followed the intended route through the material. The intention was to discover what kind of problems the user could encounter during the use of RadioWeb, with a special focus on the navigational aspects. Unless the learners could not proceed without assistance, I tried to avoid interacting with them during the sessions.

6.2.1 Observation session 1

There were 12 students present in the lab during this session while one student was observed while using the program from start to finish. A female student volunteered to be observed and subsequently interviewed. Observation revealed that she did not seem to find it difficult to get started and she navigated initially using the next-button. At one point she started using the content menu for navigation and it seemed like the next-button did not always function properly.

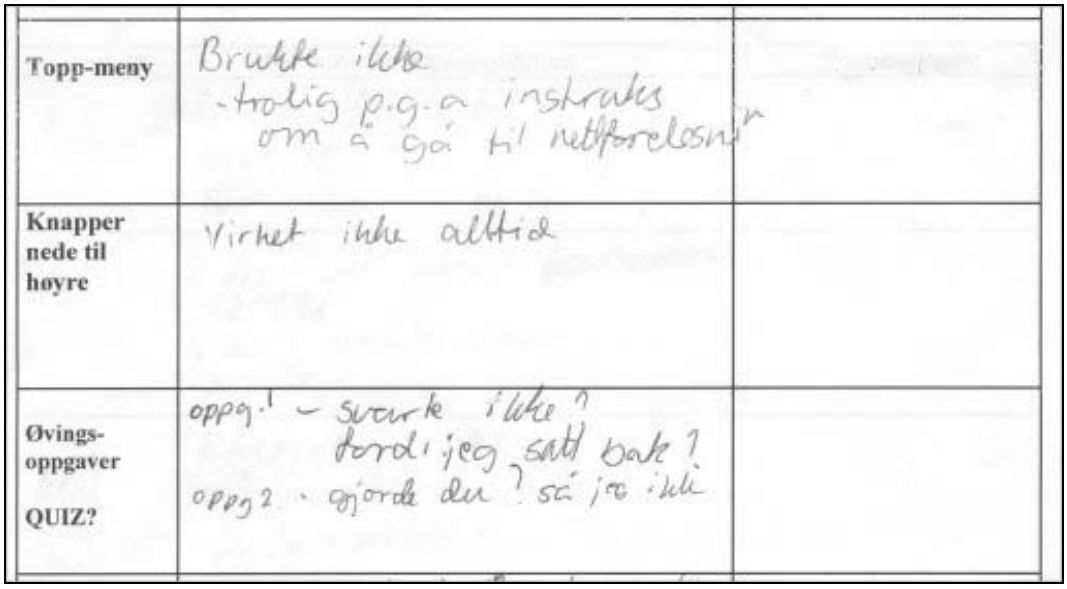


Figure 6.8. Excerpt from the review log

As she encountered the first exercise-page, the subject neglected to answer the questions and immediately moved on to the next session, but she completed the remaining

exercises. The Java applet did not look right and updated slowly. According to the developer of the Java applet, this occurred because the screen refresh rate on the monitor was too low. The applet requires a screen refresh rate higher than 75 hertz. The subject did not use the help page, the e-mail function or the discussion group, but looked at the help page while filling out the questionnaire.

At one point during this first session, the sound disappeared on all the computers, and this resulted in a complete chaos where nobody could hear the narration sound. I did not immediately identify the cause of this, but closing and reopening the browser window solved the problem. Some of the students did not know exactly where they had been in the program and viewed part of the web lecture over again. At the end of the session, I discovered that the Java applet was the cause of the disappearing sound. After viewing the applet, the sound disappeared from the flash movies. This had never occurred during earlier testing, but this had never been tested in that specific computer lab either. As a result of this, the next groups of students were instructed to close and reopen the browser window after they had viewed the applet, or to avoid opening the applet until after they were finished viewing the web lecture. Several times during this first session, other students needed assistance with technical problems such as adjusting the volume, screen resolution etc. A result of this was that observing one student all the time was impossible.

6.2.2 Observation session 2

During this session, there were 10 students present in the lab while I observed four students using the program, but I also observed what the other students seated near me were doing, see Figure 6.9. The four students were interviewed together as a group after the session. When opening a page containing a video, one of the students was prompted if she would like to install the necessary files and she looked to me for confirmation. Two students started competing in getting the most correct answers to the exercises. One student started installing the Java files which are required to view the applet, even though it was explicitly stated that these files were already installed in the computer lab. Several students did not use the button bar leading to, among others, the exercises page, but one student found the quiz and told the others about it. I saw no one using the help page, the send e-mail button or the discussion group.

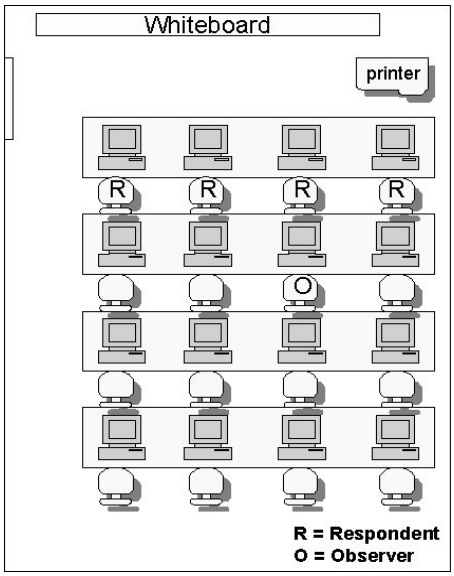


Figure 6.9. Observation of four students

6.2.3 Observation session 3

During this session, only 5 students were present in the lab so I observed them all at the same time. Two of the students were interviewed together after the session. Everyone navigated using the next-buttons and no one seemed to have any particular problems. One student discovered that there was an error in one of the questions: one correct answer was judged as wrong. Other than that no one seemed to have any problems of navigational or technical character.

6.2.4 Summary of observations

The observation sessions helped identify the following design issues:

- The next-button sometimes fails to work and the user needs to use the menu to move to the next section.
- The Java applet kills the sound in the flash movies.
- Some of the students are prompted if they would like to download files to view the video. These files should install automatically without user response, as this type of questions can confuse novice users.
- At least one student did not understand that he did not need to install Java files in order to view the applet.

6.3 Findings from the Interviews

The purpose of the student interviews was to capture the students' immediate impressions and opinions of RadioWeb. As mentioned in chapter 5, the interview guide was designed to capture both the students' *general opinion* of the program, and more specific opinions concerning *navigation and user control, the look-and-feel, the help page, the presentation of the material, the interactions, and the motivation for using RadioWeb.*

In the extracts from the interviews presented below, the 'I' refers to the interviewer while 'F1', 'F2', 'M1' and 'M2' refers to the various respondents (female one, female two, male one and male two). All interviews were conducted in Norwegian, so the extracts are translated into English by me.[28]

6.3.1 Interview session 1

The first interviewee was the female student that had been observed during the first observation session. The respondent was generally very positive towards the program, she had used similar programs before and she enjoyed using the computer as a tool for learning. She was very satisfied with the program in general, but she commented on several things concerning navigation and user control, among others, she expressed a desire to be able to wind back and forth within each flash movie.

Extract 1:

I: *How good user control did you feel that you had?*

F1: I wished I could rewind. Among other things because sometimes it went through all those cue words and then maybe continued with a little film.

I: *Yes, precisely*

F1: And then I thought: "Oh, I would like to go back and see that". In those cases there might be too little user control. And if I used the back button, I came to the previous subject, not to the beginning of the current subject.

[28] The original extracts in Norwegian are presented in Appendix E.

This tells us that the respondent also missed the opportunity to repeat the current section. This function was present in RadioWeb, but the respondent did not find it. Besides, it only allows you to repeat the current section after it has finished playing. She had no opinion concerning the colours, and she liked the fonts. She had not used the help page and therefore she had no opinion about it. When asked to comment on the presentation of the material, she said she thought that this web lecture went more thoroughly into the material than what many lecturers did in the classroom lectures, and that she thought the quality of the content was good. When commenting on the exercises, the respondent admits that the reason she did not answer the first questions was that I was looking over her shoulders and that made her a little nervous. Other than that, she liked to get exercises along the way, and she found the quiz but did not take it. She emphasizes that especially the Java applet was exciting. The Java applet lets the users see for themselves how manipulating a radiological image can be a helpful tool in making a diagnosis.

Extract 2:

I: *And what about the Java applet?*

F1: The one where we could try for ourselves?

I: *Yes.*

F1: I thought it was great, because it allows you to use some theory in practice.

She likes the idea of lectures on the Web because of the freedom to access the material independent of time and place, but she does not necessarily think that it is a good idea to replace the traditional lectures with web lectures because many students are not comfortable with computers.

Extract 3:

I: *What do you think about making a lecture web-based?*

F1: I think it is very good because then you can, as I have already mentioned, get it in your own pace, get it repeated. And I can access it whenever I want.

I: *The goal of this project has been to increase the students' previous knowledge and make them more prepared for the classroom lecture in order to achieve more interaction between the lecturer and the students. Do you think that this goal is achieved?*

F1: With this lecture I definitely think so because we have lecturers that do not explain so much basic stuff because they hardly know what class we are in… and this explains the basic and has dealt with things that I have missed during the lectures.

I: *Would you prefer this type of lectures to classroom lectures?*

F1: Well, no. But variation is always nice, so some lectures where it is possible.

6.3.2 Interview session 2

This interview was conducted as a group interview with four students, two male and two female. The general feedback from the group was positive. One student noted that it was better than she had expected. She was not all that familiar with the use of computers, and thought that it went surprisingly well to complete the program. Another student noted that the quality of the content was high because it seemed to be more carefully planned than traditional lectures, and because you had the visual material showing synchronously with the narration audio. He thought it well organized, and a good way of acquiring information.

Navigation and user control

None of the four interviewees said that they had any problems navigating the program, but only two of them found the pause-button, and they all wished for fast-forward and rewind controls.

Extract 4:

M2: I became very engaged and it gave me a lot of freedom to go back and check things.

F2: Should have been possible to wind, so that if you missed something in the beginning, you could just rewind.

M1: More pause-button and wind-button

F2: Well, there was a pause-button, but…

M1: Was there?

M2: Yes, it was

F1: I did not find it

F2: It was sort of down by the…. *[Timeline]*

Interactions

All four agreed that the Java applet was fun and interesting, but that it was a problem that you had to scroll the picture. One student noted that one of the things you could try out in the Java applet was not explained until the succeeding section.

They all agreed that the exercises were fun, even though one student noted that he thought they were too easy. Two of the students tried the mini quiz and noted that it provided a bit more interesting type of questions (drag-and-drop, etc.) than just the multiple choice questions provided during the lecture.

Presentation of the material

One of the students commented that he found it disturbing that the narration voice sometimes was a bit stuttering and that at one point the narrator was a different person than the lecturer[29]. When asked if program took too long to complete, two of the respondents strongly agreed that it should be longer.

[29] As mentioned earlier, the narration audio to the animation produced by UMS was read by the 6th year medical student.

Motivation and future use

One student (F1) thought it was tiresome to listen to a voice without seeing the lecturer. Another (M1) expresses scepticism towards viewing such web lectures alone, especially considering all the technical problems one may encounter. Yet another student (F2) noted that it was fun for a change, but that she did not want all the lectures to be online, at least not without having post-lectures. Two students agreed that in order to learn the curriculum, web lectures could replace the traditional lectures in many ways, but that other aspects should also be considered, such as access to computers, and the fact that students sit alone. Two of the students noted that students' access to computers had to be improved in order for web lectures to be a success.

6.3.3 Interview session 3

During this last interview, one male and one female student were interviewed together**.** Once again the general feedback was very positive. One of the respondents (M1) thought that it was an interesting new way of learning, as opposed to traditional lectures, while the other (F1) was very positively surprised. When asked what they thought of making a lecture web-based, the answer is like cut from an e-learning advertisement:

Extract 5:

M1: I thought it was very handy. Then you can do it anywhere, using any computer. You do not need to come here [the medical faculty] for the lectures and you can click back and forth and repeat stuff.

Navigation and user control

None of the two respondents had any problems navigating the system, but they both stressed the need for fast-forward and rewind controls. The female student suggested placing a repeat-button between the next and the previous buttons and the other student agreed to this idea. This indicates that none of them perceived that the play/pause button was also a repeat-button.

Interactions

Both the respondents tried the exercises, but expressed no particular opinions concerning them. They agreed that it worked very well as a way of breaking up the presentation and making them more engaged. They did not try the Java applet or the discussion forum.

Presentation of the material

Both the interviewees said that the difficulty level of the presented material was fitting for their level of expertise, and that they did not think it lasted too long either. The male student commented that sometimes the first part of the first word in a movie was missing. They did not have anything to comment on the colours or the fonts.

Motivation and future use

The two respondents were overwhelmingly positive to the idea of web lectures and thought that providing the entire introductory course in radiology online was a good idea. Still, the female student stressed the importance of actually meeting a staff member from the Section of Radiology and thought post-lectures were suitable for this purpose. In order to understand the subject area, they actually thought it worked better than regular lectures.

Extract 6:

I: *What do you think of the idea of making all 10 lectures web-based with succeeding classroom lectures?*

M1: It is probably a good idea. I think you learn just as much that way, more actually, than in traditional lectures.

F1: I am inclined to agree because the more specialized the teaching becomes, the less pedagogical it usually becomes. So I would think it is a good alternative.

Extract 7:

I: *What does this [the program] mean for the understanding of the subject matter. Does it make it easier to understand the subject matter or is it the same as in the classroom?*

M1: Compared to a regular lecture, I think this is better.

I: *You think it is better?*

M1: Definitely. I think so.

F1: I actually think so too because you get sort of closer and you can repeat what you find difficult.

6.3.4 Summary interviews

The interviews confirmed much of what came out of the questionnaires and observation. The general impression is positive, but everyone wish for an opportunity to fast-forward and rewind within the movies and the pause-button is easily overseen by users. The interviews also confirmed that the students enjoyed doing exercises and that RadioWeb could benefit from offering more and different exercises to the students.

6.4 User Tracking

The data collected using the internet tracker, shows that 66 unique users visited the RadioWeb page at the day of the evaluation, and 12 more during the succeeding two weeks from the day of the evaluation to day the post-lecture was given. A total of 150 users visited the page that month (May 2002). This indicates that some of the students might have visited the page after the evaluation. 99% of the visitors from April 28th 2002 until February 23rd 2003 used one of Microsoft's Windows Operating System (Microsoft, 1985-2001) and 95 % of the visitors used a newer version (5 or 6) of Internet Explorer (Microsoft, 1995-2001) to access the page. This can simply be because it is stated that the pages are best viewed with this type of browser[30].

It is interesting to note that only 15 users accessed the exercises page on the day the evaluation took place. The reason for this is not known, but it could simply be that the

[30] The observant reader will remember that the mini quiz did not function properly in Netscape's browsers.

students were tired after viewing the entire lecture, or that they had already answered the questions while viewing the lecture. This means that only 15 students had the opportunity to try the mini quiz, which can only be accessed from the exercises page.

6.5 Discussion of Methods

The methods used for the collection of data to capture the learners' opinions about RadioWeb included questionnaires, observations and interviews. The different methods provided different insights. The following section discusses some potential problems with the data collection methods and instruments used during the field test.

The responses to the questionnaires included a substantial amount of information, and feedback from these turned out to be much more comprehensive than originally anticipated. The original intention with the questionnaires was simply to get an impression of whether feedback from a larger group of students concurred with the feedback from the interviewees. Almost all of the students used the commentary field in the questionnaire to express their opinions of RadioWeb, thus producing more qualitative data than what is often the case with questionnaires. However, the findings from the questionnaires also indicate that some of the questions were poorly designed. Especially the questions where the respondents could check all the alternatives that applied, i.e. the question concerning the program's help function, generated somewhat confusing results. In addition, the findings suggest that one should have avoided the use of words like 'difficult' and 'easy' in the statements. For example, very few students answered affirmative to the statement "Navigating inside the program was difficult," even though many students commented on shortcomings related to navigation. This indicates that the choice of words should have been more carefully considered. The questionnaires did not include any questions concerning the quality of the content presentation, but several students commented on the quality of the narration audio. This indicates that the presentation of the content was important to the users, and that the questionnaire should have included questions concerning this aspect as well.

Looking back, I think that it would have been useful to collect some data about the students' access to computers and the Internet. Since viewing the web lecture requires access to the Web, such data would have been useful when considering any future development of the project.

The observation sessions and student interviews were also very useful as complementary sources of data. Several problems were discovered while observing the users; problems that had not been foreseen during the design of the questionnaires. In addition, having observed the students using the program, made it easier to understand the meaning of comments they wrote in their questionnaires. During the observations, I did not manage to avoid assisting the students with problems related to the use of the program. These problems were noted in the observation log, but providing this type of assistance to the users involves a risk of influencing the results. For example, it is very likely that my assistance led to a higher user satisfaction with the program, than if the students had not been able to proceed after viewing the Java applet. On the other hand, feedback from users unable to view the web lecture would have been of little interest. It could have been interesting, though, to compare feedback from the three groups that had access to my assistance, with feedback from the two groups that did not, and to see whether there was any difference in their satisfaction with using the program. Unfortunately, this thought did not occur to me at the time of the evaluation, so the questionnaires from the different groups were not kept apart.

The interviews proved very useful as a way of getting more detailed feedback from the users and to confirm the impressions from the questionnaires. Data from the group interviews contained more information than data from the individual interview. The respondents interviewed in groups seemed to 'trigger' each other, and I played a more passive role during the group interviews than during the individual interview. However, data from the group interviews, especially the one with four respondents, also contained substantially more 'idle talk' than what the individual interview did. Many of the issues discussed during the interviews were also mentioned in the questionnaires, but the interviews allowed the students to elaborate more on these issues. The interviews made the students' opinions and impressions of RadioWeb clearer to me, and a number of interesting points were made by the interviewees.

One potential problem with regards to the validity of the data from the end user evaluation is the fact that the evaluator was also the designer of the program. Because of this, the evaluator may unwittingly have influenced the respondents to express more positive attitudes towards the system than what they would have done in a more neutral setting. To prevent this from happening, it was emphasised to all the respondents that negative feedback would be highly appreciated, seeing that the primary goal of the evaluation was to discover potential improvements. In addition, all the interviewees seemed to feel comfortable with expressing negative, as well as positive, feedback to the evaluator. Thus, I do not think this mixing of roles constitutes a serious problem in this instance.

The various tools used during the student evaluation complemented each other quite well and, despite a few shortcomings to the research design, the different types of data collected were all useful for the purpose of discovering new design issues.

6.6 Chapter Summary

This chapter has presented the findings from the end user evaluation performed on RadioWeb. This evaluation sought to capture the users' immediate opinions of the program, and data was collected using questionnaires, interviews and observation. This formative evaluation of RadioWeb set out to discover how the prototype could be further improved. Several important design issues arose from this evaluation and these should be considered before any future development. Table **6.6** sums up the problematic aspects of RadioWeb that were discovered during the end user evaluation, and suggests changes that can be made to RadioWeb in order to correct these shortcomings.

The primary goal of the RadioWeb project was to develop online learning material to supplement the classroom lectures in radiology, and to evaluate this learning material. The motivation for initiating the project, however, was to encourage more interaction between the instructor and the students in the classroom. The next chapter discusses to what degree the RadioWeb project succeeded in achieving its initial goals.

Table 6.6. Problems and suggested improvements in RadioWeb

Functionality	Problem	Suggested solution	Importance[31]
Navigation	The user has to view an entire section in order to get something repeated. These sections can be up to a minute long.	Provide the students with fast-forward and rewind controls.	High
	Several students did not find the pause button.	1) Move the button to a more noticeable location. Maybe place it between the navigation buttons. 2) Call attention to it in a program introduction	High
	Several students either did not understand that the play/pause-button was a repeat-button, or they did not see the button.	Make the function clearer. Maybe write 'repeat' next to the button.	Medium
	Sometimes the next button did not function properly.	None yet	High
	Difficult to know where you are in relation to the menu at the side.	Highlight the current section in the menu.	Medium
Java Applet	Sound disappeared after viewing the applet	None yet. The cause of this must be identified before it can be included in the program. As a temporary solution, the applet can be placed outside the lecture pages (maybe at the exercises page).	High
	Some of the knowledge required to understand the applet is not explained until the succeeding section.	Move the applet to a later section of the program.	High
Presentation	Voice boring, monotonous, stuttering.	None yet. Not much to do except edit the narration audio or do the recording again. This is expensive and time-consuming.	Low
	Sometimes first part of the word is missing when loading a new page.	Add a short pause to the movies before they start playing.	Medium
Exercises	Some of them a bit alike	Create different types of interactions.	Medium
	Too easy	Introduce exercises with different level of difficulty	Medium
Other	Platform dependent	None yet	Low
	Sometimes users are prompted if they would like to download files to view the video.	None yet	Medium

[31] The importance of fixing the problem is my subjective opinion.

7. DISCUSSION

This thesis has described the RadioWeb project. The goal of the project was to develop web-based learning material for the introductory course in radiology and to evaluate this learning material. The motivation for providing learning material on the Web was to stimulate increased student activity during the classroom lectures. This chapter summarizes the project and discusses the project's success in achieving its initial goals.

7.1 Developing RadioWeb

RadioWeb is a web-based learning environment for students taking the introductory course in radiology at the University of Bergen. It uses a combination of animations, videos, audio, text and images in order to present information to the learners. In addition, RadioWeb provides different types of exercises, a discussion forum, and links to other topics related to the instruction of radiology.

Instructional design and software development models served as the starting point for describing the process from initial planning through the design, development and evaluation of RadioWeb, a process that lasted from May 2001 till May 2002. The process of development and initial testing of RadioWeb was described in chapter 3 of this thesis.

During my involvement with the RadioWeb project, I have learned a great deal about developing software systems. The most obvious is how to use the tools Macromedia DreamWeaver (2001b) and Macromedia Flash (2001c) in developing interactive multimedia for the Web. In addition, and more importantly, participating in the RadioWeb project has taught me a lot about working in a team and about the

importance of having close contact with a subject matter expert when developing educational software.

7.2 Evaluation of RadioWeb

A formative evaluation was carried out on the RadioWeb prototype. The research question asked for the evaluation of RadioWeb was: “What new design issues arise from a formative evaluation of RadioWeb?” A field test, described in chapter 5 and 6 of this thesis, was conducted in order to get the opinions of students from the target user group.

The general impression from the end user evaluation is that the students were satisfied with the user interface of RadioWeb, and that they thought it was interesting to access the material through the Web. It seems to be easy to understand how to use the program and how to navigate within it. The colours and fonts did not seem to annoy anyone, and the pages seem to be arranged in a satisfactory way. Results from the field test also suggest that the students enjoy viewing lectures online, and that they would like to have more web lectures in the future.

Although the great majority of the students expressed satisfaction with the program’s interface and navigation, several new design issues were discovered concerning aspects of navigation. The data clearly indicates that the students wish for fast-forward and rewind controls, and this should be provided in any future versions of RadioWeb. In addition, the play/pause-button was overlooked by so many users, that it should be made more noticeable in some way. The reason why the next button occasionally fails must also be determined. In addition, letting the users know exactly where they are in the system would make the system more user friendly. This can be easily provided by highlighting the topic which the user is currently viewing. In addition, the presentation of the content can be improved by introducing a short pause before the narration audio starts playing, or one could let the users start the animations themselves by clicking a button. Several students also noted that the narration audio could have been more exciting. Hiring professional narrators could ensure a better quality in narration, but the

upside of using the course instructor as the narrator is that he has detailed knowledge of the subject matter. In addition, it generally costs a lot less to use members of the faculty as narrators, than hiring professionals. The formative evaluation of RadioWeb also confirmed the popular view that students favour exercises, thus suggesting that a future version of RadioWeb would benefit from providing both more and various types of exercises, than what is currently available.

All things considered, the student evaluation generated many interesting suggestions to ways of improving RadioWeb with regards to the program design, but the general impression was very positive. Future development of the program should consider the above-mentioned results from the end user evaluation.

7.3 Intentions and Accomplishments

The rationale for the RadioWeb project was to deliver instruction via the Web. By doing so, one hoped stimulate student activity during the classroom lectures. An interesting question to ask at this point would be whether or not the project succeeded in achieving this. In other words:

> *Did introducing web-based learning material into the radiology instruction lead to more active students in the classroom?*

The best way of answering this question would be to conduct a summative evaluation. As noted in Chapter 2, summative evaluation is a method for judging the value of a program after the development process is finished. A summative evaluation can be conducted in order to provide data on the effectiveness of the instructional intervention, according to the instructional objectives. Such an evaluation goes beyond the scope of this project, but some effort was made in order to get an impression of the project's success in achieving its initial goals.

By observing the students and the instructor during the post-lecture, and interviewing the instructor afterwards, I hoped to get an impression of the student-lecturer communication in the classroom. As mentioned in chapter 5, only the post-lecture classroom session was observed, so I had to rely on the instructor interview for

information concerning any change in student activity. This instructor was the same as the subject matter expert and project initiator, Jarle Rørvik, and the interview with him was conducted immediately after the post-lecture had been given. The intention with this interview was to capture his impression of the student activity, and to summarize the project.

The students had been encouraged to send e-mail with questions after viewing the web lecture, and these questions should serve as a starting point for classroom discussion. Very few questions were sent, and those questions were quite trivial. In addition, only 5 students showed up for the post-lecture, and they did not have many questions either. As a result, the desired discussion and interaction between the students and the instructor was not accomplished.

The low turnout of students became an important topic for discussion during the instructor interview. The instructor did not have a clear answer as to why so few students showed up, but admitted that the turnout was usually higher[32]. Suggestions as to why so few students showed up included:

- it was not stressed that this was an important part of the evaluation and that it was important that everybody showed up
- they thought that only those who had any questions needed to come
- they wanted to protest since so many of their lectures had been cancelled that year
- they felt that they already knew the material from the web lecture, and that it was unnecessary for them to attend the classroom lecture.

In order to find out why so few showed up for this post-lecture, one could have interviewed some students, but such interviews could not be conducted at the time[33].

By delivering learning material online, one hoped to achieve more interaction between the instructor and the students in the classroom, but at least in this instance, this failed to happen. When asked how RadioWeb should be used in the future, the instructor

[32] At this time of the year there were several long weekends and it could be that many students took the day off.

[33] This is a time with many exams and little teaching at the Faculty of Medicine.

suggests that the web lecture can be used when the instructor is prevented from giving the lecture, or by students who missed the lecture, or for repetition before the exams. The fact that it takes three years from these lectures are given and till the final exams in radiology are held, implies that repetition can be an important area of use in the future. In these cases, the substance of the classroom lecture will be the same as in the web lecture, and the web lecture will not be used according to the original intentions. The instructor also admits that he is unsure about the necessity of the post-lectures considering that so few important questions were asked. This suggests the possibility that the integration of RadioWeb into the existing instruction was not as well planned as it ought to have been. One had not really considered what these post-lectures should consist of, but assumed that the students would provide sufficient feedback to base a classroom discussion on. When this failed to happen, one did not have an alternate plan for the classroom lecture. In addition, one did not foresee the low turnout of students.

Summary of project review

The post-lecture and the instructor interview revealed that:

- Results from observation of the student-instructor communication in the classroom were of little interest because so few students showed up for the post-lecture.
- There is uncertainty as to why so few showed up for the post-lecture.
- The integration of RadioWeb into the existing instruction could probably have benefited from better planning.

7.4 Concluding Remarks

This project set out to produce and evaluate a prototype for delivering web-based learning material in radiology. The focus for the formative evaluation was to discover new design issues that could guide any future development of the program. As presented in chapter 6, the students made several interesting points, and future developers should carefully consider these. I believe it is safe to say that the formative evaluation of RadioWeb succeeded in revealing potential improvements that can be made to the prototype.

In addition, the field test revealed that the students would like to have more web lectures in the future. But what are the students' motivations for wanting more web lectures? And why did so few of them attend the post-lecture? The answers to these questions remain to be found. One could even imagine a relation between the above-mentioned questions: that the reason why students wish for web lectures is so that they can skip the classroom lectures. Further investigation of students' motivation for using web lectures could have been an interesting succession to the project.

Introducing new technology into existing teaching is a process that requires thoughtful planning, and it should be emphasised that it generally takes time to create new practices for teaching. The results from the evaluation of RadioWeb can serve as a starting point for any future development of the project.

Before further development is initiated, it would be wise to carefully consider the intention of delivering online learning material. What does one want to achieve, and how can this be accomplished.

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APPENDIXES

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APPENDIX A

Pedagogisk grunnlag for studentundervisningen i medisinsk radiologi: 150-planen

Pedagogisk grunnlag for studentundervisningen i medisinsk radiologi:
150-planen.

Undervisningen i medisinsk radiologi tar utgangspunkt i gjeldende målsetninger for det medisinske studium vedtatt av det medisinske fakultet (vedtatt 091298):

Det medisinske studium er en teoretisk og praktisk utdanning som sammen med påfølgende turnustjeneste skal gi studenten et godt grunnlag for utøvelse av legeyrket og faglig videreutvikling gjennom yrkeslivet. Utdanningen skal legge grunnlaget for forskerutdanning og spesialisering.
"Salus aegroti suprema lex – den sykes tarv er høyeste lov".

- Utdanningen skal tilpasses de krav til kunnskap og ferdigheter som vil bli stilt til fremtidens leger. Studentene skal gjennom forskningsbasert undervisning lære fremtidsrettet og hensiktsmessige metoder for diagnostikk, behandling og forebygging
- Primærhelsetjenesten med nær kontakt med befolkningen til sentraliserte spesialavdelinger, og fra akuttmedisin til behandling og omsorg av kronisk syke. Videre skal studentene få innsikt i helsevesenets organisering og økonomi og utvikle evnen til samarbeid med andre yrkesgrupper.
- Studentene skal utvikle en forståelse for biologiske, psykiske, miljømessige og sosiale faktorer som ligger til grunn for menneskets helse, for utvikling av sykdom og skade, og for samspillet mellom disse faktorene. Studiet skal bidra til å skjerpe studentenes bevissthet i forhold til de begrensninger som ligger i legevitenskapens metoder, og til forholdet mellom det teknisk mulige og det menneskelig ønskelige. Det er viktig at studentene utvikler evne til etisk refleksjon og at de lærer å møte dem som trenger deres råd og tjenester med ansvarlighet og respekt.
- Det medisinske studium skal ha en naturvitenskapelig basis og profil. Studiet skal synliggjøre og problematisere medisinens vitenskapteoretiske forutsetninger. Studentenes evne til problemløsning skal utvikles, både som ledd i klinisk resonnement og med hensyn til videre utdanning.
- Det medisinske fakultet vil bestrebe seg på å skape et læringsmiljø som ivaretar studentenes motivasjon og stimulerer deres interesse for det medisinske fagfelt i hele sin bredde. Forholdene skal legges til rette for samhørighet og trygghet i studiesituasjonen. Dette anses som viktig både for den faglige innlæringen og for at studentene skal utvikle den modenhet og selvstendighet som er nødvendig for å mestre de utfordringer som studiet og fagutøvelsen.

Strategisk plan for studiekvalitet.
Handlingsplan for det medisinske fakultet ble vedtatt av Rådet for Det medisinske fakultet i 1996. Pkt. 6 i Strategisk plan omtaler pedagogisk kompetanse og læringsmiljø. Lærerens pedagogiske kompetanse skal utvikles gjennom universitetspedagogiske kurs i regi av Program for læringsforskning, seminarer og kurs internt på fakultetet, utvikling av studiekvalitetsevaluering og stimuleringstiltak til studiekvalitetsarbeid. Spesielt ønsker fakultetet å sette følgende tema ved læringsmiljøet på dagsorden:

1. Undervisningsformer i høve til mål og ressurser

2. Forelesninger som undervisningsmetode
3. Klinikk som undervisningsmetode
4. Gruppeundervisning
5. Alternative eksamensformer

Pedagogisk kompetanse defineres som kunnskap, vilje og evne til å legge forholdene til rette slik at læring finner sted.
Undervisningsformene i medisinsk radiologi er forelesninger og smågrupper. Sjølstudiet er preget av teorilesing av lærebøker, artikler etc. og gjennomgang av kasuistikker, dvs. eksempler på radiologisk utredning av ulike kliniske problemstillinger.

Kompetanse i medisinsk radiologi også omtalt som moderne bildediagnostikk kan deles i ulike nivåer:
1. **Metodelære**: Grunnleggende kunnskap om de radiologiske modaliteter, teknisk oppbygging og funksjon.
2. **Prosedyrelære:** Praktisk gjennomføring av undersøkelser med de ulike modaliteter.
3. **Bildetolkning:** Diagnostikk av sykdom v.h.a. morfologiske og funksjonelle endringer som blir uttrykt i ulike typer bilder, f.eks. ultralyd, magnetisk resonans, computer tomografi og røntgen-bilder.
4. **Indikasjoner og algoritmer:** Kunnskap om indikasjoner for bruk av de ulike prosedyrene og algoritmer for utredning av ulike kliniske problemstillinger.

Læringsmål
Hovedvekt blir lagt på generelle prinsipper for bildetolking, bildetolking ved akutte tilstander, indikasjoner for ulike radiologiske prosedyrer, forberedelese av pasientene, praktisk gennomføring av prosedyrene, vanligste utredningalgoritmene. Mindre vekt blir lagt på prosedyrelære og metodelære.
Det er viktig at læringsmålene er komplette, etterprøvbare, relevante og presise. I tabellform er de rettet mot tre nivåer:

Kunnskaper	**Ferdigheter**	**Holdninger**
• Hukommelse, gjengivelse, beskrive. • Forståelse, forklare, karakterisere. • Tillemping, bruke, beregne • Syntese og analyse • Vurdering	• Persepsjon og gjenkjenning • Imitasjon • Stereotyp handlinger • Komplekse handlinger	• Mottakelighet • Kommunikasjon

Undervisningen i medisinsk radiologi er delt i fire hoveddeler:

1. Grunnkurs	: 2 timer pr student - 3. studieår
2. Innførings del	
a. forelesninger	: 10 timer pr student - 3. studieår
b. gruppeundervisning	: 12 timer pr student - 3. studieår
3. Desentral del	: 10 timer pr student - 4./5. studieår
4. Eksamensforberedende del	: 18 timer pr student - 6. studieår
Totalt	: 52 timer pr student

Vedr. 1: Grunnkurset skal gi en oversikt over røntgenavdelingen, dens utforming/organisering og plass i et moderne sykehus. Dette skal gi studenten tilstrekkelig innsikt i hvordan de bildediagnostiske undersøkelsene gjennomføres slik at pasienten kan informeres om dette av henvisende lege på forhånd. Videre skal studenten få kunnskap om den relative ressursbruken ved de ulike radiologiske modalitetene. Denne undervisningen gies mest rasjonelt og effektivt i smågrupper. Vi kan raskt bevege oss mellom ulike deler av røntgenavdelingen og læreren skal legge opp til dialog og utdypende spørsmål. Denne delen av undervisningen har fungert svært bra.

Vedr. 2: Innføringsdelen gies som forelesninger og gruppeundervisning og skal dekke metodelære, prosedyrelære, grunnleggende bildediagnostiske prinsipper samt gi tilstrekkelig kunnskap om indikasjoner og algoritmer.

I forelesningene har en hatt som intensjon å legge vekt på følgende:

1. Systematisering av og oversikt over teoretisk kunnskap om de ulike radiologiske modalitetene og prosedyrene.
2. Systematisering av og oversikt over indikasjonene for de ulike radiologiske prosedyrene.
3. Forståelse av prinsipper og retningslinjer for god utredning av ulike kliniske problemstillinger med bildediagnostikk, dvs. tilegnelse av gode utredningsalgoritmer.

Forelesningene er i hovedsak blitt gitt av de ulike fagansvarlige, dvs at en rekke spesialister har vært involvert. Disse har stått relativt fritt i utformingen av innholdet i forelesningene. Det er en målsetting at forelesningene skal være engasjerende og skape en positiv holdning til radiologi og radiologer. En har prøvd å legge vekt på følgende:

1. Læreren presenterer bildediagnostikken fra en teoretisk synsvinkel med vekt på:
   a. klargjøring av kliniske problemstillinger
   b. valg av adekvat bildediagnostisk metode/modalitet
   c. bildediagnostiske funn
   d. sannsynlig diagnose og relevante differensial-diagnoser
      e. supplerende bildediagnostiske undersøkelser
      f. kostnad effekt og nytte problemstillinger.
   2. Læreren skal ha adekvat bildemateriale å vise.

Forelesningen som undervisningsmåte har som rammevilkår at:

1. Læreren er lege med nødvendige kliniske og pedagogiske kvalifikasjoner.

Jarle Rørvik - Førsteamanuensis ved radiologisk seksjon, UiB. 1999.

Gruppeundervisningen i innføringsdelen skal i hovedsak brukes til en innføring i bildetolkning og diagnostikk ved de viktigste sykdommene. Undervisningsmaterialet er bilder fra en rekke kasus eller pasienter. Gruppestørrelsen har vært ca 15 studenter. Undervisningen bør ha en samtaleform, dvs. at det skal være en utstrakt dialog mellom lærer og studentene. Spørsmål og svar skal gå begge veier. Dette gjør at undervisningen blir problemorientert. Kvaliteten av denne undervisningsformen er avhengig av at både lærer og studenter er aktive og engasjerte. Ofte blir den viktigste oppgaven for læreren å vekke og stimulere behovet hos studenten til å stille de rette spørsmålene. Dette forutsetter at læreren har høy faglig kompetanse slik at han virkelig eier sitt fag.

Vedr. 3: Desentral del: Denne delen av undervisningen representerer en utvidelse av undervisningstiden i medisinsk radiologi på 10 timer pr student i forhold til 120-planen. Undervisningen foregår når studentene er utplassert på røntgenavdelingen ved SiR, FSH og SSSF i 4. og 5. studieår, henholdsvis for A- og B-kullet. Disse sykehusene benevnes desentralsykehus i 150-planen. Det er et mål i 150-planen å gjøre undervisningen mer pasientnær. Dette er det tatt hensyn til i undervisningen ved desentralsykehusene. Studentene skal delta i det praktiske arbeidet på de ulike laboratoriene ved røntgenavdelingen, delta i forberedelsearbeidet til demonstrasjonene og selve demonstrasjonene. Videre skal studentene få en del av undervisningen i skjelettradiologi på desentralsykehusene. I denne gruppebaserte undervisningen skal det legges hovedvekt på frakturlære.

Vedr. 4: Den eksamensforberedende gruppeundevisningen skal gi en mer dyptgående innføring i bildediagnostikk av flere spesifikke sykdommer. Dette krever en aktiv deltakelse fra studentene. Undervisningsmaterialet er bilder fra en rekke kasus eller pasienter. Optimal gruppestørrelse vil være 6-8 studenter. Studentene får ett kasus hver som de skal utføre bildediagnostisk arbeid på og presentere for de andre i gruppen. Læreren skal ha en tilbaketrukket og veiledende rolle i denne problemorienterte undervisningen. Så langt har ikke denne undervisningen fungert optimalt etter forutsetningene. Dette vil jeg komme tilbake til under avsnittet om vurdering.

Eksamen

Eksamen i medisinsk radiologi er muntlig og kommer i uken etter at den eksamensforberedende undervisningen er ferdig. Eksamenskandidatene er delt i grupper på fire som får de samme tre kasuistikkene. Kandidaten blir presentert for en klinisk problemstilling og første oppgave blir å velge rett radiologisk utredning. Kandidaten får så de relevante radiologiske bildene til granskning. Etter noen minutter for seg sjøl må kandidaten gjøre rede for sine funn og komme med forslag til diagnose. Eventuelt må kandidaten komme med forslag til videre radiologisk utredning. Denne delen av eksamen foregår som en samtale mellom student og eksaminator. De tre kasuistikkene gjennomgåes en for en etter hverandre. Kandidatene sitter igjen i eksamenslokalet og hører på eksaminasjonen av neste kandidat til hele gruppen på fire er ferdig.

Evaluering

Studentene skal evaluere undervisningen i hver termin. Dette foregår vanligvis ved at kullet velger en evalueringsgruppe som utarbeider en terminrapport som skal godkjennes på almannamøte. Terminrapportene sendes til de seksjonene ved fakultetet som har gitt undervisningen. Undervisningsansvarlig lager så sine kommentarer og kommer med eventuelle forslag til forbedring av undervisningen i en rapport som sendes til eksamens og undervisningsutvalget (EUU) ved instituttet. EUU ved hvert institutt lager så en samlerapport som sendes til studieplankomiteen (SPK) ved det medisinske fakultet som endelig sender en rapport til fakultetsstyre/råd. Negativ omtale av lærere i grunnlagsmaterialet skal ikke taes med i rapporten fra EUU, positiv omtale kan taes med. Videre skal instituttene (v/EUU) utarbeide et opplegg for evaluering av egen undervisning. Evalueringsformene må tilpasses undervisningen og kan variere mellom kvantitativ evaluering i form av standardiserte spørreskjema som kan bearbeides statistisk og en kvalitativ metode i form av tradisjonelle terminrapporter som nevnt ovenfor eller samtaler og møter mellom undervisningsansvarlig og studentene. Det er viktig at evalueringsopplegget er slik at resultatene kan sammenliknes over tid. Denne evalueringen av egen undervisning har så langt kun blitt gjennomført i mindre grad. Fakultetet har som mål å endre på dette. Videre er det planlagt å gjennomføre evaluering av eksamen gjennom sensorrapporter. Studentene har gitt en evaluering av eksamen gjennom sine terminrapporter.

Vurdering:

I hovedsak må en kunne konkludere med at undervisningen i medisinsk radiologi har fungert godt i forhold til målsetningene for det medisinske studium. Evalueringen gitt av studentene i terminrapportene har i for en stor del vært svært bra. Dette tyder på god struktur i undervisningsplanen og gode pedagogiske evner for lærerne på radiologisk seksjon.

Et problem i forhold til gjeldende målsetninger for det medisinske studium er at kun få av lærerne ved radiologisk seksjon har forskningsbakgrunn. Betydningen av dette for kvaliteten på undervisningen, spesielt i relasjon til å oppnå målsetningen om forskningsbasert undervisning er usikker. Undervisningen i medisinsk radiologi har et konkret utgangspunkt, nemlig bildematerialet i kasuistikkene. Den erfarne kliniker vil i gruppeundervisningen kunne spille ut sin tause kunnskap på en måte som skaper engasjement, men denne konkrete situasjonen kan også bli en faglig begrensing/skranke. En lærer med forskerholdning vil kanskje være mer reflektiv og evidence based. Imidlertid har undervisningen i medisinsk radiologi ofte fått bedre evaluering i terminrapportene fra studentene enn undervisningen fra mange institutter der de fleste lærerne har hatt forskningskompetanse.

Sannsynligvis kan kvaliteten på vår undervisning bli enda bedre dersom flere av lærerne får forskningskompetanse eller tilegner seg vitenskapelige holdninger. Kunnskap om vitenskaplig metode for evaluering av radiologiske tester vil være en nødvendig forutsetning for å få en fullgod forståelse av radiologiske algoritmer. Faren ved manglende kunnskap om evaluering av radiologiske tester er at algoritmer og skjemaer over indikasjoner kan bli tvangstrøyer som hindrer en effektiv radiologisk praksis. Det er derfor viktig å formidle slik kunnskap til studentene.

Hovedproblemet ved undervisningen i medisinsk radiologi har vært at gruppene i den eksamensforberedende undervisningen har vært altfor store med 15-20 studenter i

hver gruppe. I praksis har den eksamensforberedende undervisningen blitt gitt i samtaleform og blitt en repetisjon og for en mindre del en videreføring av gruppeundervisningen i innføringsdelen. Spesielt vil den store gruppestørrelsen og at undervisningen blir gitt i samtaleform, hindre at optimal interaksjon mellom gruppemedlemene kan oppstå. Formålet med gruppeproblemløsning er at flere studenter med ulike kunnskaper, evner, personlighet og perspektiv gjennom interaksjon kan gi en bedre bedre løsning av et komplekst problem enn hva en kan oppnå ved individuell problemløsning. Det optimale antallet studenter vil være avhengig om oppgaven er lett eller vanskelig. Sosialpsykologisk forskning tyder på at i alminnelighet vil ikke mer enn 8-10 personer makte å komme i direkte interaksjon med hverandre. I problembasert læringsmetode er optimal gruppestørrelse oppgitt til 5-8 studenter.

Gruppeundervisningen i medisinsk radiologi representerer ikke det man vanligvis benevner problembasert læring, men heller det en kaller problemorientert læring. I denne formen for gruppeundervisning er aktivisering, individualisering og sjølinstruksjon for den enkelte student like viktig som interaksjonen mellom studentene. Gruppestørrelsen bør likevel ikke være større enn 5-8 studenter. Veileders eller lærerens rolle skal primært være som integrator der hovedoppgaven vil være å oppklare åpenbare misforståelser av kasuistikkene, utfordre studentene til å tenke kritisk, stimulere studentene til å stille de rette spørsmålene og problematisere i forhold til indikasjoner, algoritmer og metoder for evaluering av radiologiske tester.

Denne formen for problemorientert gruppeundervisning hadde egnet seg for bruk av PC-basert læringsmiddel forutsatt at man oppnådde tilstrekkelig interaktivitet i dataprogrammene. Videre bør programmene være sjølinstruerende. Undervisningen kan foregå på PC-stuer. Dette gir grunnlag for å individualisere læringsprosessen og fremme ansvaret for egen læring gjennom aktiv problemløsning. Videre bør en ha gruppesamlinger der lærerne vil gå gjennom kasustikkene i plenum, gjerne ved hjelp av PC, video-kanon på storskjerm i adekvat auditorium. Læreren kan samle trådene, gi oversikt og oppklare misforståelser av mer kompleks karakter.

Det medisinske fakultet planlegger nå et prosjekt der en vil prøve å utvikle slike læringsmidler innenfor medisinsk radiologi. Flere undervisere og PC-baserte læringsmidler kan legge grunnlaget for en videre forbedring og utvikling av den problemorienterte undervisningen i mindre grupper. Videre kan en utvikle en eksamensform bygget på kasuistikker i PC-programmer. En slik eksamensform vil underbygge en PC-basert læresituasjon da det er velkjent at eksamensformen legger en sterk styring på studentenes læring.

Konklusjoner:

1. Undervisningen i medisinsk radiologi oppfyller i hovcdsak målesetningene for det medisinske studium.
2. Strukturen i undevisningsplanen er god.
3. Det bør tilstrebes at flere av lærerne får forskningskompetanse.
4. Den pedagogiske kompetansen hos lærerne bør utvikles videre. Dette kan gjennomføres ved:
   a. Opprette faste lektorstillinger for hvert fagfelt.
   b. Alle lærerne bør gjennomføre pedagogisk kurs ved Program for Læringsforskning.

c. Radiologisk seksjon gjennomfører egne pedagogiske seminarer/dager, evt. med hjelp av
eksterne fagfolk i pedagogikk.

5. Gruppestørrelsen både i innføringsdelen og den eksamensforberedende delen bør reduseres. Dette kan oppnåes ved:
   a. Opprette flere lærerstillinger.
   b. Rasjonalisere behovet for antall lærere ved å utvikle PC-baserte læremidler.
6. Prosjekt: Utvikling av PC-baserte læringsmidler.
7. Prøve ut ny eksamensform.
8. Gjennomføre studentevaluering av undervisningen og evaluering av egen undervisning og eksamen.

Kilder:

1. Diverse materiale fra Program for læringsforskning.
2. Strategisk plan for studiekvalitet / UiB 1992.
3. Ideskisse / Makroplan 150-planen / Med. fak. 1997.
4. Studiehåndbok 1997-1998 / Med. fak. / UiB
5. Problembasert læring med sykehistorier i det medisinske studium. Haakon Sjursen. Medisinsk avdeling B, Haukeland sykehus.
6. Problembasert læring - ein praksisnær studiemodell. Gerd Bjørke. Tano Aschehaug, 1996.
7. Medical problemsolving: A critique of the litterature. McGuire C. Pros. Annu. Conf. Research, Medical Education (1984), 23: 3-13.

Pedagogiske elementer i systemet

Rabilda-prosjektet er et av flere tiltak for å heve kvaliteten og effektiviteten av studentundervisningen i medisinsk radiologi. Dette framgår av dokumentet "Pedagogisk grunnlag for studentundervisningen i medisinsk radiologi". Undervisningen er delt i tre deler:

1. Propedeutisk del: smågrupper på avdelingen
2. Innførings del: forelesninger og grupper
3. Eksamensforberedende del: grupper

Rabilda er i første omgang tenkt brukt i den eksamensforberedende undervisningen. Gruppeundervisningen i denne delen fungerer ikke optimalt pga store grupper (15-20). I praksis har undervisningen blitt gitt i samtaleform og en har i liten grad oppnådd interaksjon mellom gruppemedlemmene. Rabilda kan gi en økt aktivisering av den enkelte student i hvert kasus gjennom en god interaktivitet i brukerprogrammet. Videre kan en ved bruk PC-stuer oppnå god interaksjon mellom gruppemedlemmene.
Rabilda kan i prinsippet bygges ut til å bli et element i alle delene av studentundervisningen. Videre kan store deler av undervisningsmaterialet tilrettelegges for sjølstudium og repetisjon.

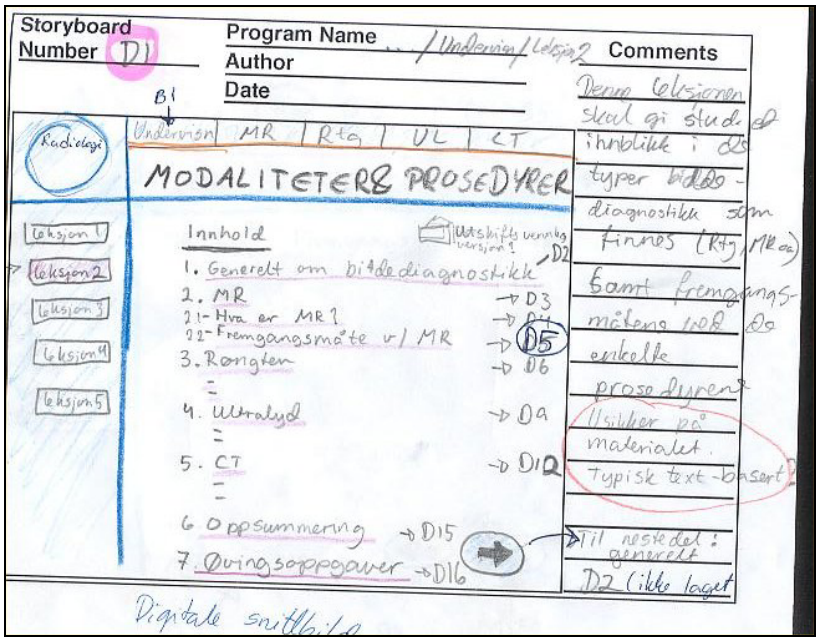
Osv. Brukeren kan arbeide med Rabilda .....

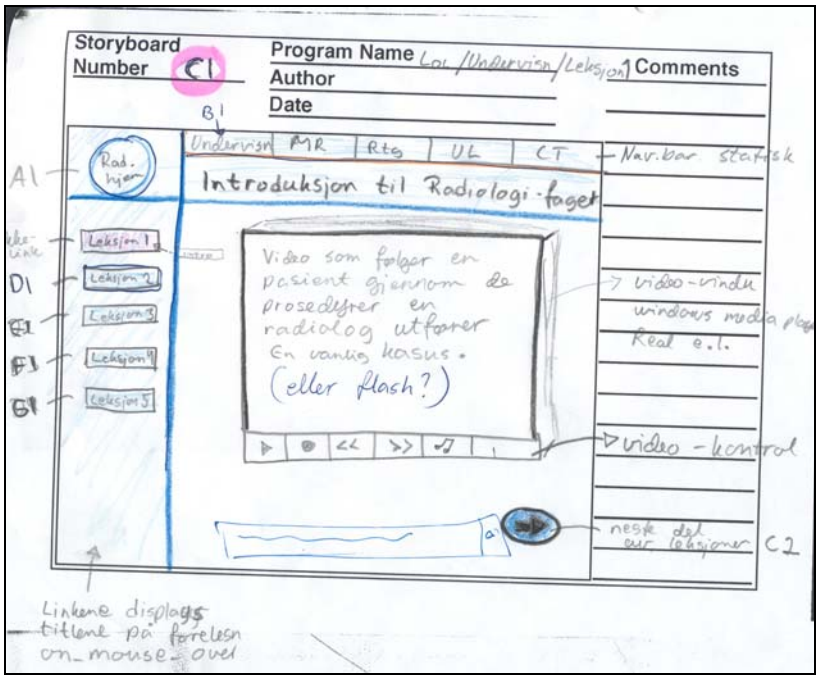
Jarle Rørvik - Førsteamanuensis ved radiologisk seksjon, UiB. 1999.

APPENDIX B

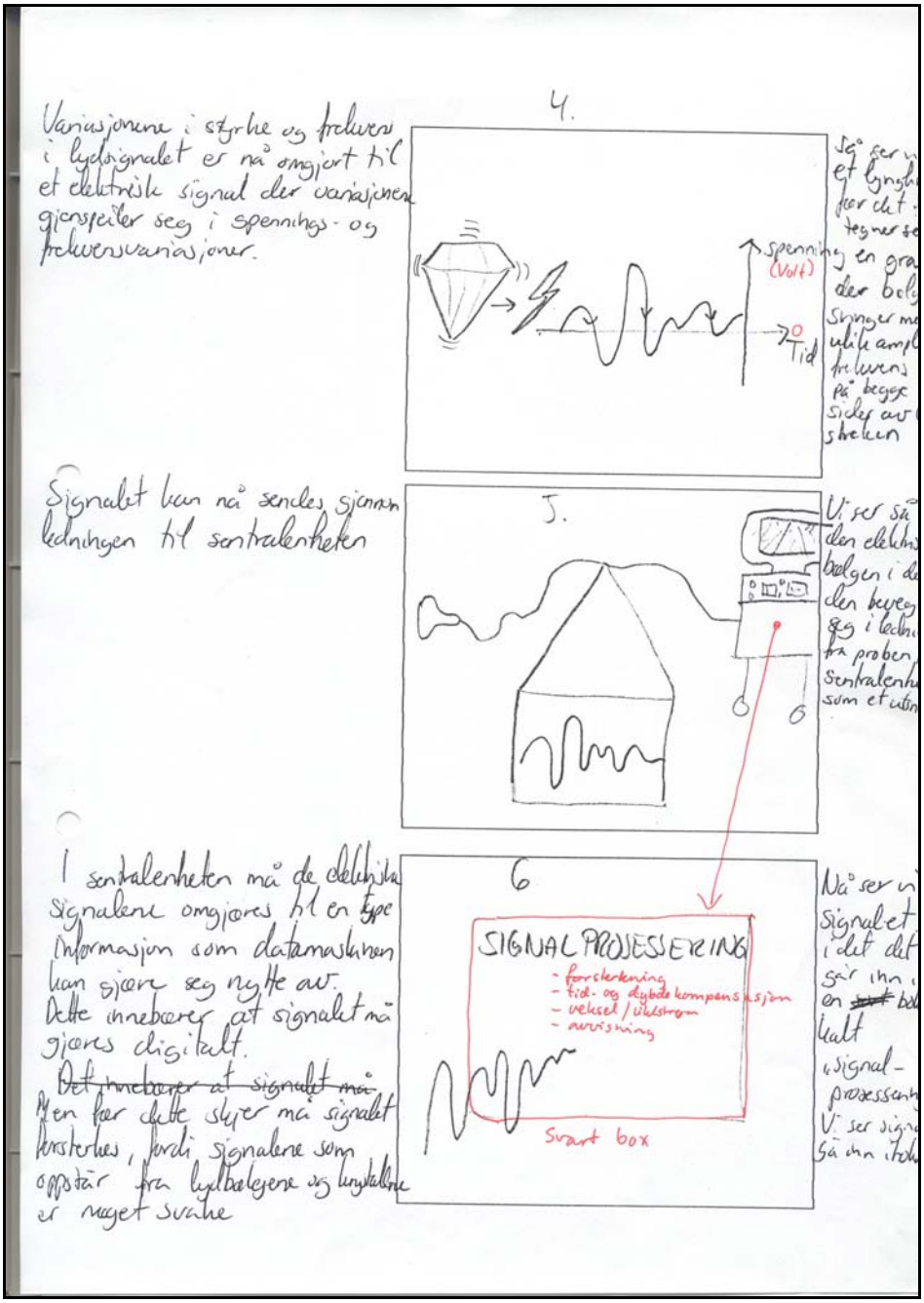
Sample storyboards, manuscripts and mock-up web-pages

Sample Storyboards

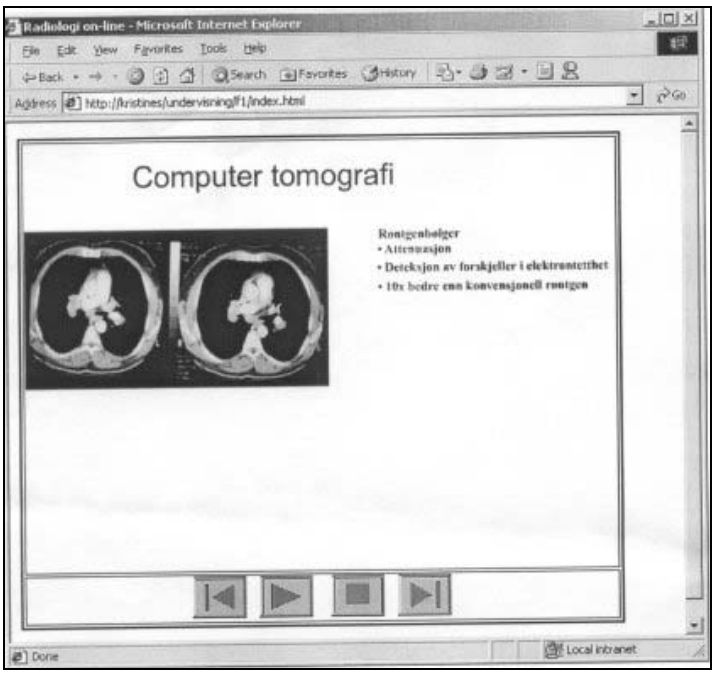


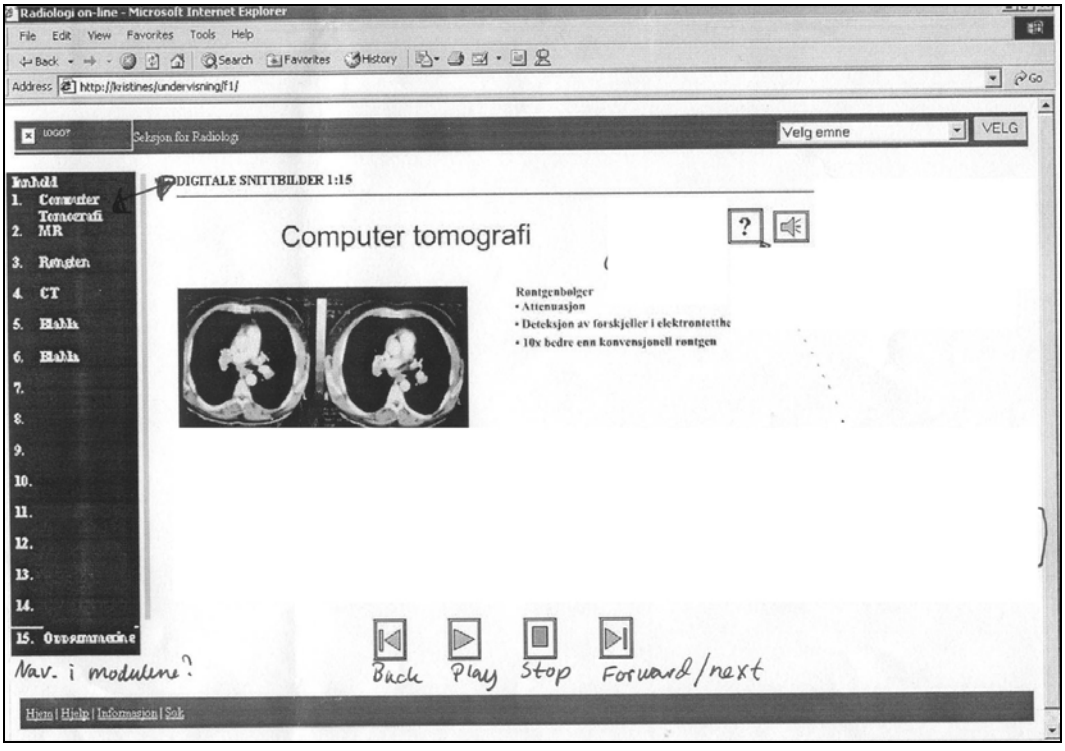


Sample Manuscript



Sample Mock-up WebPages

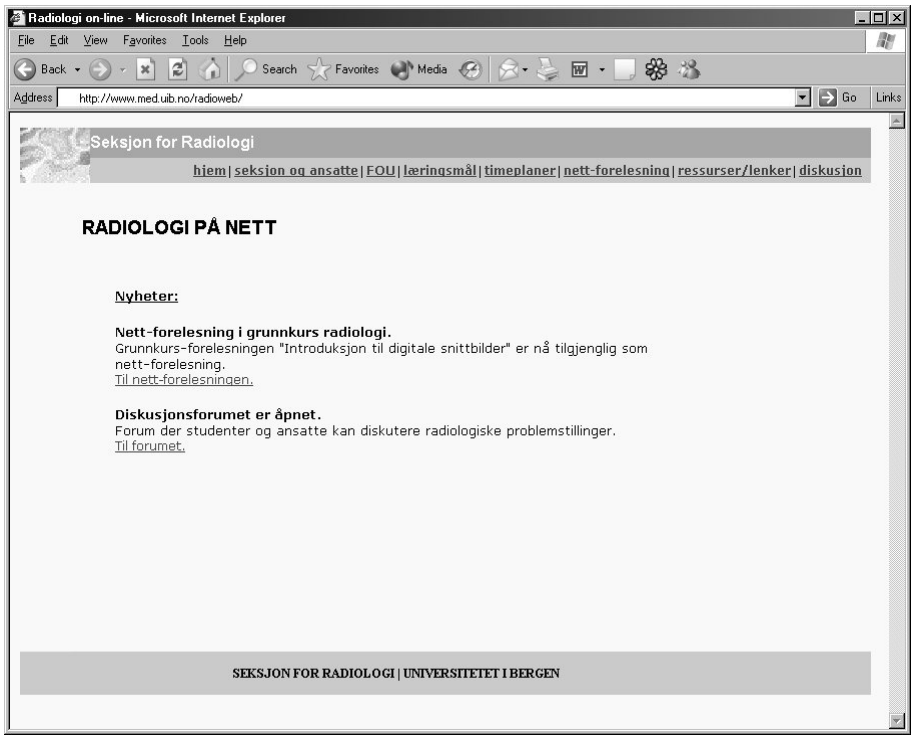




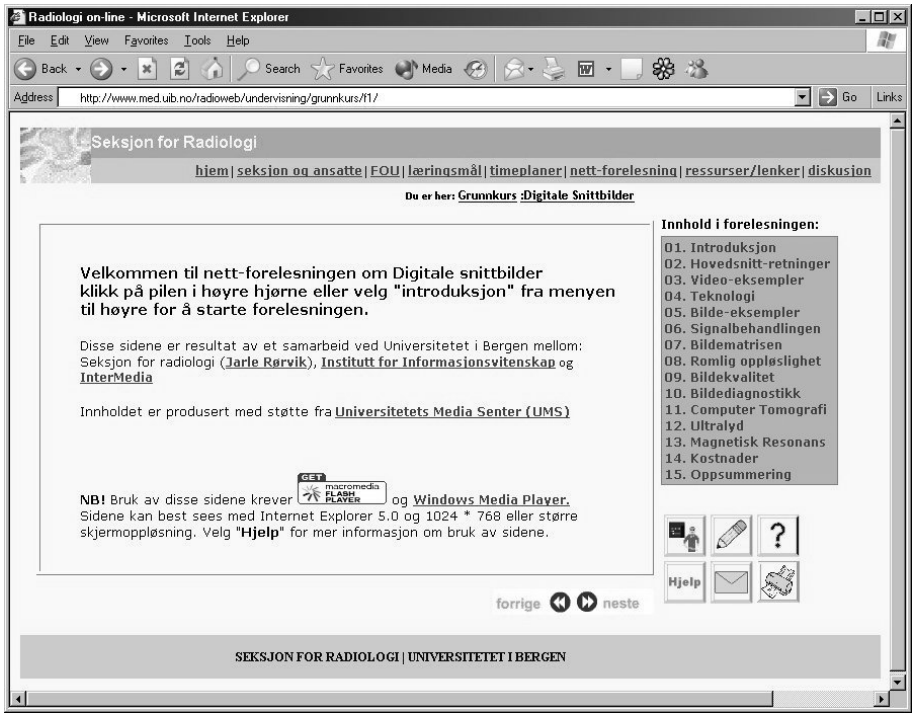
APPENDIX C

Screenshots from RadioWeb

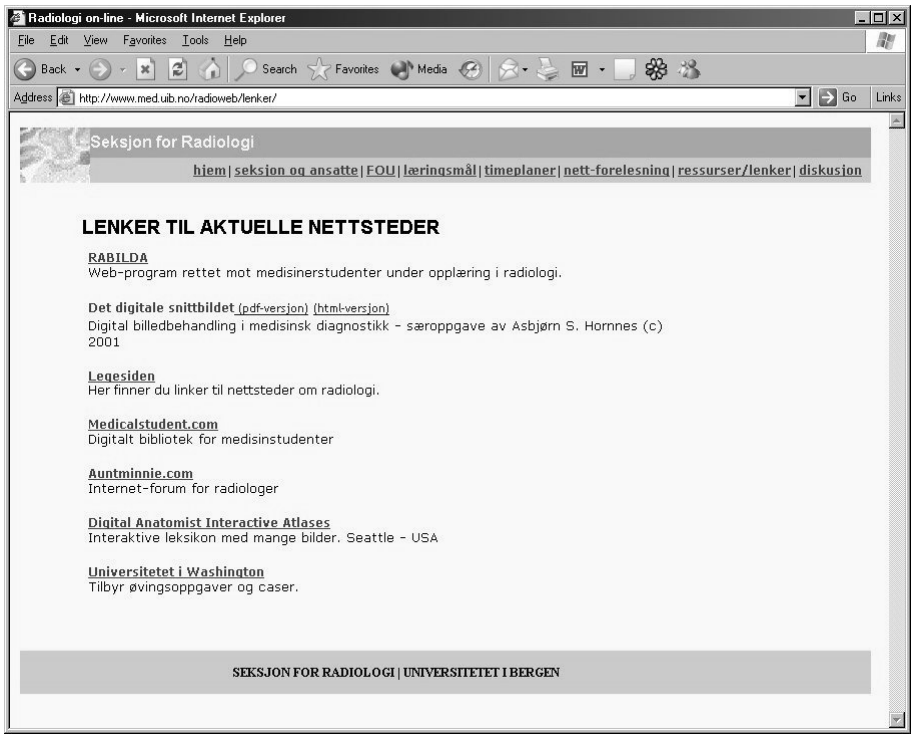
Sample Pages



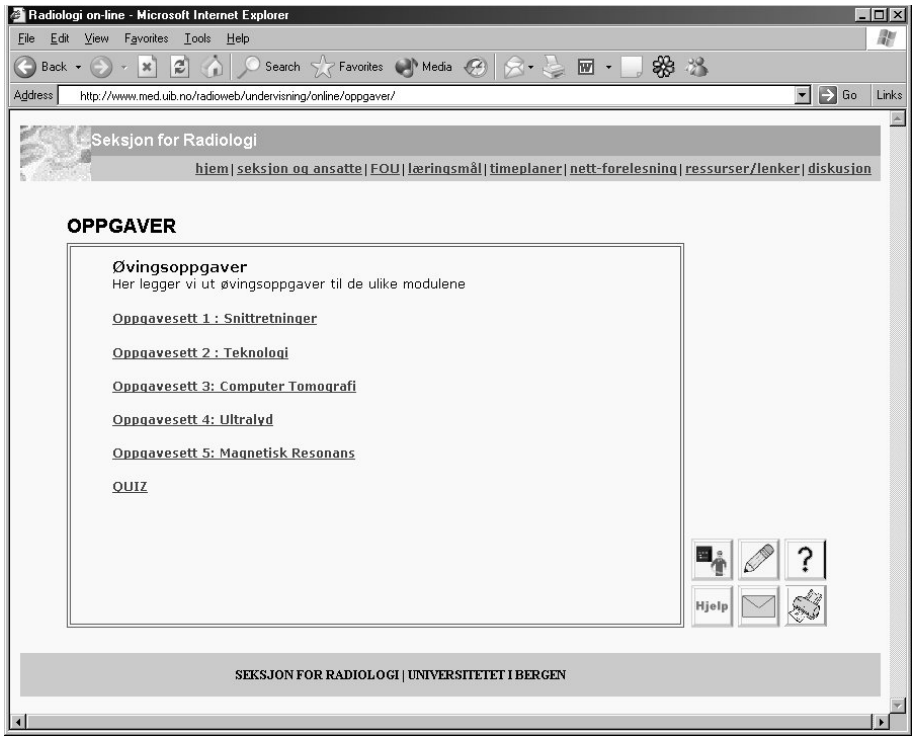
Screenshot 1. The Main Page.



Screenshot 2. The Web-lecture Page.



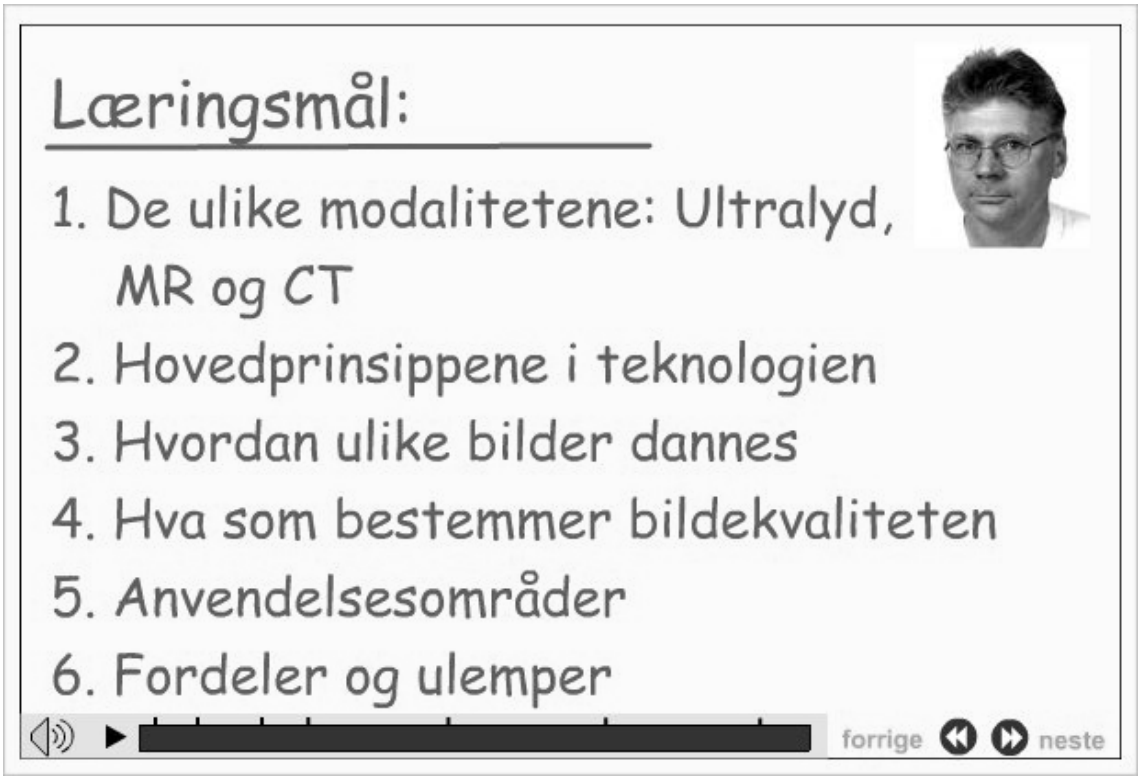
Screenshot 3. The Resources Page.



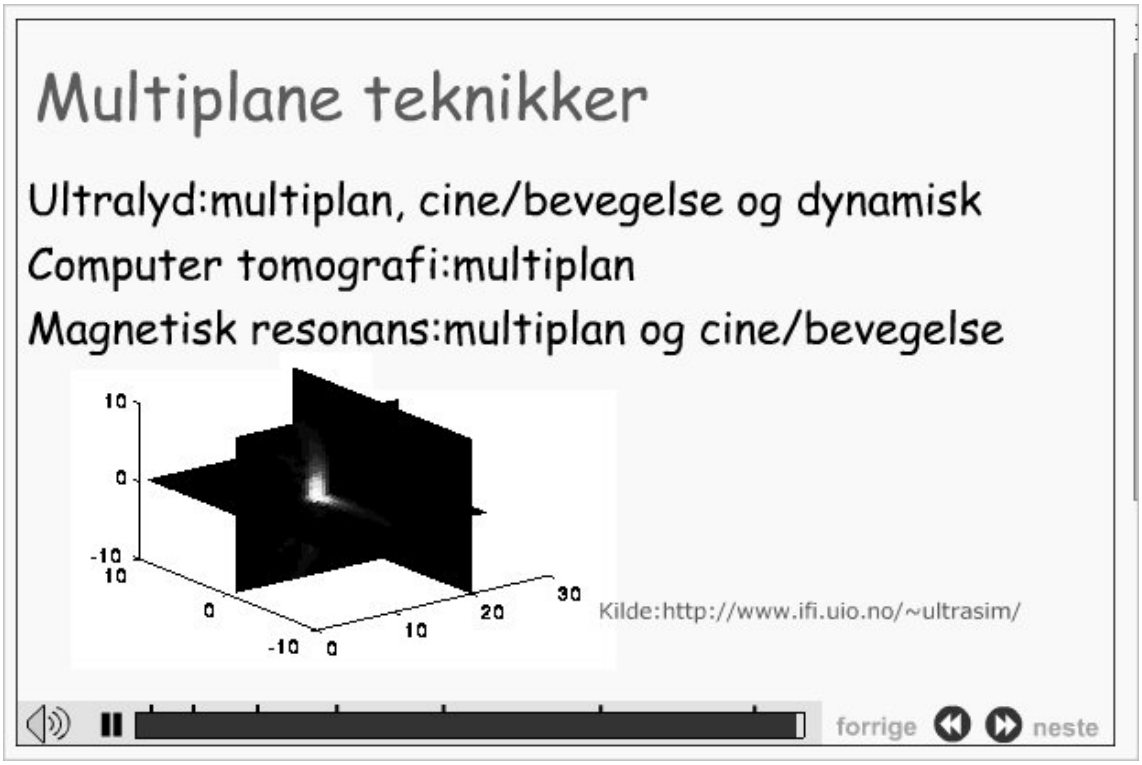
Screenshot 4. The Exercises Page.

Sample Lecture Content

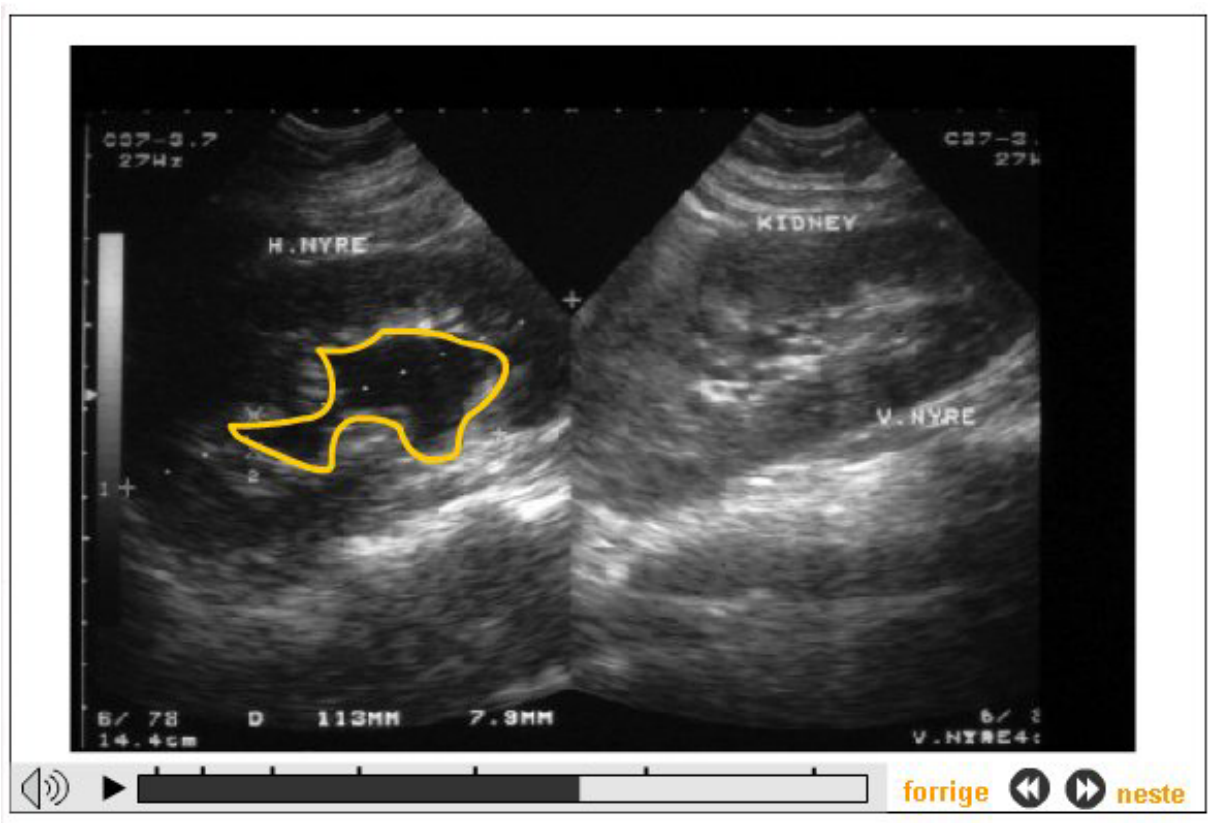
Screenshot 5. The Video Welcome.



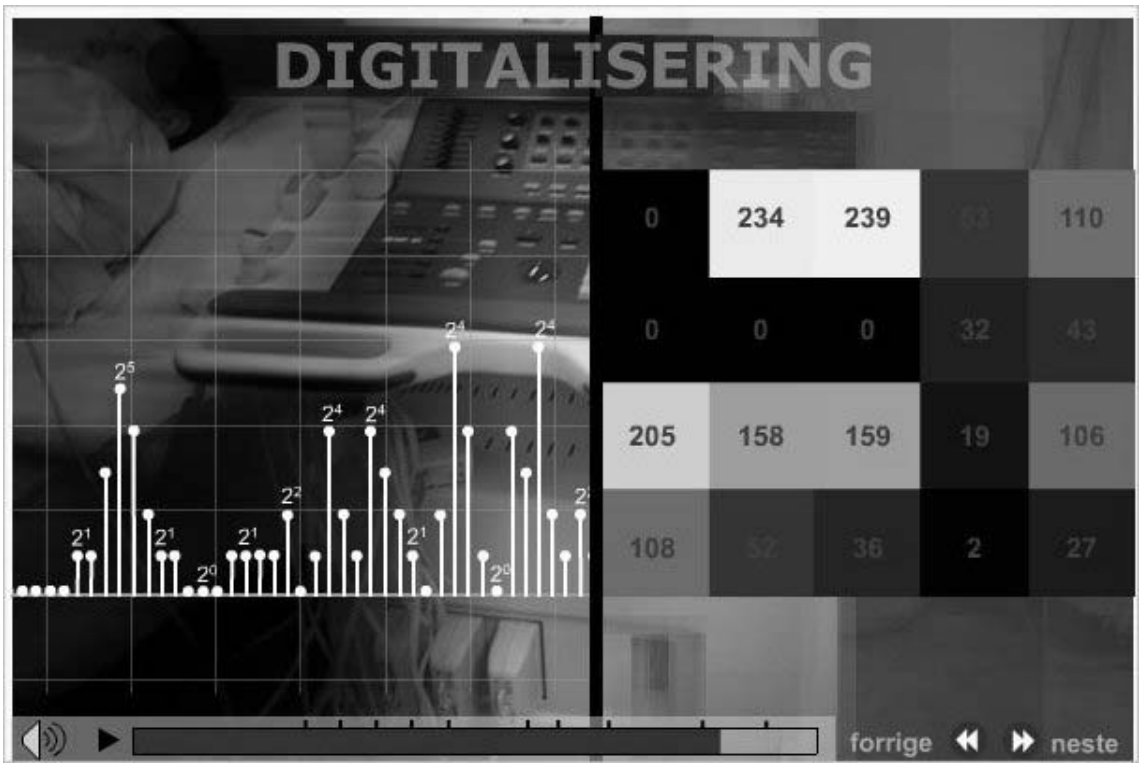
Screenshot 6. Stating the instructional objectives.



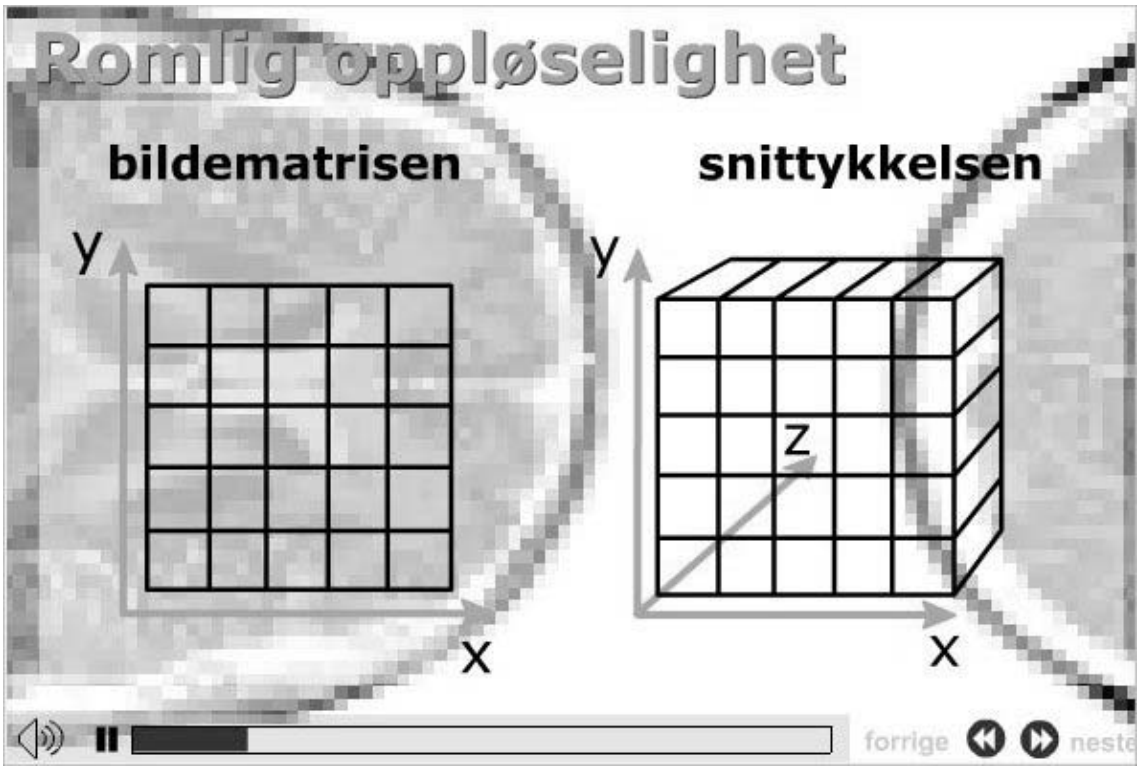
Screenshot 7. Sample content I.



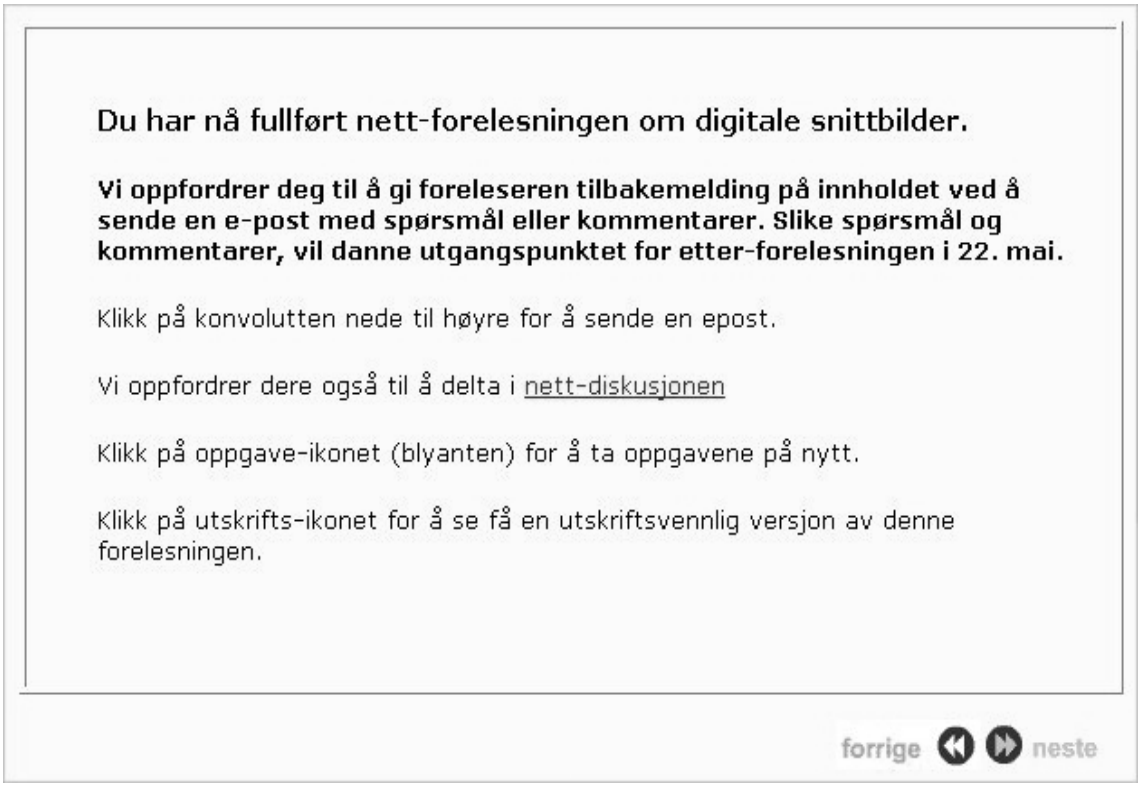
Screenshot 8. Sample Content II: Highlighting an area of a radiological image.



Screenshot 9. Sample Content III: digitalizing an image.

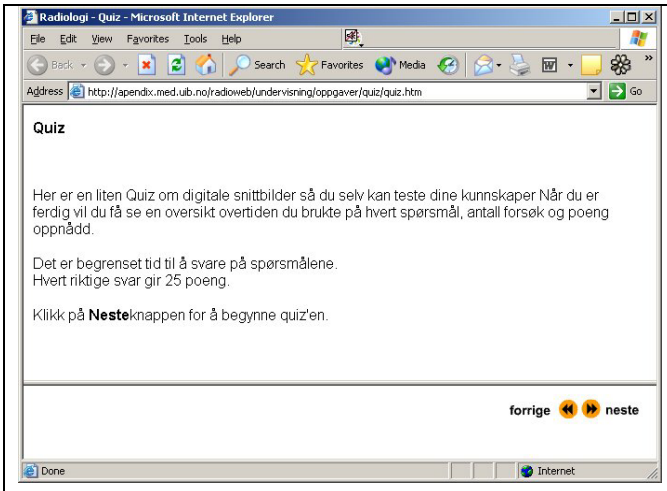


Screenshot 10. Sample Content IV: image resolution.

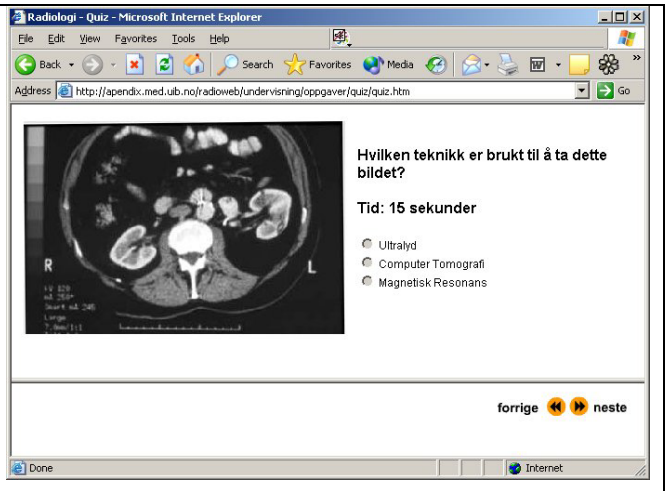


Screenshot 11. Closing Program: last lecture page.

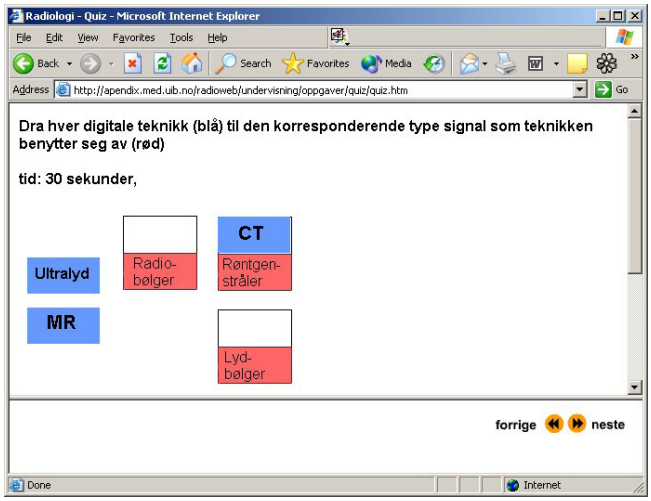
The Quiz



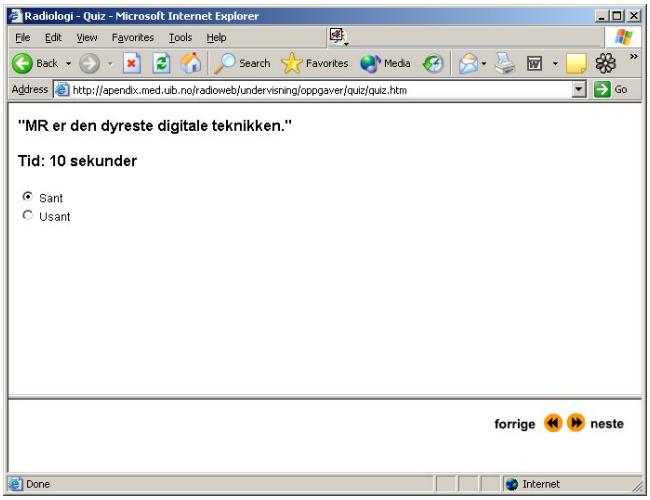
1. The Quiz introductory page



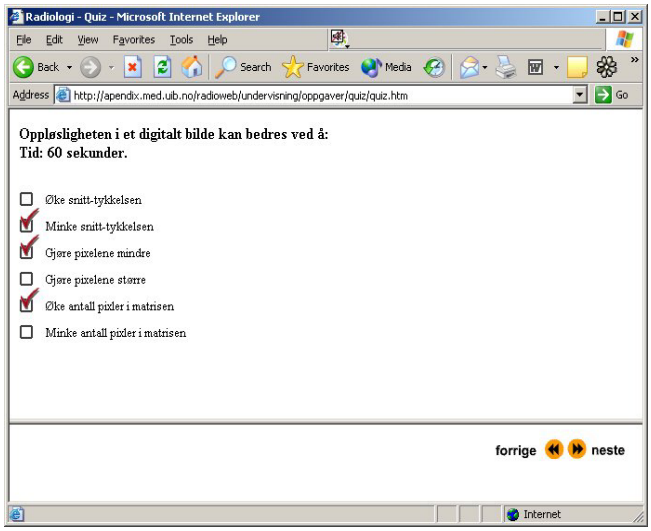
2. A Multiple Choice Question



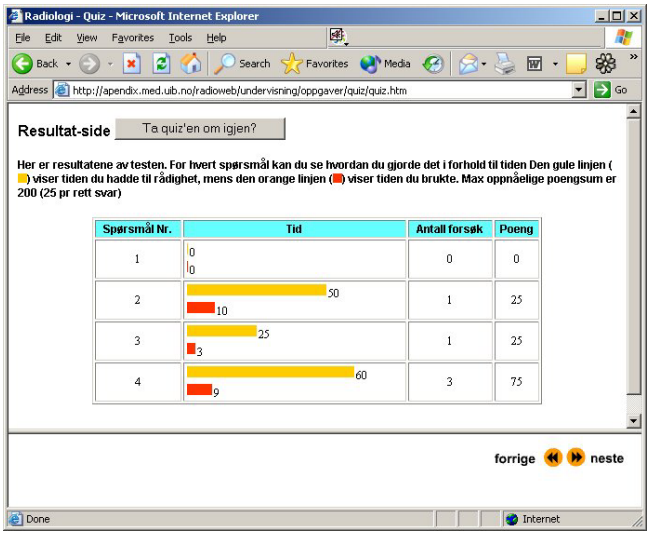
3. A Drag-and-Drop Question



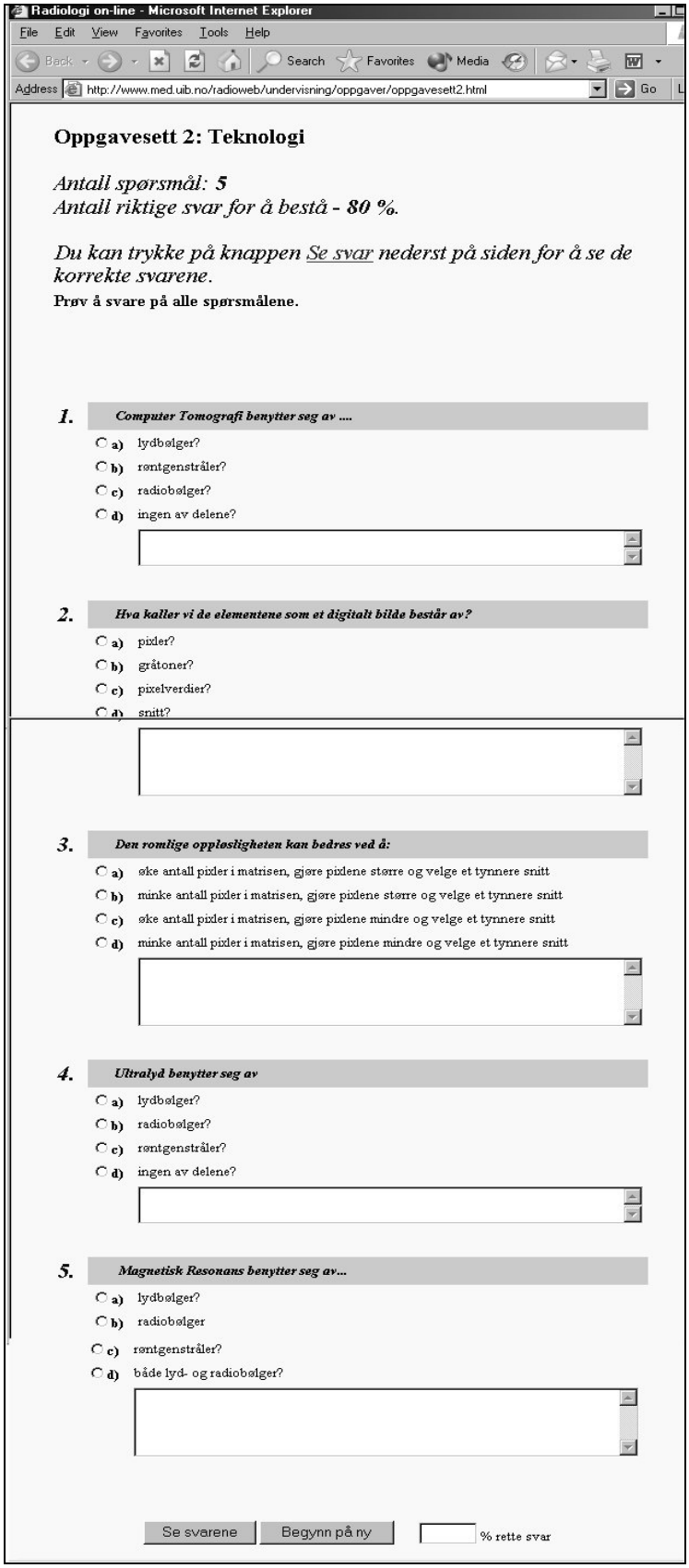
4. Another Multiple Choice



5. Check All That Apply Question



5. Feedback Page


Radiologi on-line - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address http://www.med.uib.no/radioweb/undervisning/oppgaver/oppgavesett2.html
Go
Oppgavesett 2: Teknologi
Antall spørsmål: 5
Antall riktige svar for å bestå - 80 %.
Du kan trykke på knappen Se svar nederst på siden for å se de korrekte svarene.
Prøv å svare på alle spørsmålene.
1. Computer Tomografi benytter seg av ....
a) lydbølger?
b) røntgenstråler?
c) radiobølger?
d) ingen av delene?
2. Hva kaller vi de elementene som et digitalt bilde består av?
a) pixler?
b) gråtoner?
c) pixelverdier?
d) snitt?
3. Den romlige oppløsligheten kan bedres ved å:
a) øke antall pixler i matrisen, gjøre pixlene større og velge et tynnere snitt
b) minke antall pixler i matrisen, gjøre pixlene større og velge et tynnere snitt
c) øke antall pixler i matrisen, gjøre pixlene mindre og velge et tynnere snitt
d) minke antall pixler i matrisen, gjøre pixlene mindre og velge et tynnere snitt
4. Ultralyd benytter seg av
a) lydbølger?
b) radiobølger?
c) røntgenstråler?
d) ingen av delene?
5. Magnetisk Resonans benytter seg av...
a) lydbølger?
b) radiobølger
c) røntgenstråler?
d) både lyd- og radiobølger?
Se svarene
Begynn på ny
% rette svar

The Java Applet

This section presents different screen shots of the Java-applet developed by Stig Frode Samnøy at the Haukeland Hospital. The applet allows the user to manipulate different aspects of a radiological image and shows the effect of such manipulation. This is important tools for radiologists when analyzing an image to look for irregularities.

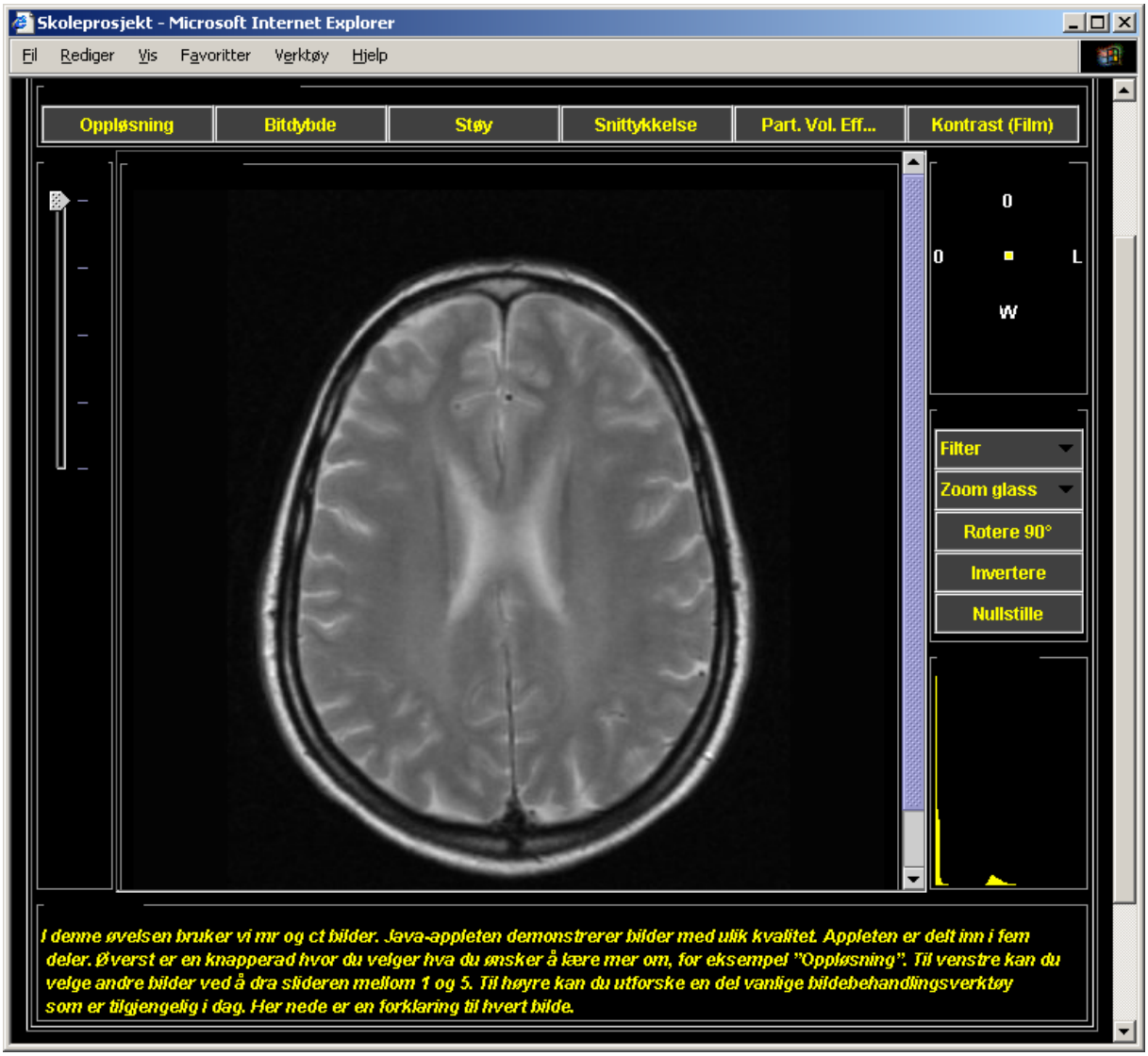


Figure 1. Opening Screen

The welcome page with menus for navigation at the top and menus for image processing to the right. At the bottom, an explanation to the image at hand, and at the left you select different image situations.

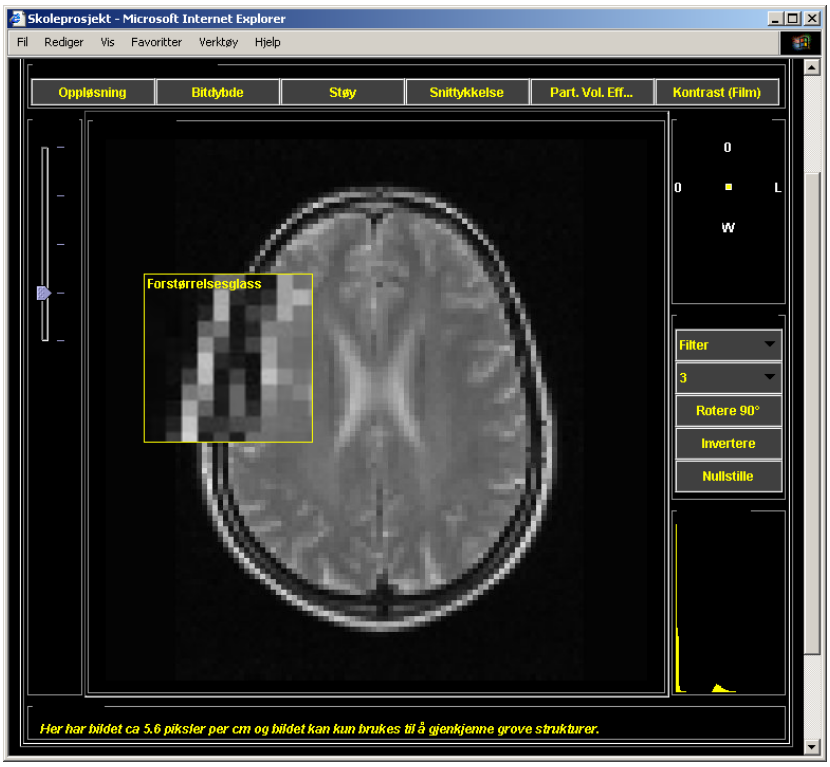


Figure 2. The magnifying glass applied to an image with poor resolution

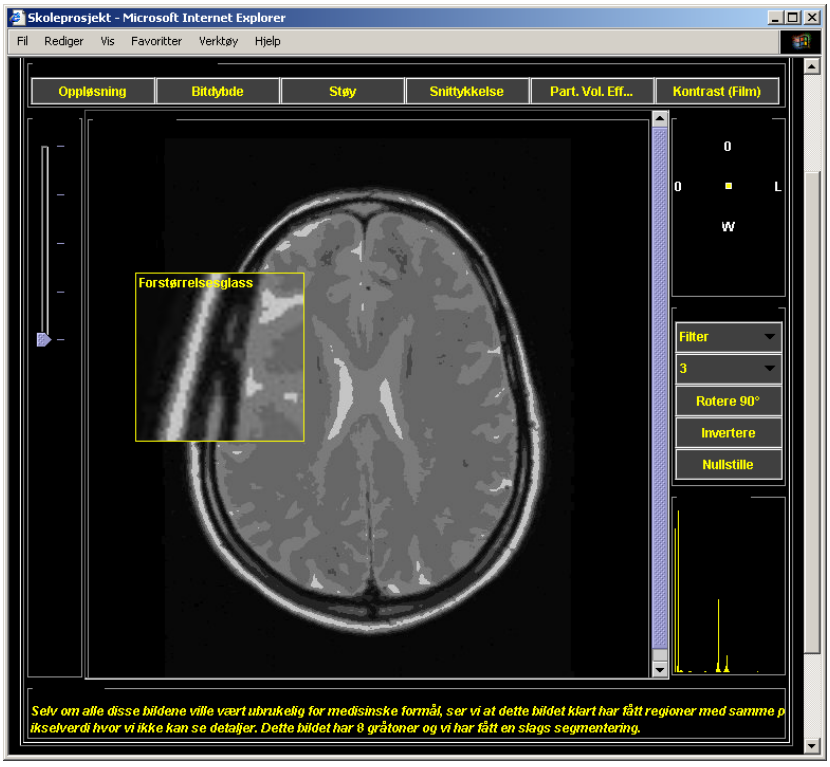


Figure 3. Image with reduced bit depth

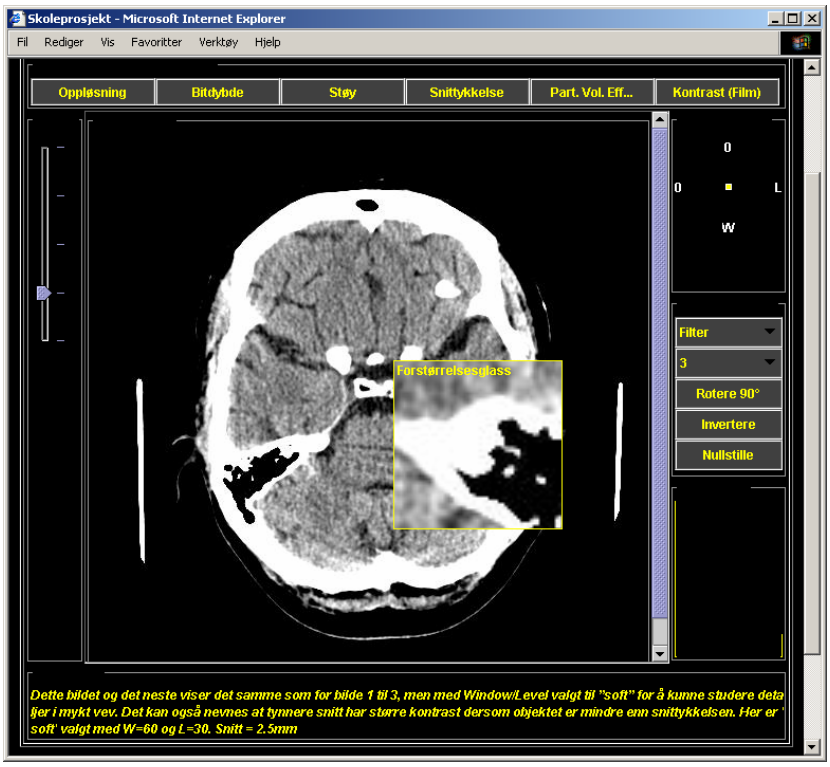


Figure 4. Image manipulated to show "soft" tissue

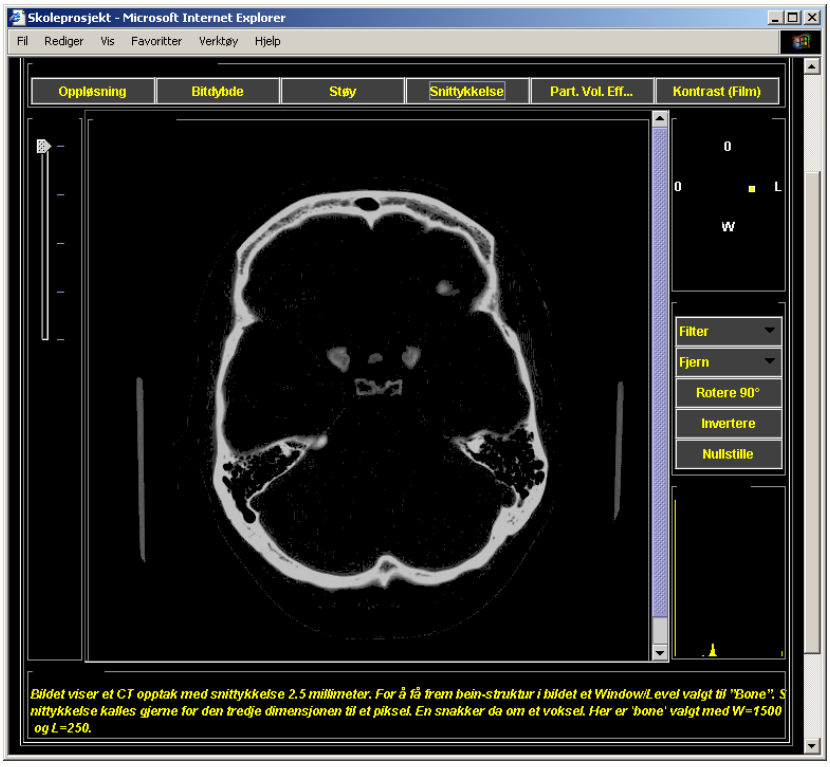


Figure 5. Image manipulated to display bone structures.

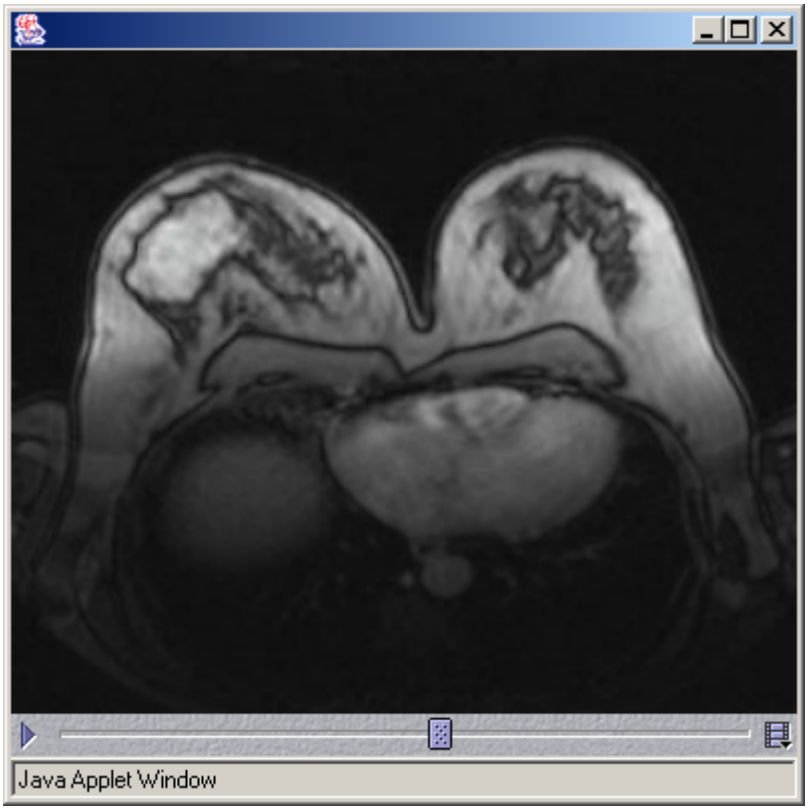


Figure 6. Film showing Intravenous Radiographic Contrast absorbed by different structures in the body.

APPENDIX D

Questionnaire, interview guides and formative review log

SPØRRESKJEMA OM RADIOWEB

Student - evaluering 15. mai 2002

Kjære deltaker. For at vi skal kunne lage et så godt undervisnings-opplegg som mulig, er vi avhengig av dine synspunkter. Vi ber deg derfor besvare dette spørreskjemaet om nett-forelesningen du nettopp har gjennomgått. Alle data blir behandlet konfidensielt.

Kjønn: **Alder:** _____

☐ Mann

☐ Kvinne

1. UTSEENDE OG NAVIGASJON (bruker-grensesnitt)

(kryss av på det svar-alternativet som best beskriver din holdning til den enkelte påstand)

Påstand:	**Svært enig**	**Enig**	**Ingen mening**	**Uenig**	**Svært uenig**
a) Fargene på sidene var behagelige					
b) Fargene på sidene virket forstyrrende					
c) Det var uproblematisk å lese skriften på sidene.					
d) Det var en logisk sammenheng mellom hvordan knappene var utformet og den funksjon de hadde					
e) Det var lett å navigere (finne frem) i innholdet					
f) Det var vanskelig å vite hvor jeg befant meg til enhver tid					
g) Innholdet i sidene er organisert på en uoversiktelig måte					
h) Alt i alt så er jeg fornøyd med hvordan sidene så ut og var organisert					

Eventuelle kommentarer:

(Kryss av på de påstandene du mener er riktige – du kan krysse av på flere alternativ)

2. HJELPEFUNKSJONEN

- ☐ a) Jeg hadde behov for programmets hjelpefunksjon
- ☐ b) Programmets hjelpefunksjon var lett å finne når jeg trengte den
- ☐ c) Hjelpefunksjonen ga den nødvendige informasjon til å løse problemet jeg hadde
- ☐ d) Hjelpefunksjonen ga meg ikke den hjelpen jeg trengte
- ☐ e) Jeg fant ikke hjelpefunksjonen når jeg trengte den

Påstand	**Svært enig**	**Enig**	**Ingen mening**	**Uenig**	**Svært uenig**
a) Det var vanskelig å få med seg alt som skjedde i skjermbildet (lyd, tekst, video)					
b) Jeg skulle ønske jeg hadde mer kontroll over avspillingen av innholdet i forelesningen (play, pause, spoling)					
c) Det var lett å forstå når et emne var ferdig, og et annet begynte					
d) Muligheten til arbeide med nett-forelesningen gjorde at jeg fikk en bedre forståelse for emnet					
e) Jeg vil gjerne ha flere forelesninger tilgjengelig på internett					
f) Det betyr mye for meg at jeg kan arbeide med et emne uavhengig av tid og sted					

3. PRESENTASJON AV INNHOLDET

(kryss av på det svar-alternativet som best beskriver din holdning til den enkelte påstand)

(Kryss av på de påstandene du mener er riktige – du kan krysse av på flere alternativ)

4. INNHOLDET I FORELESNINGEN VAR...

☐ a) vanskelig å forstå.

☐ b) enkelt å forstå.

☐ c) interessant

☐ d) lærerikt.

☐ e) kjedelig

5. DENNE TYPE NETT-FORELESNING EGNER SEG....

☐ a) til innlæring av nytt og ukjent stoff.

☐ b) som erstatning for tradisjonelle forelesninger.

☐ c) til repetisjon av allerede kjent stoff.

☐ d) som supplement til tradisjonelle forelesninger.

☐ e) annet. spesifiser:_____

6. PRØVDE DU ØVINGSOPPGAVENE UNDERVEIS I FORELESNINGEN?

☐ JA

☐ NEI. Årsak:_____

(Kryss av på de påstandene du mener er riktige – du kan krysse av på flere alternativ)

7. ØVINGSOPPGAVENE

☐ a) øvingsoppgavene var for vanskelige

☐ b) øvingsoppgavene var for lette

☐ c) det var for mange oppgaver

☐ e) det kunne gjerne vært flere oppgaver

☐ f) jeg fikk tilfredsstillende tilbakemelding på min egen innsats på oppgavene

☐ g) oppgavene gjorde programmet mer spennende å bruke

8. KOMMENTAR:

Dersom det er noe annet du ønsker å kommentere / utdype, så kan du benytte dette feltet:

Det var alt.
Takk for at du tok deg tid til å svare på dette skjemaet.

INTERVJUGUIDE - STUDENTER SOM HAR BRUKT PROGRAMMET

Forkunnskaper:

Vil du si du har mye eller lite erfaring med bruk av internett generelt? Nettaviser, surfing etc. (hjelpespørsmål: På en skala fra 1 til 5 der 5 er mye erfaring?)

Har du tidligere benyttet noen form for internett- eller databaserte undervisningsprogrammer?
I så fall: hvilke(t)?
Synes du disse var bedre, dårligere eller like bra som det du har prøvd i dag? På hvilken måte?

Er det noe du ønsker å kommentere sånn generelt? Noe som var vanskelig, gøy, nyttig, kjedelig?

Navigasjon:

Hvordan synes du det var å bruke programmet dersom du bare ser på det tekniske, ikke på innholdet?

Hadde du noen tekniske problemer underveis?

- noe som ikke virket f.eks. video, lyd etc?

Du navigerte ved hjelp av knapper og menyer. Var det intuitivt/lett eller vanskelig å forstå hvordan du skulle navigere i programmet?

- noe som var spesielt vanskelig å forstå?

Hvis du synes navigasjonen var vanskelig, kan du si noe om hva du synes du mangler, eller hva som var vanskelig? Knappene, sidemenyen topp-menyen??
(vise frem skjermbilde og be dem si noe om hvordan de synes de ulike menyene var?)

Forslag til forbedringer i forhold til navigasjon?

Hva synes du om plasseringen av neste- og forrige- knappene?
Tror du det ville vært lettere eller vanskeligere å navigere dersom knappene hadde vært plassert et annet sted. Eller spiller det ingen rolle?

- Kan du evt. forklare hvorfor?

Synes du det var en logisk sammenheng mellom hvordan knappene var utformet og den funksjon de hadde?

- kom du dit du forventet når du trykket på en knapp?

Var det lett å forstå når ett emne var ferdig og et annet begynte?
Hvorfor/hvorfor ikke(forslag til hvordan dette kunne gjøres tydeligere?)

Hjelp:
Hadde du behov for å benytte deg av programmets hjelpefunksjon?

Var programmets hjelpfunksjon lett å finne når du trengte den?

Synes du at du fikk den nødvendige hjelpen for å komme videre i programmet?

Bruk av farger og skrift:
Var fargekombinasjonene i programmet OK? Var fargene på noen måte distraherende?

Var skriftsstørrelsen OK?

Brukerkontroll:
Synes du at du hadde god/tilstrekkelig *brukerkontroll* i programmet? (Kontroll over aspekter som sekvens, hastighet, vanskelighetsgrad, læringsstrategi)

Er det noe du eventuelt ville hatt annerledes/mer kontroll over?
For eksempel når det gjelder mulighet til å stoppe underveis, kontrollere lyden, rekkefølgen, repetisjonsmulighet, annet?

Presentasjon av innholdet:
Fikk du med deg alt som skjedde i skjermbildet uten problemer?

- var informasjonen OK presentert?
- Rotete/forvirrende?

Var det noen emner som var vanskelige å forstå på grunn av kombinasjonen av lyd, bevegelse og tekst på skjermen?
Synes du at det noen steder ble for mye informasjon eller for mange ulike inntrykk på en gang?

- hvis ja: husker du eksempler?

(Dual Coding theory)

Var grafikken/animasjonene enkle å forstå?
For vanskelige?
Var det for mye illustrasjoner i forhold til tekst/lyd? For mye lyd? For mye tekst? Akkurat passe?

Innhold:
Hva syntes du om kvaliteten på innholdet i programmet?
Syntes du innholdet som ble presentert var for vanskelig/for lett? På hvilken måte?

Forslag til hvordan innholdet kan presenteres på en bedre måte? Som vil gjøre det lettere, mer underholdende etc.

Interaksjoner:

Prøvde du oppgavene i programmet?

Hvis ja:

- Vanskelighetsgrad ok?
- Passende antall oppgaver?
- Tilstrekkelig tilbakemelding på innsatsen din?
- Noe du ville gjort annerledes?

Hvis nei:

- Hvorfor ikke? (fant ikke, ikke interessert, virket ikke, annet?)

Oppgavene er lagt på en annen side enn forelesningen.

Motivasjon (studentens umiddelbare inntrykk):

Hva synes du om å lære faget på denne måten?

Tror du muligheten for å forberede seg til forelesning via internett kan øke eller minske studentenes motivasjon for faget?

Formålet med dette prosjektet er å øke studentenes forkunnskaper slik at de er mer forberedt til forelesningen. Tror du dette har gjort deg mer i stand til å forstå stoffet?

Hvis du kunne velge mellom vanlige forelesninger og undervisning av den typen vi her har lagt opp til, hva ville du foretrekke?
Hvorfor? (selv bestemme når/hvor, personlig kontakt med foreleser?)

Hvordan ville du foretrekke å bruke denne formen for undervisning; helst til innlæring av nytt stoff, eller til repetisjon, eller begge deler?

Noe annet du ønsker å kommentere/ helhetsinntrykk?

INTERVJUGUIDE - FORELESER

Bakgrunn

Du var jo den som tok initiativ til dette prosjektet. Hvorfor ønsket du å gjøre disse forelesningene nettbaserte? (mer aktive studenter...)

Forventninger

Kan du fortelle litt om hvilke forventinger du hadde til dette....hva hadde du tenkt i utgangspunktet?

Gjennomføring

Hvordan synes du gjennomføringen av opplegget har gått?
- mer å gjøre enn du hadde tenkt?

Prototypen

Hvordan er resultatet blitt, i forhold til hva du hadde forventet?
Hva synes du om designet på prototypen? (forbedringer?)

Er det noe du ville ha gjort annerledes i forhold til eksisterende opplegg?

Forslag til forbedringer?

- Mer animasjoner?
- Mer video?
- Mer oppgaver?

Formidling av stoffet...

Fikk du formidlet det du ønsket i nettforelesningen. Skilte innholdet seg fra innholdet i en vanlig forelesning? Evt på hvilken måte?
Mistet man noe? Fikk man noe ekstra?

Mål-oppfyllelse

En av hovedgrunnene til at du ville gjøre denne forelesningen nett-basert, var at du ønsket at studentene skulle bli mer engasjerte i forelesningssalen.

synes du dette målet ble nådd?

- Hva tror du kan være årsaken til dette?
- stilte studentene mer spørsmål enn tidligere?
- virket det som om de hadde en større forståelse for emnet nå enn tidligere? Mindre? Samme?

Faglig utbytte

Hva er ditt inntrykk av studentenes faglige utbytte av en slik nett-forelesning?

Hvordan syntes du nivået på det faglige innholdet har blitt?

Basert på dine erfaringer med dette opplegget. Kunne du tenke det å gjøre mer av undervisningen tilgjengelig på internett?

- hvorfor/hvorfor ikke?

Tror du kollegaene dine ville vært interessert i å gjøre sine forelesninger om til nett-forelesninger

TING Å SE SPESIELT ETTER:

_____ _____ _____
(Modul) (Student) (Dato)

Skjermbilde	Kommentarer fra studenten:	Forbedringer:
Neste/ Forrige-knapper		
Sidemeny		
Topp-meny		
Knapper need til høyre		
Øvings-oppgaver **QUIZ?**		
Applet		
Hjelp		

E-POST		
Diskusjon		

ANNET: (problemer spørsmål, reaksjoner etc...)

_____ _____ _____

(Modul) (Student) (Dato)

Skjermbilde	Kommentarer fra studenten:	Forbedringer:

APPENDIX E

Data retrieved from the questionnaires and student interviews

Data retrieved from the questionnaire.

This section presents the data collected from the questionnaire that was distributed to the students during the evaluation session.

Table 1 Opinions concerning the look-and-feel of the program and the navigation within the program.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
The colors are pleasing	16	24	0	1	0
The colors are disturbing	0	0	1	24	16
It was problem-free to read the fonts.	23	16	0	1	1
The buttons were intuitive	7	26	8	0	0
Navigating inside the program was easy	11	26	2	2	0
Navigating inside the program was difficult	0	5	2	24	10
The pages were poorly organized	1	5	3	20	12
all in all pleased with how the pages looked and were organized	15	24	2	0	0

Table 2 Opinions concerning the usefulness of the help page provided in RadioWeb.

	I needed the help function	The help was easy to find	Help solved my problem	Help did not solve problem	I didn't find help
yes	3	14	3	4	1
no	38	27	38	37	40

Table 3 Opinions concerning the presentation of the lecture.

	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree	Empty
difficult to follow everything	0	4	3	28	5	1
I wish more user control	11	16	5	9	0	0
easy to understand when one section ended an another began.	9	27	3	2	0	0
the presentation gave me a better understanding of the subject	8	26	6	1	0	0
I want more web-lectures	22	16	2	1	0	0
time/place independence is important to me	18	11	7	4	1	0

Table 4 Opinions concerning the difficulty level of the subject matter.

	content difficult to understand	content easy to understand	content was interesting	content was instructive	content was boring
yes	3	18	34	29	5
no	38	23	7	12	36

Table 5 Opinions concerning possible use of the program.

	learning new material	replace traditional lectures	repetition	supplement to lectures	something else
yes	25	10	33	30	2
no	16	31	8	11	39

Table 6 Opinions concerning the exercises provided in the program.

	questions too hard	questions too easy	too many questions	could have been more questions	satisfying feedback in questions	q. made the program more exciting
yes	1	7		26	26	40
no	40	34	41	15	15	1

Comments noted on the questionnaires (Norwegian):

Skjema	Kommentar
01.	IT-tilbudet må forbedres for at alle skal ha tilfredsstillende mulighet til å tilegne seg kunnskap på denne måten. I tillegg er det utfordringer med materiell og funksjon og "crashing" av systemet og og sidene
02.	3d) Fekk ein bedre forståelse, men veit ikkje kor lenge eg kjem til å hugsa da... 8) Syns det var gøy med nettforelesning! Kanskje litt vanskelig å konsentrere seg av og til, men det er det jo på vanlige forelesninger og...
03.	1) Savnet en stopp-knapp til å stanse midt i ei side! 8) Det er slitsomt å høre på en stemme uten å se ansiktet. Det gjør det vanskeligere å følge med enn på ei vanlig forelesning.
04.	Ingen lyd etter Java-link. Fortsett-knappen virket ikke mellom læringsmål og digit. bilder.
05.	Foreleser hadde søvndyssande/monoton/kjedelig stemme. Hakkete i opplesninga. Lite flyt. Ingen lyd etter bruk av progr.
06.	
07.	Det var ett tilfelle der neste-knappen ikkje virka. då gjekk eg vidare vha lista "innhold i forelesningen" til høgre på skjermen. Det er muleg at eg då hoppa over nokre delar/bilete, fordi eg ikkje visste 100% nøyaktig kor eg var i denne lista.
08.	At lyden etterr applet-applikasjonen forsvant.
09.	Glimrende tiltak!! Det er en fordel om man kan bla frem og tilbake på videoene (alle sammen) v/ å trykke m musepekeren! Da er det lettere å gå tilbake til ting man ikke fikk med seg uten å se hele "lyd/billedsnutten" om igjen. Litt vanskelig å skille de ulike emnene, men det kommer nok av at siden og oppsett er ukjent. vet det til neste gang. Kanskje bedre poengtert i begynnelsen av forelesningen. Mot slutten var det lett å skille de ulike emnene (CT, Ultralyd og MR).
10.	
11.	På enkelte forelesninger (ultralyd) ble det snakket for FORT. Det gjorde det vanskelig å skjønne dette nye stoffet. Terskelen for å stille spørsmål er høgere og det er litt dumt. En spoleknapp ville vært grei. Kjempebra!
12.	Av og til fekk ein ikkje med seg 1. ord i ein setning når ein starta på ny side. Av og til virket ikke "neste"-knappen, men jeg kom videre ved å trykke meg inn på rett plass fra lista til høyre. Lyden forsvant en gang. Bra forelesning!
13.	Jeg brukte ikke hjelpefunksjonen.
14.	Jeg hadde problemer med lyden en gang. av og til adlød ikke knappen. brukte da innholdsfortegnelsen på h. side for å klikke meg videre
15.	Synes tiltaket er spennende, som et supplement til tradisjonelle forelesninger. Behagelig måte å arbeide på. Muligheten til spoling hadde vært grei å ha.
16.	Er godt fornøyd med forelesningen, men skulle gjerne hatt mulighet til å spole frem og tilbake på lyd- og vdeofremvisningene. Noen av disse var ganske lange, og det er kjedelig å lytte til hele sekvensen en gang til når det

	en lurer på er mot slutten av en slik sekvens.
17.	man trenger mulighet for å kunne spole. Legg inn en pause foran lyden i hvert bilde (1sek). Mer utfyllende quiz.
18.	Ikke gjør nettforelesningene plattformavhengige (Windows) --> ikke bruk activeX, AVI-filformat, Windows Media Player. Bruk heller java, mpeg og Macro som finnes på andre plattformer (Unix, Mac) Ellers er jeg meget fornøyd, sidene er bra bygget opp. Veldig bra. Brukte ikke hjelpefunksjonen. 3e) vil gjerne ha flere forelesninger på nett - det kommer an på om dette vil gå utover annen type undervisning. 7d) flere oppgaver: aktuelle eksamensspørsmål er bra.
19.	
20.	Synes til tider at forelesers stemme var vanskelig å følge: Pauser midt i setningene som gjorde at jeg trodde setningen var slutt, men så kom det plutselig mer. Noen ganger skjønte jeg ikke at han begynte på ny setning, fordi pausen mellom setningene ble for kort. Litt stotrerte på en måte - litt irriterende. Hadde vært fint hvis det underveis ble markert/uthevet hviklet pkt. man var under; feks. fargemarkering i "innholdsfortegnelsen". Det tok lang tid før videoen startet, ingen hjelp i hjelpefunksjonen.
21.	
22.	Mer informasjon må skrives (tilsettes) på nettforelesning side. Mer bilder med defekter og spørsmål om det.
23.	Altfor kort ledning på høretelefonene. Lyden var litt dårlig. Stemmen på maskinen var litt hakkete.
24.	
25.	Synes det var veldig bra. Pluss for øvingsoppgaver. Gjerne flere oppgaver. Lett å bruke. Oversiktlig. Passelig tempo av presentasjon. Kjekt å bruke før eksamen.
26.	
27.	
28.	Det virker litt som høytlesning, savner litt naturlig fly i audio delen av presentasjonen. Ellers var alt kjempebra! Veldig veldig positiv opplevelese.
29.	
30.	
31.	Et meget godt konsept. brukte ikke hjeplefunksjonen. 5e) egner seg som foløper til forklarings/fordypnings-forelesningen.
32.	Lyden forsvant etter java-applet. Måtte bruke "refresh", men hadde ingen refresh-knapp på skjermen, måtte trykke F5 etter instruksjon fra veileder. det hadde jeg aldri funnet ut alene. Brukte ikke hjeplefunksjonen da vi hadde veileder på PC-salen!
33.	Kunne vært en "repetisjonstast" mellom "forrige" og "neste"-tastene. Selve "forelesningsvinduet" kunne vært større. Pluss for organisering av sidene!
34.	Det burde vært mulig å spole frem og tilbake innen en del av forelesningen (slik at man f.eks. kunne høre bare et par setninger på nytt)
35.	Det er litt lenge å sitte en time foran skjermen. Opplegget var bra, men blir litt kjedeligere enn vanlige forelesninger? Hadde vært fint med noen slike timer i semesteret. Radiologi virker som et "fag" godt egnet m. bilder osv.
36.	Knappen for å få frem neste bilde hang seg opp en gang.
37.	Innlesningen var til tider dårlig. Det ble lest så seint at det var vanskelig å

	følge med. Dessuten bør alt som står skrevet leses høyt.
38.	Brukte ikke hjelpefunksjonen. Var litt vanskelig å få med seg teksten. Kunne hatt en pause i lyd der hvor teksten skiftet midt i avspillingen. Rakk ikke lese teksten. Kjempe fin måte å arbeide med stoffet
39.	Det er vanskelig å se bilder i en stor forelesningssal, men med den gode kvaliteten på nett-forelesningen var det mye lettere å se patologi som tidligere har vært meget vanskelig å se.
40.	Ordliste - mulig å slå opp på mye brukte, nye ord (definisjoner). Kjekt med oppgaver, men noen av oppgavene var litt like. fint tiltak!
41.	Burde vært ulike stadier/trinn av oppgaver. Lette, medium og vanskelige. Ellers meget bra. Det må være mulig å bruke hjemmefra. Dersom man bare skal stole på noen få maskiner, blir det mer stress, kø og dårlig utnyttet tid enn å ha hatt en vanlig forelesning. Veldig flott, men bør kunne være tilgjengelig overalt

Comments noted on the questionnaires (English translation):

Respondent	Comment
01.	The ICT facilities must be improved.
02.	I got a better understanding of the subject taught, but I don't know if I will remember it. Thought web lecture was fun. Maybe a bit difficult to concentrate sometimes, but that is also the case with regular lectures.
03.	Missed a stop-button to stop during playing. It is tiresome to hear a voice without seeing the face. It makes it more difficult to pay attention than in a regular lecture.
04.	No sound after java-applet. Next button didn't work between two pages.
05.	Lecturer had a soporific/ monotonous/ boring voice. Stuttering reading. No sound after applet.
06.	
07.	One time the next-button didn't work. I moved on using the side-menu. I might have skipped some pages as I didn't know for sure were I was.
08.	Sound disappeared after the applet.
09.	Excellent initiative! It would be an advantage if you could move back and forth in the videos (all of them) using mouse clicks. It will make it easier to go back and repeat what you missed without having to view the entire movie again. A bit difficult to separate the topics from one another. Maybe clarify that in the beginning. At the end it was easy to separate the topics.
10.	
11.	In some of the lectures (ultrasound) it was spoken too fast. Made it difficult to understand this new material. Higher threshold for asking questions. Winding-button would be nice. Great!
12.	Sometimes missed first word in a sentence when you opened a new page. Sometimes the next-button failed, but I used the menu on the right. Sound disappeared once. Good lecture!
13.	
14.	Problem with sound once. Sometimes the next-button failed, but I used the menu on the right
15.	I think its an exciting initiative as a supplement to traditional lectures. Pleasant way of working. Opportunity to **wind** would be nice.
16.	I am pleased with the lecture, but would like the opportunity to **wind** back and forth.
17.	You need the opportunity to **wind**. Add a small pause before the sound. More detailed quiz.
18.	Do not make web lectures platform dependent. Beyond that, I'm very pleased. The pages are well organized. Very good.
19.	
20.	Sometimes the lecturer's voice was difficult to follow. A bit stuttering. Would be nice if it was marked were you were, e.g. with colors in the menu. Took a long time for the video to start.
21.	
22.	More information must be added to the pages. More images with defects and questions related to that.

23.	The sound was not too good. The voice a bit stuttering.
24.	
25.	I think it was very good. Plus for exercises. Would like more exercises. Easy to use. Well arranged. Suitable pace. Nice to use before the exam.
26.	
27.	
28.	Seems a bit like read-aloud, miss more natural flow in the audio presentation. Beyond that, everything was great! Very positive experience.
29.	
30.	
31.	A very nice concept.
32.	Sound disappeared after the applet. Had to use ”refresh”
33.	Could have been a repeat-button between the “previous” and the “next” buttons. The lecture window could have been larger. Plus for organization of the pages!
34.	Should be possible to **wind** back and forth within sections of the lecture.
35.	A bit boring to sit one hour in front of the computer.
36.	Next button failed once.
37.	Audio was sometimes bad. It was read so slow that it was hard to follow. Everything that is written should be read aloud.
38.	Could have had a pause in the audio when the text changed. Didn’t have the time to read the text. Great way of working with the material!
39.	It is difficult to see pictures in an auditorium, but the good quality on the web-lecture made it much easier.
40.	Dictionary – possibility to look up frequently used, new words (definitions). Nice with exercises, but some of them were a bit alike. Nice initiative!
41.	Should be different stages of exercises – easy, medium and hard. Other than that, very good. Must be possible to use from home. Very nice, but should be available everywhere.

Extracts from interviews

This section presents the excerpts from the interviews conducted with students that are quoted in the thesis. The extracts were translated from Norwegian to English by me in the thesis. Below they are here presented in Norwegian.

Interview session 1: interview conducted with one female student.

I = Interviewer
F1 = Respondent (Female One)

Extract 1:

I: Brukerkontroll, altså avspilling, rekkefølge, hastighet. Hvor god brukerkontroll synes du du hadde?
F1: ja, bortsett fra det at jeg kunne ønske jeg kunne spolt tilbake. Blant annet fordi det var noen ganger den hadde vært gjennom den... alle de stikkordene som kom opp og så gikk det kanskje videre med en liten film.
I: ja, nettopp
F1: og så tenkte jeg ”oi, nå skulle jeg gjerne hatt... gått tilbake litt og sett på det, eller ja. I de sammenhengene var det kanskje litt lite brukerkontroll. og så kunne jeg også tenkt meg... hvis jeg tok tilbake-knappen, så kom jeg på temaet før der igjen, jeg kom ikke til begynnelsen av temaet.
I: nei, visst. Det gjør du ikke.
F1: og da måtte jeg igjen... og så måtte jeg ta en forover
I: Du kan faktisk... når du er ferdig med å avspille, hvis du bare trykker på ”play” igjen så begynner den på nytt
F1: åja
I: men det forstod du ikke, så da var ikke det noe bra
F1: nei
I: da må det gjøres litt tydeligere

Extract 2:

I: ok. Og den appleten, den java-appleten med bilde?
F1: den som vi kunne prøve selv litt?
I: ja
F1: det synes jeg var kjempebra, for da får man på en måte litt teori i praksis
I: men skjønte du den?
F1: ja, jeg måtte se litt om og sånn, men ja.

Extract 3:

I: ja, hva synes du om det å gjøre en forelesning nett-basert?
F1: ja, eh.. jeg syns det er veldig bra fordi da kan man, som jeg allerede har sagt, da kan man få det i sitt eget tempo, man kan få det repetert, og så er det sikkert veldig kostbar affære.. og så kan jeg gå å ta det når jeg vil og ja..

I: jo, formålet med dette prosjektet.. Det har vært da å øke studentenes for-kunnskaper, sånn at man blir mer forberedt til forelesnigen og møter opp litt mer forberedt så man kan få litt mer interaksjon mellom foreleser og studenter. Tror du dette har, tror du dette gjør..oppfyller det målet? Tror du du er mer i stand til å diskutere dette stoffet om en ukes tid eller..
F1: Med denne forelesningen her så tror jeg...jeg tror absolutt det fordi ... vi har forelesere som ikke forklarer så mange ting, sånne basale ting fordi de vet kanskje knapt hviklet kull vi går på ...
I: mm-mm
F1: og denne her har forklart det basale og ... og det har vært ... den har tatt opp ting som jeg har savnet på forelesningene
I: mm-mm
F1: så jeg tror det <mangler noe her> akkurat nå når jeg gikk gjennom den, så gikk jeg kanskje ikke så inn for at nå skal jeg lære det, nå gikk jeg mer og så "oi, hvordan er det her" og, ja kikket litt. Tenkte kanskje mer på hvordan ting fungerte og hvordan ...om jeg likte det og sånne ting. Men hadde det vært en ... ellers ville jeg kanskje sittet og skrevet notater på ting jeg ville tatt med meg videre og sånn.
I: så hvis du.. hvis vi bare hadde gitt dere web-adressen og sagt at dere måtte ... ja ..."lek med dette hjemme"
F1: ja
I: så ville det kanskje vært en litt annnen situasjon
F1: ja
I tror du.. vile du foretrekke dennetype forelesningerfremfor den i forelesningssalen?
F1: eh...nei ... men variasjon er alltid bra. Så...gjerne gitt altså...noen forelesninger der det er mulig. Begge deler
I: jatakk, begge deler ☺ så heller et supplement til det dere allerede har, ikke en erstatning
F1: jeg tror kanskje det kan være litt dumt å erstatte det fordi det er veldig mange som ikke liker å sitte på dataen og... for de blir jo det... De vil jo lære mindre, så...
I: nei, det er et helt ok svar det

Interview session 2: Group interview conducted with four students, two male and two female.

I = Interviewer
F1 = Respondent (Female One)
F2 = Respondent (Female Two)
M1 = Respondent (Male One)
M2 = Respondent (Male Two)

Extract 4:

I: først; hva synes dere? Sånn...umiddelbar reaksjon?
F2: det var bedre enn jeg hadde trodd
I: bedre enn du hadde trodd?
F2: ja, for jeg er ikke så veldig data-interessert, så jeg føler at jeg detter lenger og lenger bak og ... så jeg var redd det skulle bli mye mer sånn "klikk underveis" og at jeg skulle stå helt fast da, men .. det gikk forbausende bra
M2: men.. jeg synes det var veldig interessant. Jeg synes forelesningen var interessant, jeg tenkte ikke på at dette var bare en sånn prøve-forelesning. Jeg levde meg inn i det og det ga meg veldig mye frihet til å kunne hoppe tilbake igjen å sjekke ting og gå ...
F2: skulle gått an å spole, så hvis man mistet noe på begynnelsen så kunne man liksom bare spolt tilbake... "hva sa han egentlig der?"
M1: litt mer pause-knapp og spole-knapp
F2: det var jo pause-knapp, men...
M1: var det det?
M2: ja det var det
F1: jeg fant den ikke
F2: den var liksom nede ved...
M1: men jeg synes konsentrasjonen og kvaliteten på det som ble sagt ble så høy på grunn av at det på en måte har blitt forberedt på en litt annen måte kanskje, da. Det han sier er på en måte gjennomtenkt på forhånd på en annen måte enn en vanlig forelesning og så blir det det visuelle samtidig. Det blir veldig sånn oversiktlig, god måte å få informasjon på, synes jeg.

Interview session 3: Interview conducted with two students, one male and one female.

I = Interviewer
F1 = Respondent (Female One)
M1 = Respondent (Male One)

Extract 5:

I: hva synes der om å gjøre en forelesning nettbasert på denne måten?
M1: jeg synes det er veldig greit, da kan du jo gjøre det hvor som helst, med hvilken som helst datamaskin. Trenger jo ikke opp hit for forelesningen.
I: nei..
M1: ...og du kan klikke deg frem og tilbake i forelesningen og repetere ting og, ja...mye enklere
I: ja..men... mister du noe på veien liksom?
M1: får jo ikke spurt foreleseren personlig der og da
F1: du kan jo ikke spørre foreleseren om ting du lurer på, men du har ofte veldig høy terskel for å spørre en foreleser i et fullsatt auditorium...så det kan godt være du får det samme utbyttet av en epost for eksempel

Extract 6:

I: det er jo et for-prosjekt, så det er snakk om å gjøre da alle de ti forelesningene på samme måten, med etter-forelesninger der man kan diskutere temaene litt mer. Hva synes dere om den ordningen?
M1: det hadde sikkert vært en god ide, det. Tror man hadde lært like mye på det som, mer på det faktisk, enn på å kjøre sånne tradisjonelle forelesninger <uklart>som de har gjort nå</uklart>
F1: jeg er faktisk tilbøyelig til å være enig for det at jo mer spesialisert undervisningen blir, jo mindre pedagogisk har de en tildens til å bli, så..ja, jeg vil faktisk tro det er et godt alternativ altså.
I: det ville vært interessant for dere?
F1: mm-mm [bifallende]
I: nå skal dere jo ha den etter-forelesningen.. faktisk i neste uke eller om to uker..
M1: ja, da får man jo muligheten til å snakke med foreleseren, da
I: ja, det er planen..
F1: ja, for det er et poeng at avdelingen skal ha et ansikt utad på en måte. At vi faktisk treffer et menneske fra seksjonen. Det synes jeg er ganske viktig. Men det er ikke nødvendig at de står foran oss i tyve timer

Extract 7:

I: tror dere..hva har dette å si for forståelsen av temaet...altså gjør det det lettere å forstå dette emnet eller er det det samme som i forelesningssalen?

M1: ihvertfall sammenliknet med en vanlig forelesning så synes jeg dette er bedre
I: du synes det er bedre?
M1: helt klart. Jeg synes det
F1: jeg synes faktisk og det for du kommer liksom nærmere og du kan repetere det du synes er vanskelig og du får de levende bildene <rett bort til?> deg
I: ja, for som sagt: det er jo snakk om å ta de ni andre og da..
M1: du kan mer følge ditt eget tempo
F1: ja, jeg tror dette emnet egner seg veldig godt fordi bildene er veldig viktige
I: ja, det er kanskje det som passer best innenfor medisin, jeg vet ikke.
F1: kan godt være, faktisk
I: men dere synes det er en god ide?
F1: absolutt
F1: ja, fin ide

APPENDIX F

Interview with Subject Matter Expert

Interview with subject matter expert and initiator Jarle Rørvik. Summing up the project.

Du var jo den som tok initiativ til dette prosjektet.Hvorfor ønsket du å gjøre disse forelesningene nettbaserte?
Bakgrunnen var det pedagogiske grunnlaget som vi har utarbeidet for undervisningen i radiologi, der et av punktene var å prøve å utvikle et nettbasert undervisningssystem eller undervisningsformer.

Så det var allerede vedtatt?
Ja, det er et dokument jeg utarbeidet som ledd i den obligatoriske undervisningen i pedagogi som man må ta når man begynner å undervise på universitetet. Det var en del av strategien for å forbedre undervisningen i radiologi. Vi var litt usikre på hva vi kunne oppnå når det gjaldt læringseffekt, men vi var helt sikre på at vi kunne øke tilgjengeligheten. Og vi så muligheten til å redusere undervisningsmengden. Det første vi prøvde å utvikle var Rabilda. Men den nettforelesningen var noe jeg ikke hadde tenkt på i første omgang, men jeg fikk som ansvar å utarbeide en strategi for økt bruk av IKT i medisinsk utdannelse og da fikk jeg den ideen at noen burde lage en prototype på en nett-forelesning. Vi gikk jo på internett og så litt på hva som fantes. Vi så på den stanford-modellen og lurte på det med delt vindu med opptak av foreleseren mens han holdt en vanlig forelesning i et auditorium og powerpoint-tekster. Så det var i utgangspunktet det vi hadde tenkt å lage, og så tok vi kontakt med InterMedia.

Hva var selve målsetningen med å gjøre en forelesning nett-basert? Var det bare å innføre teknologi?
Nei, det var ikke bare for å innføre ny teknologi eller for å gjøre ting mer tilgjenglig. Det var for å prøve å øke egenaktiviteten hos studentene. Det har liksom vært vedtatt at forelesninger i plenum er kjedelig og at det er noe man ikke husker noe av i ettertid, spesielt i et fag som radiologi som er spredt utover i små porsjoner i løpet av tre år.

Hvilke forventninger hadde du til prosjektet?
Forventningen var å få til økt aktivitet fra studentene. At man kunne få til en større grad av kommunikasjon, organisert i form av etter-forelesningene. Hvordan de etter-forelesningene skulle foregå hadde jeg vel egentlig ikke tenkt så mye over, men det er klart at etter-forelesningene må være relativt enkle å lage til og i stor grad bruke den nett-forelesningen på en eller annen måte, sånn som den ligger der. Ellers får man ikke lærerne til å gjøre det, hvis de må forberede en veldig god forelesning i løpet av en uke/14 dager for hvert kull. Jeg har ikke tenkt nøyaktig hvordan det skulle gjøres. Det var i hovedsak å svare på spørsmål og utdype ting som var vanskelig. Men det kom veldig lite spørsmål og de som kom var veldig enkle/banale. Det kan være at stoffet at var relativt selvforklarende. Målsetningen har vært å presentere tilstrekkelig mye stoff til at de får en viss forståelse av innholdet/temaet. Hvis du skal forstå fullt ut alt som blir tatt opp der, så krever det egentlig ganske store fysikk-kunnskaper og innsikt i forskjellige ting som tar mye tid å gå inn på.

Hvordan synes du gjennomføringen av prosjektet har gått? Ble det mer å gjøre for deg enn du hadde tenkt?
Ja, det ble nok litt mer å gjøre for meg. Men jeg synes det var nyttig, en veldig kjekk prosess å være med på. Jeg har fått lære mye og har fått innsikt i en god del. Jeg var nok ikke klar over hvor mye arbeid det ville kreve og har nok ikke hatt den tiden jeg skulle hatt for å gjøre en fullkommen

jobb. På den andre siden er det kanskje litt realistisk i forhold til sånn som det er hvis en setter i gang et slikt prosjekt. At du stort sett må basere deg på folk som ikke har tid?

Tror du kollegaene dine ville være villig til å ofre så mye tid på et sånt prosjekt?
Vi har relativt få forelesninger og disse forelesningene er på en måte vårt ansikt utad. Så hvis de først er villig til å gå inn på å lage en nett-forelesning, så tror jeg at de er villig til å bruke en god del tid.

Selve prototypen - hva synes du om resultatet i forhold til utgangspunktet?
Jeg synes resultatet er mye bedre enn jeg hadde tenkt. Når jeg sammenlikner med stanford-modellen, så synes jeg dette er mye bedre. Jeg hadde fryktet at studentene skulle synes det var kjedelig. Men etter at jeg snakket med dem, så skjønner jeg hva som er det litt fine med prototypen. Det at du har et stort bilde som du fokuserer på, og at du gjør en del ting med bildet slik at det blir veldig visuelt. Det tror jeg gjorde at folk ikke syntes det ble kjedelig, men at det var artig tross en kjedelig, monoton stemme... Jeg syntes jo det var forferdelig å høre min egen stemme. Det er jo alltid fælt å høre på seg selv, men jeg ser at det å lage lyden, og lage en interessant stemme, at det krever både trening og mye arbeid.

Men jeg synes resultatet er veldig bra, spesielt at det er fokusert mot det visuelle og at ikke foreleser og stemmen kommer i fokus, men at stoffet kommer i fokus. Det synes jeg var bra. Opplegget med delt vindu syntes jeg på langt nær var så godt konsept. Jeg synes dette konseptet er mye bedre.

Inneholder den alt den bør inneholde eller er det noe du savner?
Jeg synes ikke det skulle vært noe mer, men det skulle vært litt mindre tekst. At en hadde fått litt mer animasjoner og så bare et par punkter som poppet opp. Jeg synes ikke vi fikk helt en god balanse der.

Fikk du formidlet det du ønsket?
Jeg synes at nå formidler jeg stoffet på en rimelig grei måte. Jeg ville kanskje strammet det litt inn og gjort noen forandringer, men nå får jeg hvertfall formidlet budskapet og stoffet på en rimelig forståelig måte som de aller fleste skulle kunne tilegne seg.

Er det noen forskjell på innholdet i denne forelesningen og den forelesningen som du pleier å holde i auditoriet.
Hovedbudskapet er det samme. Denne forelesningen inneholder jo mye mer når det gjelder ulike typer animasjoner, men temaet er det samme. Jeg føler ikke egentlig at jeg har mistet noe. Jeg syntes ikke jeg fikk denne forelesningen helt til i auditoriet. Stoffet innbød til enten å gi en struktur og en overfladisk forståelse av tingene eller å gå veldig i detalj, og jeg greide aldri å finne helt balansen. Jeg er vant med å holde gode forelesninger, men akkurat dette syntes jeg var vanskelig å presentere på en god måte.

En av hovedgrunnene til at du ville gjøre denne forelesningen nett-basert, var at du ønsket at studentene skulle bli mer engasjerte i forelesningssalen. Men bare 5 stk møtte opp. Har du noen formening om årsaken til at så få møtte opp?
Nei. Jeg vet ikke om det var presisert godt nok for dem at dette var en viktig del av evalueringen, at det faktisk var viktig at alle møtte opp. Eller om de oppfattet det som at det bare var de som lurte på noe som skulle møte opp. Det pleier veldig sjeldent å være så få som møter opp til en obligatorisk forelesning. Jeg trodde det ville møte opp mange flere - det eneste jeg kan tenke meg

er at det var så dårlig fremmøte av forelesere på de andre forelesningene som de skulle ha. Nærmest som en protest, jeg vet ikke. Det kan ikke ha noe med nett-forelesningen å gjøre for den var de jo veldig positive til.

Kanskje de følte at de allerede hadde fått med seg stoffet? At de ikke trengte å møte til forelesningen?
Ja, jeg tror nok det har vært en viktig faktor.

Men det ville jo vært synd for prosjektet. Man ønsker seg mer aktive studenter, men hvis man får mindre aktive studenter som ikke engang møter opp. Hvis dette er et symptom på hvordan det vil bli i fremtiden....
Ja, det er visse indikasjoner på det og det angir jo da en fare med den type forelesning. At man faktisk oppnår det motsatte. I stedet for økt kommunikasjon mellom studenter og lærer, så blir det faktisk mindre.

Men du hadde ikke planlagt noe opplegg for de etter-forelesningene?
Nei, ikke noe annet enn at jeg hadde tenkt å bruke de spørsmålene som kom inn. Jeg hadde ikke tenkt å lage en egen forelesning.

I utgangspunktet hadde du tenkt å ha en etter-forelesning etter hver nettforelesning. Vil du forsatt gjøre det på den måten, eller kunne man kuttet ned på antall forelesninger?
Nei, det tror jeg ikke jeg vil gjøre. Jeg tror vi må beholde de forelesningene. Og enten så må vi kjøre opplegget med powerpoint-presentasjoner og så må de nettforelesningene ligge der i bunn så vi kan bruke dem dersom foreleser ikke møter opp, og for studenter som ikke har anledning til å møte. Kanskje man kan ha 1-2 timer der man svarer på spørsmål fra de nett-forelesningene som måtte være. At man hadde begge deler. Men jeg tror nok at å bare satse på nett-forelesninger blir galt, det kan vi ikke gjøre. Ihvertfall at man beholder noen av de forelesningene tror jeg er viktig, av forskjellige grunner.

Hvordan vil du da integrere RadioWeb inn i den eksisterende undervisningen?
I radioweb vil jo en del av det undervisningsmaterialet som vi har være tilgjengelig. I og med at studiet er spredt over 3-4 år, så vil de kunne gå inn i de forelesningene senere og gå gjennom dem, så jeg ser at de har en viktig plass i det opplegget. Jeg vil jo bruke de nett-forelesningene kanskje i andre sammenhenger, når du har videre- og etterutdannelseskurs.

Men tror du det vil bli brukt, på den måten vi hadde tenkt, fremover. Hvis man ikke tvinger dem til å møte opp å se dem?
Det vet jeg ikke. Jeg vil jo tro at noen vil bruke dem. De som ikke kan møte opp på forelesning. Og denne gangen var det faktisk fem av ti forelesninger som gikk ut eller ikke ble gitt i sin helhet fordi foreleser var syk eller glemte at han skulle ha forelesning. Der kunne man jo brukt nett-forelesningene. At en assistentlege kunne gått gjennom nett-forelesningen i plenum.

Som en backup-løsning?
Det er en mulig anvendelse, og for de som ikke møtte opp, og for repetisjon.

Hvis man har den for de som ikke møter opp, så tenker du at etter-forelesningen skal være den samme som nett-forelesningen. Da blir det i så fall bare dobbelt-opp. At man enten kan gå på forelesning i salen eller man kan se den på nett?

Jeg er usikker på hvor viktig det blir å ha den etter-forelesningen. Dømt ut fra de spørsmålene som kom nå så var det ikke mange vesentlige/viktige spørsmål som ble stilt.

Man kunne eventuelt prøvd denne forelesningen på et kull til. At de får prøve den i en hel uke, ikke bare 90 minutter.
Jeg er absolutt innstilt på å få prøvd det på nytt. Kanskje når man har fått tenkt litt mer gjennom det og diskutert litt mer hvordan en sånn etter-forelesning kan legges opp.

Hvis man ga dem en uke, kunne man sett om det kom flere, mer interessante, spørsmål
Det kan vi godt gjøre. Men uansett så syntes jeg at man har tilstrekkelig med gode grunner til å gjøre alle forelesningene nett-basert, selv om man ikke har den etter-forelesningen. Jeg vil gå inn for det, og kommer til å søke om penger til en stilling og til å få gjort det. Jeg vil søke fakultetet om penger til å opprette en 20% stilling som skal jobbe med de nett-forelesningene over ett års tid. Jeg tror ikke det skal være noe problem å få foreleserne med på det. Det blir litt enklere for de som skal gjøre det nå. Dette stoffet her var ikke vårt primærstoff, vi har ikke så veldig dyp forståelse for det selv.

Sånn sett var det kanskje ingen god ide å begynne med denne, da det ble vanskeligere for alle som var involvert å forstå konseptene .
Nei, det var kanskje feil sånn sett. På den annen side var jeg ikke fornøyd med den forelesningen i det hele tatt så jeg følte det måtte gjøres noe og jeg synes resultatet har blitt bra.

Hva er ditt inntrykk av studentenes faglige utbytte av en slik nett-forelesning?
Ikke noe annet enn det de sa da jeg var tilstede. At de synes det var veldig bra. At det faglige innholdet var interessant og at de hadde et godt faglig utbytte. Problemet i medisin er ofte at man skal ha en viss forståelse for ting, ikke en grunnleggende forståelse av veldig mye. En vanlig radiolog kan en del mer enn det som kommer frem i den forelesningen, men det er relativt få som kan så veldig mye om digital billedprosessering - det er et eget fagfelt.
Ellers synes jeg dette har lært meg hvor mye man kan lære av å komme i kontakt med andre miljø på universitetet.

APPENDIX G

Data retrieved from the system tracker

System Tracking: Web-Lecture Page

This appendix contains data concerning the use of the RadioWeb. Data was collected using the free tracker from eXTReMe (http://extremetracking.com/)

Summary		Period: 204 Days	
Daily Unique:		**Totals:**	
Today	2 / 23 Feb, Sun, 2003	Unique Visitors	570 - 76.71%
Yesterday	1 / 22 Feb, Sat, 2003	Visits incl. Reloads	743
Average	2	Reloads	173 - 23.28%
Highest Day	66 / 15 May, Wed, 2002	Visitors via Referrers	535 - 93.85%
Weekly Unique:		Website Referrers	46
Current Week	12 / Wk 08, 2003	Javascript Enabled	569 - 99.82%
Last Week	24 / Wk 07, 2003		
Average	12	**Most accessed:**	
Highest Week	73 / Wk 20, 2002	Browser	MSIE 5
Monthly Unique:		Operating System	Windows 2000
Current Month	56 / Feb, 2003	Screen Resolution	1024x768
Last Month	89 / Jan, 2003	Screen Color	32 Bit (16.7M)
Average	47	Searchengine	-
Highest Month	150 / May, 2002	Keyword	
Highest Hour of the Day	11:00 - 11:59	Domain/Country	.no / Norway
Highest Day of the Week	Wednesday	Continent	Unknown

UNIQUE VISITORS

Last 20 Months	Unique Visitors
Dec	1
Apr	3
May	150
Jun	51
Jul	13
Aug	31
Sep	24
Oct	52
Nov	53
Dec	47
Jan	89
Feb	56

GEO TRACKING

Domains / Countries		Unique Visitors	
.no	Norway	266	46.66%
-	Unknown	223	39.12%
.net	Network	58	10.17%
.com	US Commercial	9	1.57%
.fi	Finland	3	0.52%
.se	Sweden	2	0.35%
.it	Italy	2	0.35%
.arpa	Old style Arpanet	2	0.35%
.dk	Denmark	2	0.35%
.de	Germany	1	0.17%
.es	Spain	1	0.17%
.fr	France	1	0.17%

SYSTEM TRACKING

Browsers

Unique Visitors

MSIE 5	319	55.96%	
MSIE 6	220	38.59%	
Netscape 4	19	3.33%	
Netscape 6	5	0.87%	
MSIE 4	3	0.52%	
Opera 6	2	0.35%	
Netscape 3	1	0.17%	

Netscape 4.38% - MSIE 95.08% - Other 0.35%

Operating Systems

Unique Visitors

Windows 2000	195	34.21%	
Windows NT	152	26.66%	
Windows 98	118	20.70%	
Windows XP	85	14.91%	
Windows 95	15	2.63%	
Macintosh	3	0.52%	
Linux 2	1	0.17%	
Other	1	0.17%	

Windows 99.12% - Mac 0.52% - Unix 0.17% - Other 0.17%

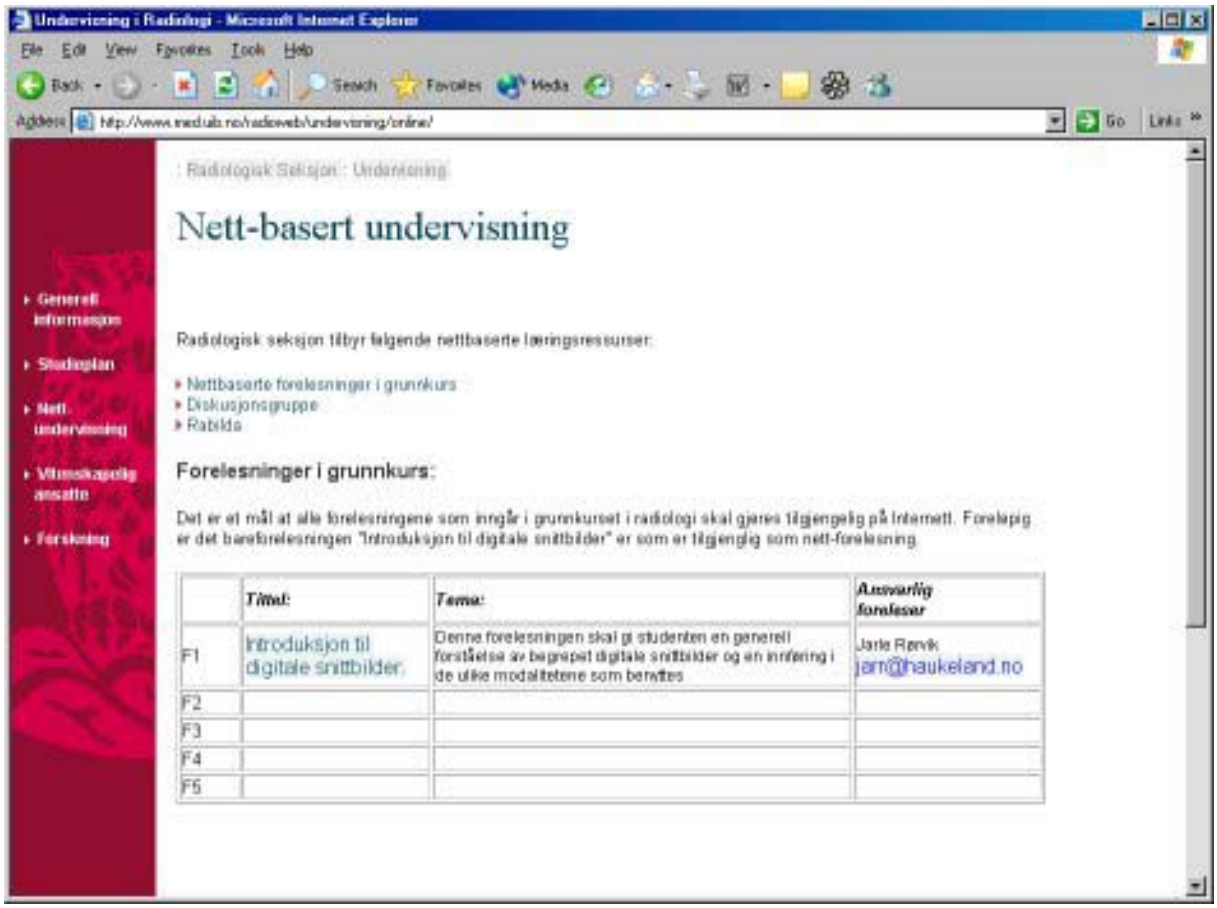
Screen Resolutions		Unique Visitors
1024x768	400	70.29%
800x600	92	16.16%
1152x864	42	7.38%
1280x1024	23	4.04%
Other	9	1.58%
640x480	2	0.35%
1600x1200	1	0.17%

Screen Colours		Unique Visitors
32 Bit (16.7M)	278	48.85%
16 Bit (65K)	244	42.88%
8 Bit (256)	23	4.04%
24 Bit (16.7M)	23	4.04%
Other	1	0.17%

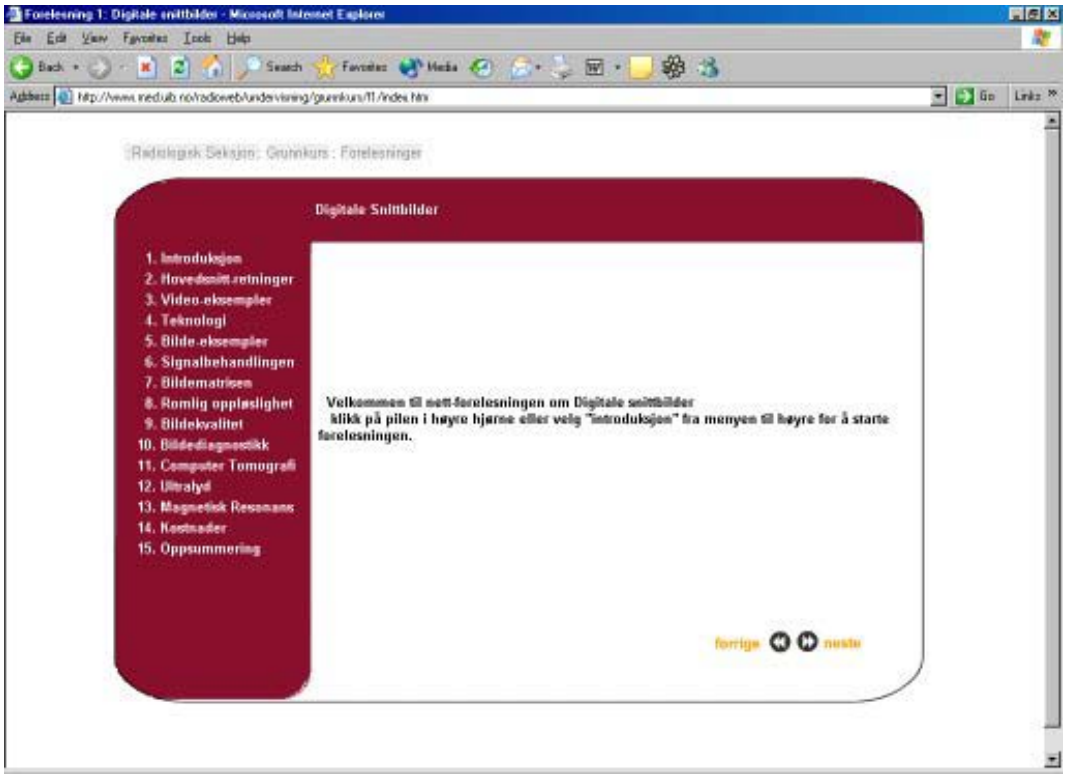
APPENDIX H

RadioWeb – The Next Generation

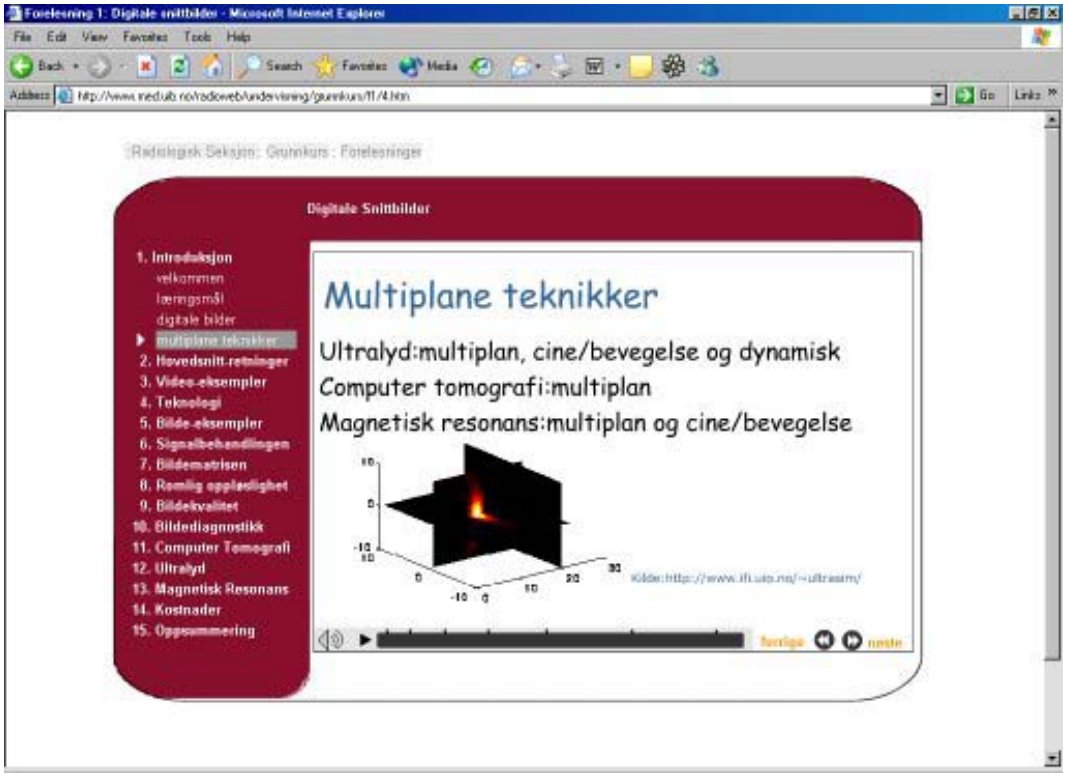
Screenshot 12. The new main page



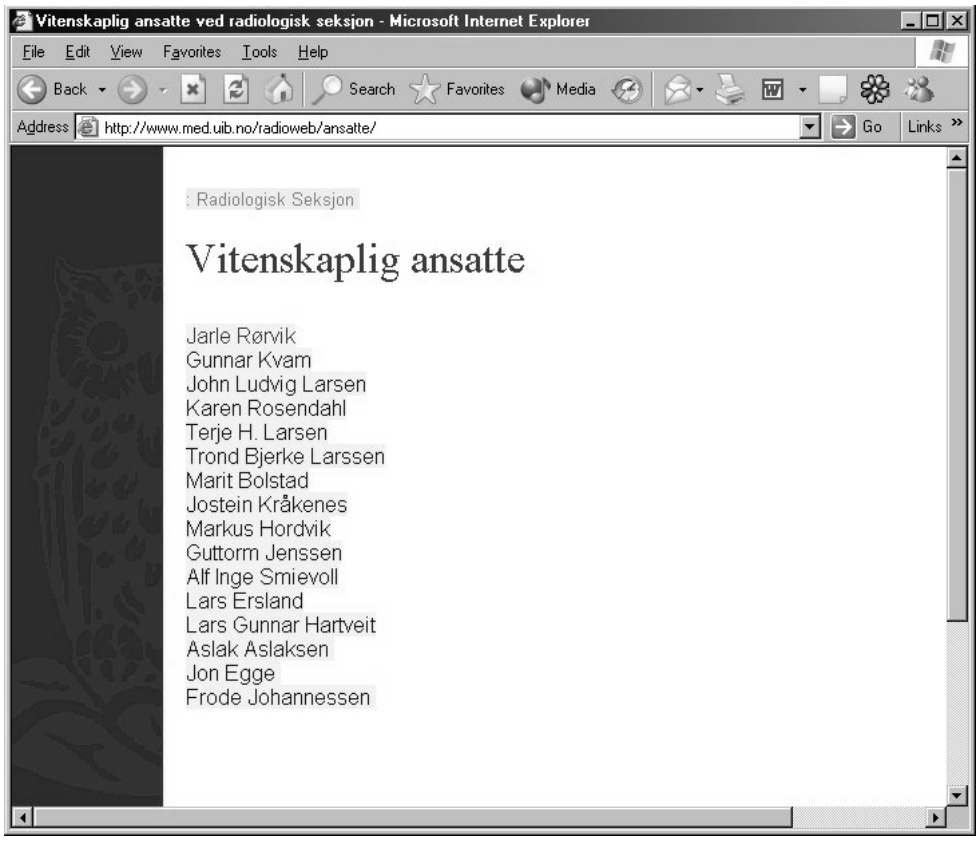
Screenshot 13. The new web lecture page



Screenshot 14. The new web lecture layout



Screenshot 15. The new web lecture layout with extended content menu



Screenshot 16. The new staff web site

Screenshot 17. Personal pages for faculty members