Technology Support for Teaching Health Care Quality Improvement

by

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We accept this thesis as conforming
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ABSTRACT

Use of technology in education seems a promising factor to improve students' learning. Most educational institutes have already invested or are ready to invest in educational technology. The School of Health Information Science, University of Victoria, British Columbia, is one of the pioneers of using technology in different courses in its program. This study investigated some aspects of introduction of technology, particularly Internet/CD-ROM based resources and digital video to improve students' learning and performance in a course for teaching Health Care Quality Improvement. Since the introduction of this course in the early eighties, it has gone through several changes. Since 1995, the instructor introduced experiential learning components in the course. The most important component was the addition of a project to the course. After several iterations of this project-based approach, video recording of all discussions and presentations related to the project sessions was started. This provided a basis for developing instructional material to further improve the students' success in their project. The implementation and assessment of this approach is the subject of this thesis. The author edited digital video clips and combined them with informative text and some questions to improve students' performance. These were arranged in a CD-ROM/Website by using video-streaming technology. In the most recent offering in the course (Fall 2000), this material was presented to the students. In order to evaluate the results, a questionnaire was handed to all the students in the class. The result of the questionnaire, students' comments and the instructor's self evaluation were the main sources of information for evaluation. The study showed that most of the students (70.8%) found the new

approach helpful to perform better in their projects and improve their learning. The distant education participant in this project also found the digital video very helpful. However, some students appear overpowered and their creative choices appear to become restrained by the power of the video material. In conclusion we believe that the new approach improves students' performance in their project on campus. The new approach also promises to be effective for distant delivery. However, there should be caution with the selection of material and the manner and context in which it is presented in order to prevent undesirable effects such as the adoption of ineffective approaches.

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Introduction

The development of new technologies has opened new avenues for teaching and learning. Regardless of the specific field of study these technologies can make positive or negative changes in both teaching and learning activities. Investigation of these changes helps to find approaches to positive use of technology for teaching.

This study evaluates the effectiveness of the attempts to improve a course on Health Care Quality Improvement (HCQI) in the School of Health Information Science. The School of Health Information Science at the University of Victoria (UVic) in British Columbia is the only institution in Canada that offers a degree in Health Informatics (HINF). The School had, therefore, to develop all of its course offerings and most of the supporting materials "from scratch"- i.e. without the ability to resort to a model. The effort described in this thesis is just one example among several other uses of innovative teaching approaches introduced at the School (Coward, 1989; Miller, Protti, Wright, & Guerriere, 1998; Moehr, Leven, & Rothemund, 1982). It explores the technology support of one course, which includes a realistic Quality Improvement project.

The study objective was to identify different aspects of technology support for the HCQI course. These include:

1. How do Internet/CD-ROM (Compact Disc-Read Only Memory) based resources impact the students' performance in their project?

2. What are the main effects (positive or negative) of technology support for HINF460 course?
3. What are the effects of Internet/CD-ROM based materials for distance education participants?
4. How does the current method of delivery of HINF460 meet the characteristics of the best practices of teaching?

Background

Health Information Science 460: Health Care Quality Improvement (HCQI)

The faculty of human and social development established the Health Information program in 1982. Professor Denis J. Protti was the new program's director. Other professors from different background joined the program such as professor Jochen Moehr who is a medical doctor with a Ph.D. in Medical Informatics from Germany, Dr. Walter Dietker, Dr. Ken Thorton, and Professor Gerhard Brauer. The program also has many adjunct professors from health care professions (Coward, 1988).

The school offers an undergraduate degree consisting of 40 courses and four cooperative education work terms, which leads to a Bachelor of Science Degree. The graduate studies in the school at the Masters or Ph.D. level are only by special arrangement with the Faculty of graduate studies. During the past twenty years the school accepted several students with different background for the graduate studies (The School of Health Information Science, 2001).

The mission of the School is "to improve health care delivery systems by educating individuals to be effective developers, users and managers of health information resources; by advancing knowledge through research; and by providing a consultative service to the health care community" (The School of Health Information Science, 2001).

The school's educational goals are the training of professionals with high capabilities such as problem solving, change management and with a good

understanding of ethical and sociological aspects of information technology (The School of Health Information Science, 2001).

Within general applied science and, in particular, Health Informatics there are challenges to not only convey knowledge of the pertinent basic sciences, but also to introduce basic skills for critical thinking and real life problem solving.

In order to meet these goals, there needs to be an interface between the teaching environment and the professional world. One of the approaches adopted by the School of HINF is to incorporate a professional project into an undergraduate course. The Health Care Quality Improvement (HCQI) course deals with health care quality improvement in a project-based approach.

The HCQI course provides an overview of the methodology for Continuous Quality Improvement (CQI).[1]

Course objectives are stated as learning:

1. The philosophy of CQI and TQM.
2. Implementation of methods of problem identification, selection and analysis.
3. Selection and monitoring approaches to remedial action.
4. Describing alternatives for the establishment of QI teams.
5. Functioning effectively as a member of such teams (Appendix B).

[1] CQI is a strategy to engage all personnel in an enterprise to continuously improve to quality of products and services. A related approach is Total Quality Management (TQM), which employs process control measures to ensure attainment of defined quality standards

Old approach

The HINF HCQI (HINF460) course has evolved considerably since it was first introduced in the early eighties. It was originally based on the Quality Assurance (QA) paradigm. QA emphasizes the monitoring of incidents, adverse reactions, etc., and attempts to achieve their elimination or conformance to acceptable levels of occurrence. Initially, the HCQI course was delivered in lecture format with occasional guest lectures from practitioners. While student course evaluations, as well as the grades achieved in midterms, final exams, and the term papers were generally satisfactory, they were not thought to be sufficient for mastery of this practice in the often challenging and fast paced health care environment. Consequently, at the beginning of the nineties the emphasis was shifted from the QA paradigm to that of TQM/CQI. Concurrently, with this shift was the realization of the advantages of the latter approach throughout the industry. Starting in the mid-nineties, a project component was incorporated in order to provide a more adequate representation of professional reality (Figure 1). The course has been offered to distant learners as well.

New approach

Since the adoption of the new approach in 1995, three major components have been incorporated into the HCQI (HINF460) course (Table1):

1. Lectures
2. Guest lectures
3. Project (practical component)

Since the early nineties, the core text for the course has been "Curing Health Care" by Berwick et al. (Berwick, Godfrey, & Roessner, 1990). This choice has been reconsidered many times and retained because of the engaging style of this book.

An increasing number of references on methodology (Gaucher & RJ, 1993; Leebov, 1991; Wilson, 1987) and group work (Campbell, 1998; Scholtes, Joiner, & Streibel, 1988) are kept on reserve for the class in the library. Additional references are provided in a literature list including many classics of the TQM/CQI literature (Deming, 1986; Juran & Gryna, 1988).

Lectures and Guest Lectures

Lectures cover principles of CQI and associated methodology. They are emphasized before the start of the project and continue concurrently with the project (see Table 1). The purpose of the lectures is to explain and exemplify different principles of TQM/CQI such as the scientific approach, customer orientation, and the comprehensive involvement of all stakeholders. Guest lectures are typically started in the second half of the semester. Guest lectures include coverage of the new role of the Canadian Council for Health Services Accreditation (CCHSA)[1] in health care quality improvement. Selected TQM/CQI practitioners are invited to explain their approaches to and experiences with quality improvement in health care.

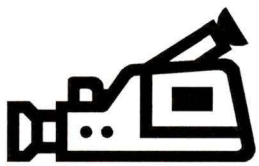
[1] The Canadian Council for Health Services Accreditation CCHSA is a non-profit, non-governmental organization; its primary role is to help health services organizations across Canada fulfill their potential. CCHSA objectively reviews the quality of services and compare them to a set of national standards. "The mission of the Canadian Council on Health Services Accreditation (CCHSA) is to promote excellence in the provision of quality health care, and encourage the efficient use of resources in health organizations, for the benefit of Canadians"(Canadian Council On Health Services Accreditation, 2001).

Figure 1- Course Evolution

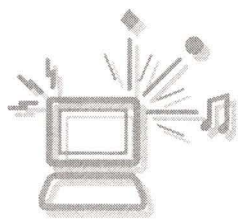
Frontal Lectures

1995 — Project-based Approach

1997 — Use of Observation Room



1998 — Use of Video Recording



2000 — Multimedia Material

The Project

The project component is the core of the new course and the principal component for introducing experiential learning. It involves the entire class in one quality improvement project rather than having different groups pursue different projects. This choice was made in order to achieve control over the quality of the work, ensure a more homogeneous learning experience, and in an effort to tackle more demanding projects, which would benefit to external health care institutions.

Didactic and practical considerations required an adaptation of the standard quality improvement approach. In order to achieve group sizes that are in accord with the recommended size for quality improvement circles (around 9 members), groups are formed within the class of around 30 students. The assignment of individuals to the group is done randomly in order to avoid gross differences in the competency of the group, which tend to result from free association of students. The students are complemented by CQI group members from the workplace, in which the project takes place. Ideally these are fully active CQI group members. More often, though, they act as "experts" for the problem area and are available as consultants for the CQI group, where students take the make active role. These role differentiations are influenced by the circumstances of the project and are difficult to maintain in a standardized fashion that matches ideal perceptions.

Different CQI groups are assigned to different phases of the project, such as problem definition, diagnostics, and remedial intervention. Both, random group

composition and assignment to successive project phases, are concessions to the didactic context, which contravene principles of CQI.

We currently use 4 groups for 5 phases:

1. Discussion of problem area and project scope involving the whole class,
2. CQI group 1: Problem Definition and Team Building,
3. CQI group 2: Diagnostics I,
4. CQI group 3: Diagnostics II, and
5. CQI group 4: Remedial Action.

The emphasis on diagnostics is based on the experience and assumption of the instructor that this is the most critical phase. Note that there is no "implementation" phase. This was deemed to fall outside the available time frame and competency and is therefore exempt from the responsibility of the students and left to the representatives of the work place with whom we collaborate.

The standard, fairly detailed course description, provided by the instructors of all courses in the School, is augmented by a detailed schedule for this course (see Table 1). This fixes the dates for lectures and their content, and those of project sessions, reporting sessions and guest lectures. Care is taken that the methods required for different phases of the project can be covered prior to the project "Quality Circle" sessions, which might make use of it.

Date 1999	Subject	Part			CQI	Meth	Team
W-Sep 8	Introduction, Organization, Quality, Personal Experience w. QA	A	B	C			
T-Sep 14	Definitions, History → QA, CQI, TQM in Health	■					
W-Sep 15	4 Stage Approach; Problem Definition; Information Acquisition: Observation, Interview, Questionnaire Creative Techniques	■					
T-Sep 21	**Project 0 (P0): Defining Project Scope (All groups)**	■					
W-Sep 22	Overview of Group work, reporting and presentations	■					
T-Sep 28	Teamwork	■					
W-Sep 29	**P1: Identifying & Selecting Problems**		■		**1**	**4a**	**4b**
T-Oct 05	Diagnostics, Analytic Techniques	■					
W-Oct 06	**C1: Reports & Critiques of P1**		■		1	4a	4b
T-Oct 12	PFDs, Ishikawa diagramming, Pareto diagramming	■					
W-Oct 13	**P2: Selecting Problems & Team Building**		■		**2**	**3a**	**3b**
T-Oct 19	Diagnostic Techniques & Validation	■					
W-Oct 20	**C2: Reports & Critiques of P2**		■		2	3a	3b
T-Oct 26	Remedial Interventions	■					
W-Oct27	**P3: Diagnostics**		■		**3**	**1a**	**1b**
T-Nov 02	Management of Change, Holding Gains	■					
W-Nov03	**C3: Reports & Critiques of P3**		■		3	1a	1b
T-Nov 09	Guest lecture: Linda Birdsall: QI Team & Technology Assessment			■			
W-Nov10	R E A D I N G B R E A K						
T-Nov 16	Guest lecture: Christine Penney: Quality Improvement, the CCHSA and Accreditation in Canada			■			
W-Nov17	**P4: Remedial Action**		■		**4**	**2a**	**2b**
T-Nov 23	M. Campbell: Dangers in the Practice of TQI/CQM in Health			■			
W-Nov24	**C4: Reports & Critiques of P4**		■		4	2a	2b
T-Nov 30	Questions for Exam, Course Evaluation	■					
W-Dec 01	**Final Summary Presentation**	■					

Table 1- A sample class schedule

(CQI= CQI group, Meth= methodology-critiquing groups, Team: Teamwork critiquing groups

A= Instructional lectures, B= Project work, C= Guest lectures)

The work is scheduled in such a way that each group has at least a week between a "Quality Circle" session and the previous and subsequent reporting sessions (Table 1). In this way, each group has at least a week for preparation of their "Quality Circle" session, and another for preparation of their report. In practice, groups tend to start preparing their "Quality Circle" sessions before the reporting

session of the previous group, e.g., by doing research on appropriate methods, by the collection of material or by collecting information from stakeholders. Likewise, involvement often continues beyond the report date, e.g., in the form of modification of a submitted work or provision of advice for subsequent groups.

In a newer attempt to improve the course delivery, an important part of the work is done in one "Quality Circle" session during scheduled class time, i.e., within a 90-minute time frame. All classmates observe the work of the "Quality Circle". For less obtrusive observation, work is done in an observation room. The rest of the class observes from an adjacent room through a one-way mirror and with the aid of two remotely controlled video cameras and two video monitors. In this way the perception of being observed is reduced for the project group.

Figure 2- CQI group in observation room
Around the table are three students and to the far right a representative from a health care institution.

Figure 2 shows one of the CQI discussion sessions in the observation room. Around the table are three students and to the right a representative of a health care

institution, which is the subject of problem for the CQI project. The reflection in the background and to the right result from the one-way mirrors hiding the cameras and the rest of the class.

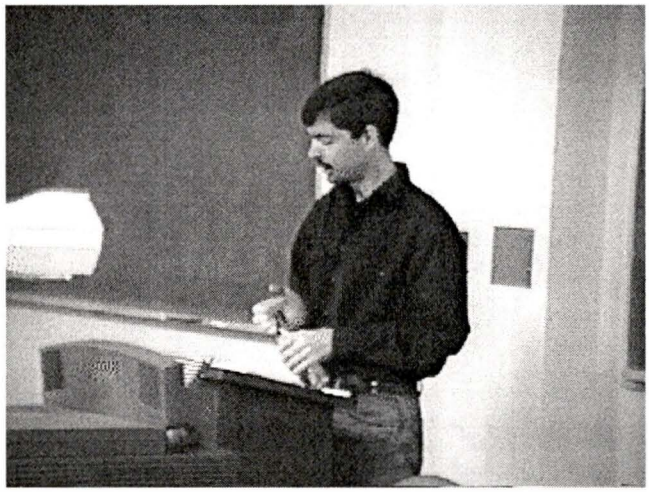


Figure 3- CQI group class presentation

One of the other groups is charged with critiquing the CQI group's teamwork and their selection and correct application of methods. Care is taken that groups are not critiquing the same group by which they were previously critiqued. The resulting team and methods critiques are presented with the report of the results of the corresponding CQI group.

All work is subsequently presented in class and documented in written reports (Figure 3). Three reports result for each project session: CQI project report, team critique and methods critique. The project work, presentations in class, and written reports are critiqued in writing and graded by the instructor. Grading is done independently of the students' assessments. All written output is made available to

the whole class on a LAN server. The students' output as well as written assessment from previous years is also made available.

The work of the CQI group during the quality circle session, and the presentations in class are video recorded. The video records are available to the class for review and analysis. These videos are also used for the production of edited video material to be used as an instructional aid in class and as an instructional aid for delivery of the course by distance education (see below).

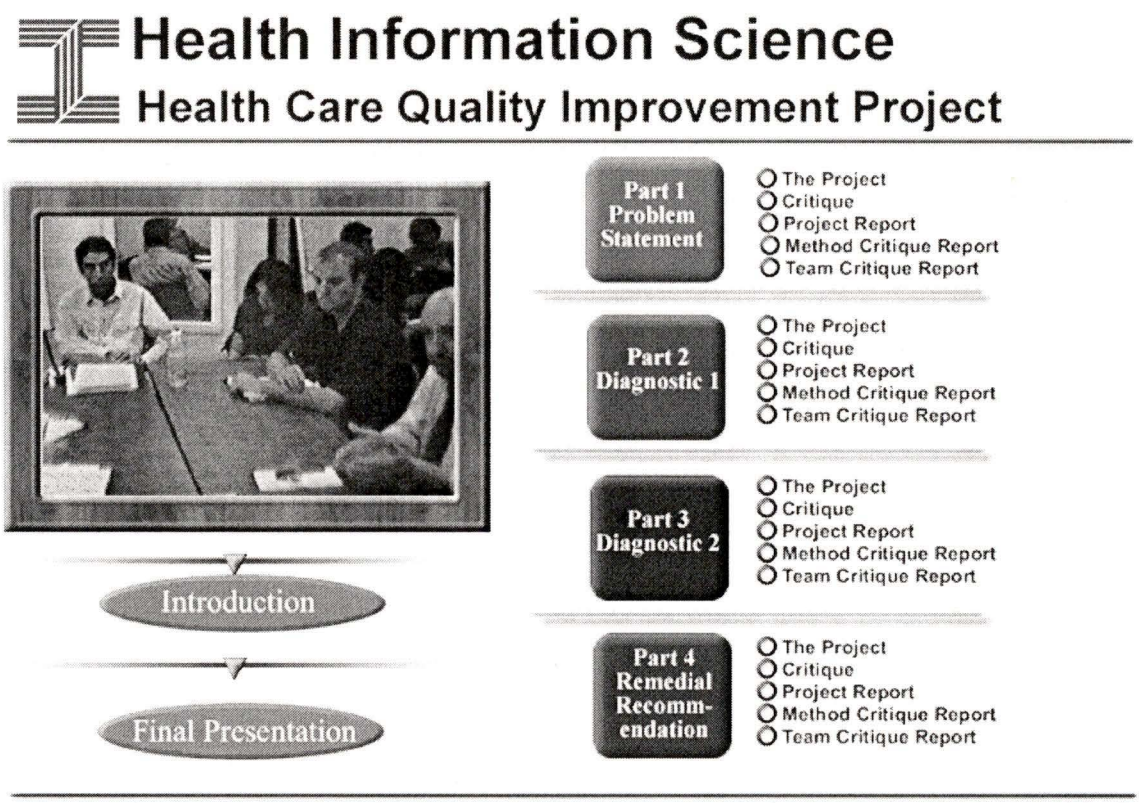


Figure 4- CD-ROM/Website Table of contents.

Clicking on the hyperlinks will lead to explanatory text with video clips and reports (see attached CD-ROM).

As previously stated, the project is the main component of the new approach. The course delivery relies on the availability of a suitable (preferably health care related) real world project, which is difficult to procure. This is because the health care quality improvement project has to meet a number of rather stringent criteria:

1. It has to be a project of interest to a health care institution. Since the University of Victoria does not include a health care or health sciences faculty, the collaborating health care institutions, are external to the university.
2. The scheduling of the project must be compatible with the scheduling of the course, which is currently placed in the fall term, September to December of every year.
3. The project can neither be too trivial, nor too complex for the students involved.
4. The work of the students must get the consent of all stakeholders involved.
5. Ideally, there should be organization's willingness to make personnel available to participate in the project.

The selection of projects is therefore primarily opportunistic. It initially proved difficult to find collaboration from health care institutions. So the first four CQI projects were tackling problems within the School rather than in external health care institutions. The projects conducted so far, have addressed improvement of the following problems and processes:

1. The placement of students in Co-op work terms within the School.
2. The quality of teaching at the School.

3. The management of work load in courses within the School.
4. The electronic communication among students, staff and faculty within the School.
5. The high incidence of musculo-skeletal injuries in nurses aides in regional long-term care facilities.
6. The documentation of services for billing purposes in regional long-term care facilities.

The project's characteristics are difficult to meet, so it is possible that there is no project available, and the course would have to be taught without a project. Since the students in the course produce ample written output, it becomes possible to use output of previous courses as a substitute for a real project. For instance the choice of methods and some aspects of team collaboration can be assessed on the basis of written output produced by previous projects. This has been done twice in the case of students who had to take the course in distance mode. Based on the assessment of the course instructor, according to the grades achieved by the students, and according to the evaluative comments, it was reasonably effective (Moehr, 1998-2000). Since the introduction of video recording of the project sessions, it became further possible to use video-recorded material from previous group sessions as a more realistic substitute for a project. Furthermore, this material is suitable as substitute for a project in class as well as in distance mode. This approach was taken in the course of a distance mode student during the academic year of 2000-2001. Again, all measures of success were very positive (see below).

Another problem of the course is the initiation of active work by students. According to the instructor, students sometimes thought they were required to "role play" rather than apply themselves to determining a real solution to a real problem (Moehr, 1998-2000). Students do not necessarily know how to prepare or what to prepare for; therefore, it is highly desirable to provide examples. Again, these can be taken from the material recorded during previous courses. In 1999, for example, this has been done based on the material collected in 1998 and in 2000 on the basis of material from1999.

Review of literature

Part1- Learning theories

The spectrum of learning theories

There are many theories about learning. Two extremes of are represented by behaviorism and constructivism. These are discussed in more detail below.

Behaviorism

Among the theorists associated with behaviorism are J.B. Watson, E.L Thorndike, and B.F Skinner (Forrester & Noel, 2001). Thorndike believed that learning happens gradually as a result of establishment of successful responses to a stimulus (Thorndike, 1971). Traditional teaching is mainly influenced by behaviorism (Forrester & Noel, 2001). Other examples of behaviorist influence are "the use of exams to measure behavior of learning and the use of rewards and punishment in the school system" (Forrester & Noel, 2001).

Don Tapscott in his book "growing up digital" addresses behaviorism in a different way: "Broadcast Learning", which is based on instruction in which a teacher (or expert) transmits or broadcasts the information to the active memory of the students (Tapscott, 1998). The broadcast media are lecture, textbooks and assignments, which are "one-way, centralized, and with an emphasis on predefined structures that will work the best for the mass audience". The broadcast approach has been the major approach in teacher-centered education, which goes back a long time (Tapscott, 1998).

From a behaviorist point of view, Computer Assisted Instruction (CAI) is a "prominent tool" for teaching. In simple terms, CAI presents the learner with a problem or question and assesses the response given by the learner. Depending on the

assessment, the next problem or further explanation or instructions are provided. The question is acting as the stimulus, which makes the user to give an answer, and the user gets the results, which may be a reward (Forrester & Noel, 2001).

Constructivism

The constructivist theory of learning introduces a different paradigm that emphasizes learners' ability and motivation to construct learning (Forrester & Noel, 2001). Famous theorists in constructivism are John Dewey, Lev Vygotsky, Jean Piaget, and Seymour Papert (Forrester & Noel, 2001). The principles of constructivist pedagogy are summarized in four principles by Jacquelin and Martin Brooks"(Brooks & Brooks, 1993):

1. Posing problem of emerging relevance to students.
2. Structuring learning around a primary concept.
3. Seeking and valuing students points of view.
4. Adapting curriculum to address students' suppositions.

Introduction of digital media to the education area has the potential to facilitate the change from the behaviorist approach to the constructivist approach (Tapscott, 1998).

A comparison between the two paradigms

Tapscott believes that by using digital media, educators and students can shift to an interactive active learning environment. Through this shift he believes there are a number of changes: "from instruction to construction and discovery", "from teacher

centered to learner centered", and "from one-size-fits-all to customized learning" (Tapscott, 1998).

Jacqueline and Martin Brooks point out the following difference between the traditional (behaviorist) and the constructivist classrooms:

In a constructivist classroom the pursuit of questions is valued, while a fixed curriculum is valued in a traditional classroom. The activities in a traditional classroom are mainly based on the textbook. In a constructivist classroom these activities based on the resources which are more flexible than a textbook and based on the subject of the activity and could be changed by the students. In a traditional classroom in order to validate learning the teacher looks for the correct answer while in a constructive classroom the "students' point of view" is more important. In a traditional classroom the emphasis is on individual work. The constructivist classroom encourages group work (Brooks & Brooks, 1993).

Part 2- Technology support for teaching

Instructional technology

Educational technology involves different people, procedures, ideas and devices in a complex and integrated process to devise, implement and manage problems in the area of human learning. The meaning of technology is beyond hardware. In other words, any reliable technique or method for engaging learning could be considered as technology (Ely & Plomp, 1996).

Use of Internet/CD-ROM in support of teaching

Technology should not only be used as a delivery vehicle, but also as a tool for engaging learners, facilitating thinking, knowledge construction, and representing learners' ideas. Technology can facilitate the process of learning by doing and defining "a safe, controllable problem space for student thinking" (Jonassen, Peck, & Wilson, 1999). It is important to remember that "the aim of education is not technology, rather technology is a tool to facilitate the learning process" (Jonassen et al., 1999).

C. J. Bonk (1998) has investigated possible use of the Internet in traditional courses. He introduced a ten-level model to integrate traditional courses and the Internet.

At the first five levels, in Bonk's opinion, the Internet acts as an information source or a place to share resources and is not the major component of a course. At level 6 and 7 students get grades according to their work on the Internet. At the last three levels the Internet plays a central role within the course. The difference between the last three levels is based on the location of the students or institutions. These are the ten levels:

Level 1- Marketing/syllabi via the Internet.

Level 2- Student exploration of the Internet resources.

Level 3- Student-generated resources published on the Internet.

Level 4- Course resources on the web.

Level 5- 'Repurposed' Internet resources.

Level 6- Substantive and graded web activities.

Level 7- Course activities extending beyond class and on the Internet.

Level 8- Web as an alternative delivery mechanism for on-campus students.

Level 9- Entire course on the Internet for students located in different locations.

Level 10- Course fits within larger programmatic Internet initiative (Bonk, 1998).

Obviously, the Bonk's model can support behaviorist as well as constructivist approaches.

Steps for transferring course material to CD-ROM/Internet

T. King (1998) has proposed different steps to prepare "polymedia-teaching" materials for use in Internet/CD-ROM based courses (King, 1998). The following is a brief review of her work:

Model selection

Model selection is the first and most important step; it is equivalent to strategic planning in an organization. Model selection identifies activities and tools that are needed in the preparation of course material. It is important to clarify the purpose of using the multimedia for the teaching approach.

Content and material selection

This step is the main factor for success of an Internet/CD-ROM based course. Transferring from a traditional to a technology-supported course is not simply a matter of changing the format of material to digitized or electronic deliverable media. It is a matter of designing a new course for a new approach based on the traditional

course. The model selection and the purpose of the course have a direct influence on the contents. It is important to consider the audience of the course as one of the factors in the material selection. In some cases, it is useful to get input from the audience regarding what they would like to see in the teaching material.

Media construction/preparation

Text

Text should be changed to a standard electronic format. One possible option is word processor compatible files, which is preferable if a limited amount of text is presented. The most desirable formats are web browser compatible pages (e.g. Hyper Text Markup Language (HTML) or Portable Data Format (PDF). Choice of color, text size, and linking objects through the hypertext are other factors, which may affect the user satisfaction/participation.

Images

The original material usually contains black and white images. These images should be scanned and whenever possible color filled using image processing software. For new material, it is highly recommended to create full color and highly detailed images and add them to the HTML pages.

Video/Animation

Motion pictures in addition to still images offer a further complement to teaching material. Connection speed or user's bandwidth may be a big issue for using video on the Internet. Currently the best available technology for video delivery is streaming. It brings the possibility of using longer videos with little or no download delay.

If video material is previously recorded, there are usually a few changes necessary: editing and adding effects, noise filtering, and color or image correction.

Methods

Technology support for the HCQI course

Use of educational aids such as overhead, blackboard and general-purpose technology such as telephone and email were part of initial attempts to support teaching quality improvement in the HCQI course. The metamorphosis of the old to the new approach and the addition of the project component to the course created new problems, which enticed us to use new techniques for improvement of the project component. Use of observation room, recording of CQI sessions, and offering of recorded videotapes for preview, were part of attempts of improvement.

In the latest approach for further improvement our goals for technology support of the HCQI course include:

1. To develop video clips that can be offered as streaming video or via CD-ROM and can be used: (a) as a model for future classes, or (b) as a basis for problems to be solved in the absence of a project and for distance education.
2. Development of project related texts from existing student reports and critiques, and instructor feedback.

Both approaches are in support of the project as the central new component of the course.

Description of setting and participants

To run this project, we needed computer-based teaching material to use in the classroom.

A collection of the video clips collected in previous realization of the course was transferred into digital format. Related informative text and questions for further discussion were added to the clips and organized into several web pages with links to these clips. These clips demonstrate previous students' performance in project work and in presentation, thereby setting a benchmark for performance for current students. To reduce the effects of bandwidth limitation, the first version of the material has been organized both on a CD-ROM (for users with slower Internet connections) and on an Internet server. It has been used during the last offering of the course during the year 2000. Students were exposed to good examples of performance to emulate as role models. Strategies that were not as effective are used as examples of approaches one should avoid.

The author had himself taken the course in the Fall of 1999, and attended the use of the material in the realization of the course in 2000 as an external observer. His experiences were helpful during the process of editing and choosing video clips for the new complementary electronic material.

Part1-Constructive components

The idea of using multimedia in computer-aided education started in the early 90's when CD-ROM was introduced in the marketplace. The spread of the Internet brought the idea of using multimedia in Internet-based educational offerings. Multimedia includes text, audio, graphics, video and animation. The need for downloading multimedia components, which are usually big files, limited the use of these important tools in network based training material. Progress in the networking technology and specifically the use of streaming technology opened a new era in the delivery of multimedia instruction via the Internet.

In order to make deliverable material, analog recordings of video and audio have to be digitized. Digital recording media (e.g. digital camera, digital recorders) are available, but streaming technology does not yet support such input. This is accomplished through specialized hardware devices, which are now available for personal computers.

For the work at the School of HIS we chose the following components:

1. Digital and analog cameras.
2. Osprey 100® capture card.
3. Real Producer® software.
4. Adobe Premiere® 5.1 video editing software.
5. A Windows NT®-based Pentium III® platform.

One of the important advantages of video streaming or CD-ROM based video is the elimination of downloading.

A combination of streaming technology and new compression methods has added the ability to deliver longer video clips such as lectures or presentations on the Internet/CD-ROM. It is also useful for live delivery of video or audio. Unfortunately it is not yet an interactive solution for live lecture delivery on the Internet since the current streaming technology tools are similar to radio/TV broadcasting.

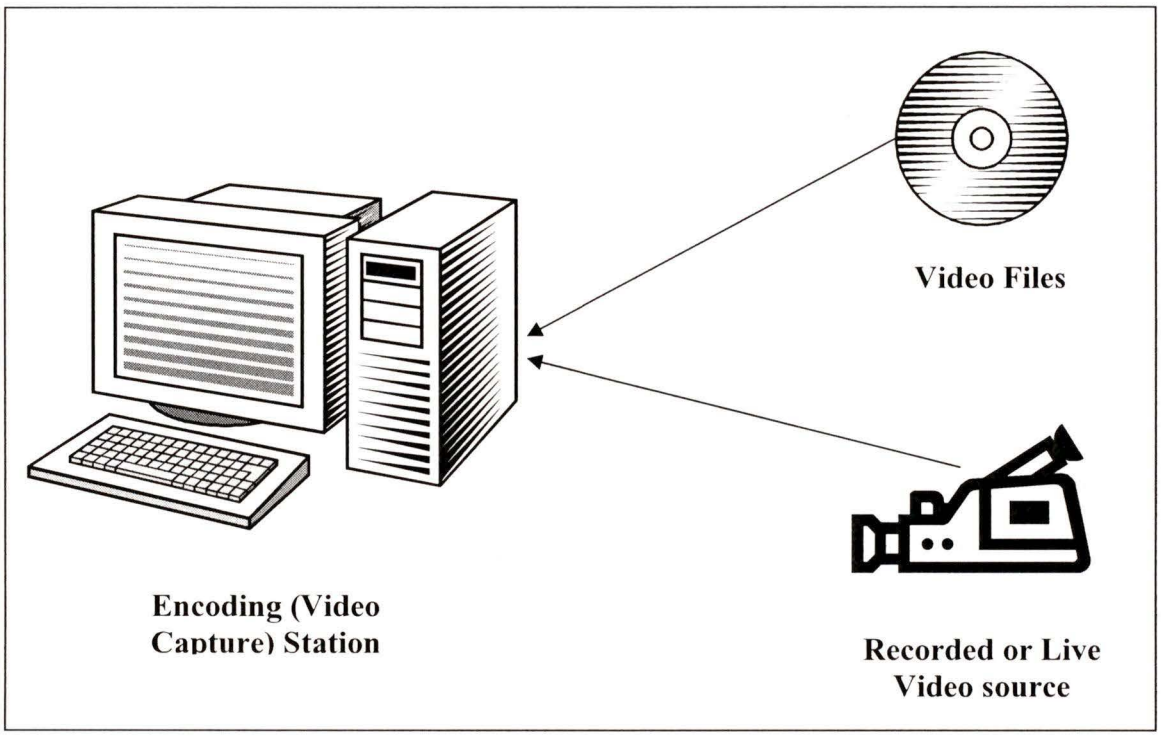


Figure 5- A simple video capturing setup

Figure 5 shows a schematic picture of a video capturing station. In order to make a stream of video/audio it should be changed to a deliverable digital format. For example RealMedia® is a system, which uses a highly compressed format to make streamable media.

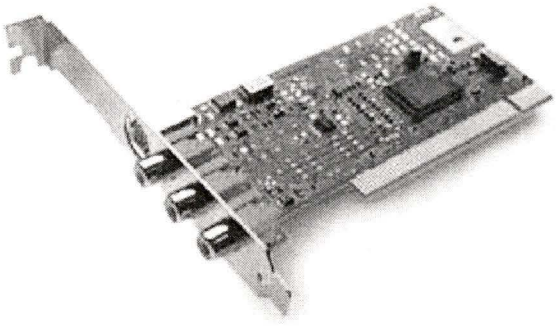


Figure 6- Osprey® 100 capturing card

Figure 6 shows a picture of Osprey 100®, which is the industry's de facto standard for many providers of video content. It is the selected card by Real Networks and Microsoft. It enables software encoders of both companies to produce high quality video (ViewCast Corporation, 2000).

The streamable media can be sent to a streaming server, which supports different video streams simultaneously for different users. The ability of server hardware and software is an important issue in streaming technology. Another important factor is having different streaming media according to users' network

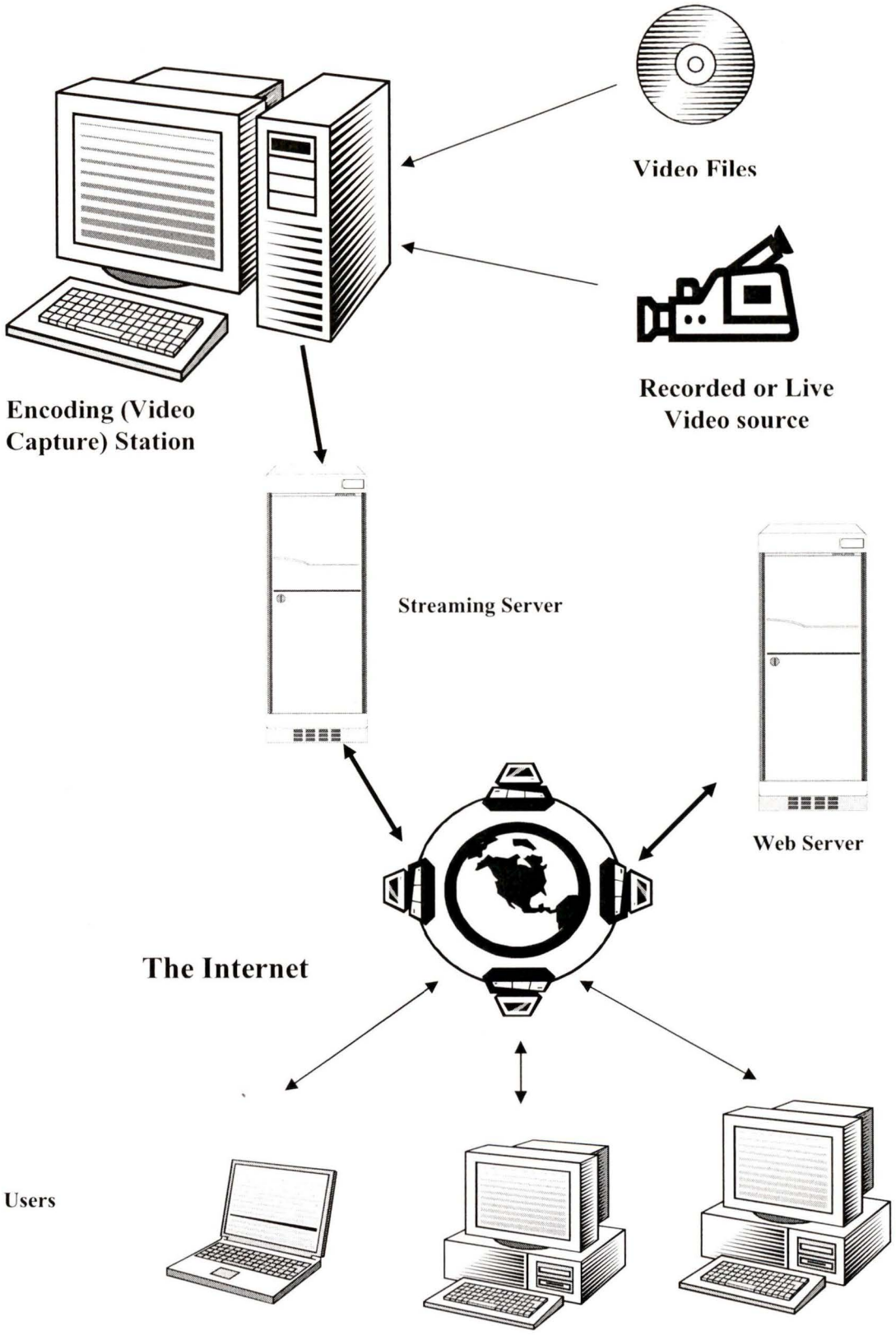


Figure 7- Schematic streaming server setup

connections. It will give the user the freedom of choice between better quality and higher speed depending on the bandwidth of the users' Internet connections. Figure 7 depicts a schematic setup of a streaming server.

Model selection

Among the ten levels of Internet integration for delivery of a traditional course, a mixture of level 3, 4 and 5 seems appropriate to improve the HCQI course. At level 3 students' output is posted on the Internet. At level 4, Internet resources and students' resources such as lecture notes, PowerPoint® presentations, etc., are made available on the Internet. At level 5, students' work is posted on the Internet for use of other students (but not for all the Internet users). The effort was to make the material as interactive as possible and make the students think critically. Most of the efforts to improve the HCQI course since 1995 has been done in order to make it more student centered and shift part of the responsibilities to students and make the instructor more as a facilitator.

Content and material selection

A selection of video clips and printed output from previous classes, demonstrating "good" as well as "poor" examples of

1. Preparation
2. Methods selection
3. Group interaction
4. Critiquing, and
5. Presentation in class

was prepared and provided with context to serve as an example, or as a substitute for a project observed in the real world in order to exercise methods and team work critiquing.

Media construction/preparation

Summary of development efforts

The activities for development of material for this course included editing of reports, review of all video records and selection of scenes for instructional purposes. Editing and formatting of the reports took about 20 hours of an editor's time. Enforcing stricter standards for reports can reduce this effort in the future. Preparation of the video editing required approximately two months during which approximately 100 hours were spent for reviewing literature, and vendors' material and ordering and installing hardware and software. Twenty hours of recorded videos were reviewed several times to identify appropriate video scenes (100 hours). The editing of the selected scenes took approximately 150-200 hours. Development of the HTML pages for the CD-ROM and the web server proceeded through several iterations, totaling another 150 hours approximately.

Routine work of this kind would be more economical because the learning period could be eliminated, although a certain amount of ongoing research would be required.

In the present exercise it was a great advantage that the author and editor had participated as a student in the class effort that had been recorded.

In the meantime, another student who had not been part of the class and who therefore required an orientation with the material, has edited one of the four phases of the subsequent class. This effort amounted to 100 hours. It can therefore be safely

assumed that the total effort under routine condition would be in the order of 400 hours for a project of this type.

CD-ROM based material

For a variety of reasons we decided to choose CD-ROM as our main method of delivery of material. These included: unreliable Internet connection, which is most of the time out of control of the users or the University personnel, low bandwidth of users' Internet access, and the fact that the streaming server at the University is under development. In fact the current streaming server can only handle twenty-five concurrent streams and it is extremely slow. Fortunately the size of our site was less than the capacity of a CD-ROM. Each group of students as well as interested individual students was given a copy of the CD-ROM. (see attached CD-ROM).

Part 2- Analytic components

Evaluation techniques

Evaluation has been described as a tool that provides feedback for continuous improvement. This part describes different techniques for collecting information in order to evaluate the instructional process. According to the primary sources of information, the techniques are in three different categories: Information from students, information from colleagues and information from the instructor (Newby, 1996). In our approach, we decided to use the students and the instructor as our primary sources of information and we left information from colleagues for the future.

Rationale

Study of the effects of the introduction of the new technology to classroom on students' performance and learning is an important factor for effective usage of instructional technology. Investigating Students' experiences with technology makes it possible to have a better understanding of results of our new teaching approach. This requires qualitative and quantitative methods.

Our approach includes:

1. evaluation of the subjective experience of the students, on the basis of written narratives and responses to questions and observation of their video recordings and researcher's notes
2. evaluation of the performance of the students by instructor, and
3. self evaluation by the instructor

Sample

To have a better understanding of students' opinion we used the whole class as our sample. There were 29 students in our class. We also included one distance education student in our study sample. The distance education student was not presented with the questionnaire but invited to comment in free text regarding the learning experiences with a considerate three-page letter.

Information from students

1. Marks: Instructors mainly base their evaluation on different kinds of written or oral tests. Seeking the help of another person in the evaluation of students' knowledge would make the results more reliable (Newby, 1996). The method of evaluation, for example objective or subjective approach, influences the result of

the evaluation. We also reviewed students' marks over the course of different years of delivery of the HCQI course.

2. Questionnaire and comments: Time limitations made us to do only a "test run" or experiment in which a small group of students were exposed to the new technique before large-scale usage. Although not necessarily able to assess all possible effects of a new approach, it is able to serve as a direct test of a hypothesis and helps to identify potential problems in the instruction method (Newby, 1996). We used the Internet/CD-ROM based material in our class during the fall of 2000 to explore students' experiences, and assessed this experience using a questionnaire (see appendix A). The questionnaire consists of 19 questions. The first 9 questions concerning our use of the technology and were devised by the author, they were then discussed with the supervisor and fellow students and modified as indicated by the responses. A three point Likert-scale was chosen to categorize the answer options in order to decrease the effort for respondents. The second part of the questionnaire included 10 questions covering biographical, ability and personality characteristics taken from the publications of Doyle (Doyle, 1983).

Information from instructor

At the School of Health Information Science of the University of Victoria, instructors are routinely required to provide a self-assessment of their teaching. This includes a review of the courses' goals, objectives and instructional approaches, as well as their perceived effects, and implemented as well as anticipated or recommended changes to the course. The self-assessments provided by Dr. Moehr the

current instructor of HINF460 the HCQI course, are the basis of the information from the instructor used here.

Instructors review different available instruction materials, as well as their previous work to identify best choices for their new approach. A comprehensive preview helps to understand which part of the material is useful to gain the specific goals in the process of teaching and learning. (Newby, 1996) Instructors also can think about the instruction material and try to identify different areas, which need special attention or improvement. It happens both during and after implementation of instruction techniques. An instructor may try to adjust the new approach during the period of observation (Newby, 1996). Instructors also observe students' interaction and performance and based on their observation instructors can evaluate themselves.

Human subject protection

All students in 1999 and 2000 class have signed a form for being videotaped (see Appendix C). Because the evaluation was considered consistent with the usual practice of anonymous evaluation of the courses at the University of Victoria (University of Victoria, 2000), we received a waiver for ethical review from the ethical review committee at UVic. In order to keep students' confidentiality, all the assigned grades had been removed before being made available for this study.

Results

Part 1- Experiences with technology

Using new technology gives the researchers new experiences about the strengths and weaknesses of each technology. Providing this information could be helpful for other researchers who are working in the same field. The following part discusses the researcher's experiences in choosing and implementing the hardware and software used in this study.

Hardware

1-Computer system: Choosing an appropriate computer system in the fast changing environment of hardware industry is not so easy. After several weeks of research and consultation a Windows NT®-based 500 MHz Pentium® III was chosen for the project. Because Windows 2000® didn't support some of the hardware at that time, Windows NT® was the appropriate operating system. The system was equipped with a fast SCSI[1] hard drive with 10000rpm for the best capturing speed. Because of the budget limitations the hard drive capacity was only 10 GB which was a problem for

[1] "Acronym for Small Computer System Interface. Pronounced "scuzzy," SCSI is a parallel interface standard used by Apple Macintosh computers, PCs, and many UNIX systems for attaching peripheral devices to computers. Nearly all Apple Macintosh computers, excluding only the earliest Macs and the recent iMac, come with a SCSI port for attaching devices such as disk drives and printers. SCSI interfaces provide for faster data transmission rates (up to 80 megabytes per second) than standard serial and parallel ports."(INT Media Group Incorporated, 2001)

capturing longer video clips. A fast graphic accelerator with 32MB of memory and AGP[1] interface was chosen.

2-Capture card: As mentioned before Osprey® 100 was chosen as the capture card. Some of the reasons for choosing this card are as follows:

- It was the recommended capture card by most companies.
- The price was reasonable.
- Another project with the same capture card had been successfully finished the TV services at UVic.

Software

1- Video editing: For video capture and editing Adobe Premiere® 5.1 was chosen. Adobe Premiere® perfectly fulfilled our needs since it has a user friendly interface and it has a wide range of capabilities which in fact we didn't use many of those for this project. While capturing there is no way to monitor the process of capturing. An extra monitor or TV set is needed to control the input video. During the project, for an unknown reason we were not able to capture more than 5 minutes. We reinstalled the program and in another attempt we reinstalled the whole operating system but didn't help. One possibility is conflict between different programs. In conclusion, Adobe Premiere® seems to be a good choice for low budget video editing for a professional quality.

[1] "Accelerated Graphics Port is an interface specification that enables 3-D graphics to display quickly on ordinary personal computers. AGP is an interface designed to convey 3-D images (for example, from Web sites or CD-ROMs) much more quickly and smoothly than is possible today on any computer other than an expensive graphics workstation."(TechTarget.com Inc., 1999)

2- Video compression/Video Streaming: for this project as mentioned before RealNetworks® products was used. First reason for this choice was the availability of a RealNetworks streaming server® at Uvic. In order to put the video clips on the Internet, having a video-streaming server is essential. But that was not the only reason. In fact RealNetworks® offers the most compressed form of video compression software which was also useful for the purpose of CD-ROM version of the web site. The availability of demo version with most of the complete version options was another reason for this choice. The downside effects of using demo software were the lack of technical support and expiration of demo versions and the need to downloading the software again.

3- Web page design: A combination of HTML coding and Netscape® Composer was used at the beginning of the project. HTML coding like any other programming language takes more time but the programmer has the freedom of choice. Netscape® Composer has the basic options to build a web page. The program interface is easy to follow and it is faster than HTML coding. Some minor coding is needed while using Composer since it doesn't keep the relative links to the actual web site. It keeps all the links to the computer that is originally the web page built. Later in the project Macromedia® Fireworks® and Dreamweaver® were chosen as substitutes. Fireworks® is a high quality graphic program designed for web page publishing and building amazing pictures and graphic effects. Dreamweaver® is the complement program to manage web sites and building professional web pages. Both programs were helpful to build high quality web pages in a short time. Since they have many (sometime complex)

capabilities the learning time was long and sometimes the manuals are not helpful. Tutorial programs were not as helpful as they promised.

Part 2- Evaluation results

Information from the students

1. Students' marks: The following table shows average grades students' achieved in their project work during 1997-2000.

	1997	SPRING 98	FALL 98	1999	2000
Group 1	84.67	91.67	86.00	79.17	85.83
Group 2	79.33	84.50	92.83	84.00	92.17
Group 3	83.00	88.17	83.67	86.67	78.00
Group 4	85.67	90.17	92.17	83.17	85.17
Average	83.17	88.63	88.67	83.25	85.29

Table 2- Students' marks

As the table shows, there is no significant difference in students' marks in several years.

2. Questionnaire results: The questionnaire that was used to collect students' responses is shown in Appendix A. Out of 29 class participants 24 students (83%) filled out the questionnaire; among questionnaire respondents 37.5% were female students. 71% of respondents were between 20-24, and the rest were 25-40 years old. 70 % of participants were in their third year of study and 25% in the fourth year. Table 3 shows the distribution of answers obtained in the first part of the questionnaire (Appendix A):

Question*	Agree	No Opinion	Disagree	No Answer
CD/Internet-based Video material met students' need for project completion	62.5%	29.2%	0	8.3%
CD/Internet-based Video material led students to wrong choices	25%	33.3%	37.5%	4.2%
CD/Internet-based Video material narrowed students' perspective of available methods	37.5%	37.5%	20.8%	4.2%
CD/Internet-based Video material was helpful for preparation of observation room CQI sessions	70.8%	20.8%	8.3%	0
CD/Internet-based Video material improved students' learning in the course	54.2%	33.3%	8.3%	4.2%
The VHS video tapes were helpful for preparation of class presentation	50%	37.5%	8.3%	4.2%
Watching the observation room VHS tapes improved students' learning in the course	62.5%	20.8%	12.5%	4.2%
The new approach of using VHS and CD/Internet based video was useful and improved students' learning	70.8%	20.8%	4.2%	4.2%
The printed output from last year was useful for students' work	79.2%	16.8%	4.2%	0

Table 3- Questionnaire results

(*For exact formulations of questions consult appendix A)

Our questionnaire probes for positive as well as negative effects of the Internet/CD-ROM based components that we had introduced in attempt to support the project work. The results summarized in table 3 show that while there were substantial positive effects- as anticipated and intended- there were also some effects that one would want to avoid.

As the first row of the table shows, none of the participants were in disagreement with the positive effects of CD-ROM/Internet based video material for

project completion. In fact, 62.5% were in agreement about positive influence of CD-ROM/Internet based video for their project preparation. The majority of students agreed that the video material on the CD-ROM/Internet helped them in their project (62.5%), in the preparation for the observation room sessions (70.8%) and, in general, improved their learning in the course (54.2%). Only 8.3% of students disagreed with the CD-ROM/Internet based material having a positive effect on their learning. The same pattern surfaced, with a little lower agreement, for VHS material, i.e. the unedited video recordings produced during the current project. Only half of the students found the VHS video recordings helpful for preparation of class presentations; however, 62.5% find VHS recordings helpful in their learning. It is noteworthy, however, that 25% of students believed that the edited CD-ROM video material gave them a wrong example. But obviously the majority of participants either disagreed with this effect or had no opinion. Another important aspect is that 37.5% of the students believed that the video material narrowed down their perspective. 70.8% of students believed that the new approach was useful and improved their learning in the course. Finally the usefulness of printed material was also confirmed by almost 80% of students.

Tables 4 to 9 show the data collected through the second part of the questionnaire. Based on table 4, the majority of self reported class grades (75%) are in the A's and B's range. Most of the students were expecting to be awarded grades similar to those they received in other academic studies (75%); in contrast, almost 21% of the students believed that they would get a better grade than in other courses, none expected a lower grade.

	Almost all A's	Mostly A's & B's	Mostly B's & C's	Mostly C's & lower	Not answered
Students Typical Grades	8.3%	75%	12.5%	0	4.2%

Table 4- Students' typical grades

	Higher than usual	About the same as usual	Lower than usual	Not answered
Grade expectation	20.8%	75%	0	4.2%

Table 5- Students' expectation about their grades

Tables 6 to 8 depict students' attitudes when things are "out of control", their attitudes towards the HINF program, and how they describe themselves.

	Very uncomfortable	Uncomfortable	Comfortable	Very comfortable
Students' attitude when things are "out of control"	16.7%	41.7%	37.5%	4.2%

Table 6- Students' attitudes when things in life are "out of control"

According to table 6, almost 58% of students experienced uncomfortable feelings when things in life are "out of control", while almost 42% consider theirselves to be at ease in such situations.

	Very negative	Negative	Positive	Very positive
Students' overall feeling about HINF	0	8.3%	54.2%	37.5%

Table 7- Students' overall feeling about the school

Based on the Information in table 7 the majority of students (91.7%) had a positive attitude about the School of Health Information Science and/or the program they were enrolled in.

Student describing themselves	I enjoy school; I'm persistent and want to do my best.	I find school boring, futile; I prefer to be by myself.	I'm very energetic, a "driver"; I enjoy pressure.	I hate pressure; I try to avoid confrontations.	No answer
	58.3%	8.3%	20.8%	8.3%	4.2%

Table 8- students' personal description

Table 8 depicts that the majority of students is either enjoy the School (58.3%) or perceive themselves as enjoying pressure, as a driver and as energetic (20.8%). Further statistical analysis of the data has been done. Due to the small sample size, however, the results of these analyses were statistically inconclusive.

3- Students' comments: Students' comments showed that their first impression of having access to video materials both in VHS and digital was really positive. They believed that most of the video material was described in printed material, but they found the course more interesting by having the video clips available. This was particularly pronounced in the case of students taking the course by distant mode. They believe the videos helped to "understand exactly why certain methodologies worked and how others didn't". One of the benefits of video material over text

material was perceived to be the "thorough explanation as to why something is or isn't working in just a few seconds". One student commented that "watching fellow classmates actually working through a problem is much more enjoyable than reading about it, and much more memorable". Looking back, the students said they remember the contents of video material more than the written text. They mentioned in order to answer the questions about the video clips they have to watch them repeatedly, which contributed to solid memorization. From the distance learning student's comments it seems the video material was very important factor to facilitate learning.

Information from the instructor

According to the course instructor's self-evaluations during 1998-2000, the new approach has made significant improvements to the HCQI course. Regarding the method of delivery, the instructor believes that the project part of the course works optimally and students have a great learning opportunity in the project and develop appropriate skills. Moreover, the use of the observation room with video recording of the project sessions and observation of classmates through one-way mirror was perceived as very valuable. The instructor thought that the observed students appreciated the removal of the pressure to "perform". The instructor also believed that the students particularly appreciated the video recordings and the opportunity to go back over previous sessions.

The instructor also expected that having the critiques available on the server was beneficial to the success of the course, and that the evaluation covers the course adequately and the students get ample and detailed feedback.

Overall, from instructor's point of view, the majority of the students seemed to appreciate the intense learning opportunity, and had expressed the feeling that they gained mastery of the subject with the new approach in the course.

Discussion

Limitations of the study

The research methods in our study are subjective ones including questionnaire, students and instructor's comments. Our study covers only the project portion of the course and improvement of students' performance in their project. For a better understanding of students' learning, the study would ideally have had to cover all activities in the course and the influence of instructional technology on each of those activities. This was not done because of the three months time constraint to conduct and evaluate the study. For the same reason and due to the research settings and size of the class our sample number was not large enough to conduct further analytic statistical studies. Also, using a questionnaire with open-ended questions or interviews would be beneficial to gather more qualitative data. These limitations could be overcome in future studies.

General consideration

The experiential learning in the Health Care Quality Improvement course is provided by the project and the way it is conducted, i.e., the concentration on one project, and the environment of students not only in the execution of the project but also in the critiquing of other students' performance in this context. The role of the technology explored is to support these experiential learning approaches. This is therefore the context in which the questions addressed in this thesis have to be seen.

Question 1- How do Internet/CD-ROM based resources impact the students' performance in their project?

Our findings in course evaluation, students' comments and instructor's self-evaluation seem to support that the new approach, with use of edited video clips presented in context, has improved the delivery of the HCQI course. Use of video in both unedited VHS and edited digital format helped students in doing their project and improved their performance.

However video examples may in some cases have reduced the critical thinking process among students and narrowed their choices. In some other cases, some groups have adopted examples, which originally had been chosen as examples for sub-optimal approaches, in their project activity without modification.

The data also shows that the effects of the Internet/CD-ROM material on students' project work and learning were perceived more positively than the unedited VHS recordings. This could be the result of greater ease of use of digital video on readily available computers in several computer labs at the University as compared to normal VHS video recordings for which a VCR is required (and there are not many labs available). Another factor may be that digital video clips were selected purposefully to give specific examples of good or bad approaches to QI and with some text to provide context and orientation whereas the raw VHS recordings were lacking these improvements.

The importance of text references should not be overlooked. According to students' evaluations and comments, they found the written text output of previous

years very helpful to plan and perform their projects or in preparation for their reports.

Although several studies showed that gender and years spent in post secondary school are unrelated to students' evaluation, there seems to be some exceptions (Doyle, 1975). A number of studies suggest that more advanced students tend to evaluate more favorable than the others (Costin, Greenough, & Menges, 1971). The reasons could be their ability to recognize better instruction or desensitization to poor instruction (Doyle, 1983). Our finding fits into this pattern since the majority of students are in their third and fourth year of study (95%).

Students' grade expectation could also influence their evaluation (Doyle, 1983). Our findings showed the same pattern. Almost all students (except one unanswered) expect to get the same or higher marks than in other courses. This might result in more favorable evaluation of the course.

Studies by Moen and Doyle have subsequently shown that students who have a positive orientation towards their educational institution tend to evaluate their instructor more positively than the students with a negative orientation (Doyle, 1983). Our study showed that the majority of students (almost 92%) had positive attitudes towards the School and its program. Again this may explain part of the overall positive evaluation.

Question	Agree	No Opinion	Disagree	No Answer
CD/Internet-based Video material led students to wrong examples	25%	33.3%	37.5%	4.2%
Comfortable with things getting out of control	2	3	4	
	22.2%	33.3%	44.4%	
Uncomfortable with things getting out of control	4	5	5	
	28.6%	35.7%	35.7%	
CD/Internet-based Video material narrowed students' perspective of available methods	37.5%	37.2%	20.8%	4.2%
Comfortable with things getting out of control	3	3	3	
	33.3%	33.3%	33.3%	
Uncomfortable with things getting out of control	6	6	2	
	42.9%	42.9%	14.3	

Table 9-Distribution of students' assessments of the value of video material by their attitude towards things getting "out of control".

Table 9 shows the breakdown of students' perception of the value of examples presented on video as an orientation for their work. As noted previously, almost 40% of students had perceived that the examples on video narrowed down their perspective, and 25% had expressed that the examples led them to wrong choices. The table breaks these answers down by the students' attitude towards "things being out of control." Although the data show no statistically significant differences—due to the small sample size— there is a slight suggestion that those who are uncomfortable when "things are out of control" are also more susceptible to getting confused by video material. This impression warrants further analysis and if confirmed, should be taken into consideration in further work on technology support for teaching.

In conclusion we believe video examples are really helpful both to facilitate students' performance and learning; however, one has to carefully balance theoretical

instruction and video examples in order to prevent limiting students or confusing them into imitating bad examples instead of good ones.

Question 2- What are the main effects (positive or negative) of technology support for HINF460 course?

The results of the questionnaire and students' comments revealed some positive and negative effects of the new approach. Most of the students believed that the new approach helped them to prepare and perform their project. However, there were some cases that the chosen examples directed them into the wrong choice. The other negative effect was narrowing down the students' points of view and limitation of critical thinking. These findings are only the effects on the project part of the course. Further investigation on the impact of the new approach on other components of the course and students' learning in general are needed to be done.

Question 3-What are the effects of Internet/CD-ROM based materials for distance education participants?

Both student's comments and the instructor's self evaluation showed that Internet/CD-ROM based material particularly digital video helped the distance educators to have a better understanding of written material. These findings are similar to other researcher in the 60's (Schramm, 1967), which showed the instructional television, which can serve as an efficient "tool of learning" has a positive effect on students' learning. Although our findings showed this positive effect, further investigation with more participants required to confirm this finding.

Compliance with seven principles for good practice in teaching

Question 4- How does the current method of delivery of HINF460 meet the characteristics of the best practices of teaching?

In March 1987, the American Association for Higher Education (AAHE)[1] Bulletin first published "Seven Principles for Good Practice in Undergraduate Education." That document was followed by a "Seven Principles Faculty Inventory and an Institutional Inventory" (1989) and by a "Student Inventory" (1990). The Principles, created by Art Chickering with help from higher education colleagues, AAHE, and the Education Commission of the States (ECS)[2], distilled findings from decades of research on the undergraduate experience, which are now used very widely (Chickering & Ehrmann, 1994). These principles are:

1. Good practice encourages contacts between students and faculty
2. Good practice develops reciprocity and cooperation among students
3. Good practice uses active learning techniques
4. Good practice gives prompt feedback
5. Good practice emphasizes time on task
6. Good practice communicates high expectations
7. Good practice respects diverse talents and ways of learning

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[1] **The American Association for Higher Education** (AAHE) "envisions a higher education enterprise that helps all Americans achieve the deep, lifelong learning they need to grow as individuals, participate in the democratic process, and succeed in a global economy."(The American Association for Higher Education, 2001)

[2] "**The Education Commission of the States (ECS)** is a national, nonprofit organization that helps governors, legislators, state education officials and others identify, develop and implement policies to improve student learning at all levels.

The mission of the Education Commission of the States is to help state leaders identify, develop and implement public policy for education that addresses current and future needs of a learning society."(The Education Commission of the States, 2001)

The current approach has been over the past two years implemented to improve the quality of the teaching process in the HCQI course. It is therefore of interest to ascertain to what extent the new approach complies with Chickering and Ehrman's Seven Principles of Good Teaching.

The usage of a list server in the School of HINF improves students' communication with their instructor is in accordance with the first Principle: "Good practice encourages contacts between students and faculty." A number of list servers have been established for the course, which allows every student to send questions, comments or requests to the instructor or classmates. Class notes or any other comments by instructor are posted within 24 hours to the course list, which makes them available to all students. On the other hand, it seems that using a bulletin board might have also been helpful. In this mode the questions remain on the board till the end of the semester, allowing an easier way to review all the questions and discussions around them.

The focus of group work, which is addressing a real life Quality Improvement project and the mutual peer critiquing, guarantees interaction among students. This satisfies the second Principle of good practice: "Good practice develops reciprocity and cooperation among students." A problem with group work is that it is hard to evaluate each individual in the group. So if a member of the group produces better work, everybody benefits of that member. Changing the method of group selection in a way that balances strengths or weaknesses in each group could solve this, e.g., by assuring that verbal or writing ability are similarly represented in every group. This is worth considering in the future but may be difficult to attain. Another way to deal

with this problem might be to increase the weight of individual contributions. This is, however; hard to achieve, given the basic construction and goal of the course. The advantage that some students pulled by benefiting from their classmates is also balanced by the fact that most other courses place heavy emphasis on individual achievement. The confirmation of good practices may therefore contribute an optimal compromise.

The third Principle of good practice deals with active methods of learning ("Good practice uses active learning techniques"), which is the core of the HCQI course. Collaborative methods, such as group work, discussion/brainstorming sessions, group presentation and peer critiquing of the work of students, are all different methods of active learning which are currently used in the HCQI course.

Students get feedback on their work from the instructor and from their classmates. All of the reports and feedback with the exception of the actual mark awarded are posted on the list server for the course in effort to assist the students improve their performance for the next step of the project. This satisfies the fourth Principle of good practice:" Good practice gives prompt feedback". Having a more sophisticated marking approach and use of some objective methods as well as students' critiques in evaluation might further improve compliance with the fourth principle. Examples could be the approaches that are now available for automated checking for plagiarism. Some thought should be involved in this kind of possibilities.

During the course, students are expected to work independently and deal with the problem the same way they would in real life. Students gain a lot of experience in

dealing with real life situations: They gain critical thinking skills during the problem solving and when critiquing their classmates; they use their communication skills to collect related data or perform interviews with people who may or may not comply; they also develop teamwork and presentation skills, in accordance to the seventh Principle of good practice: "Good practice respects diverse talents and ways of learning."

We believe that the chosen teaching approach enables students to adjust their learning process in a way that is compatible with their needs. They not only are free to choose their approach to solve the problem and free to use any kind of useful ideas for their project, report or critique, but they are also able to take on roles that serve the purpose of the group best.

In addition, technology support in the HCQI course could be used for different presentation of material to satisfy different learning styles. This is a worthwhile consideration for future delivery of the course.

Conclusion

Out of the vast number of technologies that are candidates for the improvement of learning, this study focuses on the CD-ROM/Internet as the main medium to deliver examples and pose problems related to group problem solving in a course on Health Care Quality Improvement.

Instructors or designers of technology-based courses should always keep in mind that technology itself couldn't solve learning problems; rather, the course design should

facilitate the learning process through the available technology. Technology is only a tool to further the goal of education.

We can summarize our findings as follow:

1. Our study shows that the chosen approach for technology support is a positive improvement for the course.
2. The video material, and particularly digital video material, provide very strong examples and seem to be recalled better than traditional lecture mode.
3. The new approach seems to be suitable for distance delivery of the course.
4. We should exercise caution with the selection of material and the manner and context in which it is presented in order to prevent undesirable effects such as the adoption of ineffective approaches simply because they are recalled better than appropriate ones for which examples may not (yet) be available.
5. The chosen teaching approach for the HCQI course improves its compatibility with Chickering and Ehrman's Seven Principles of Good Practice in Teaching.

These results are a good basis for further improvement of the course and more comprehensive long-term evaluations.

The experience also shows that small pilot projects like this one are desirable when introducing new technologies into teaching and learning endeavors because unintended side effects do occur and the degrees of freedom are rather large. A well-evaluated pilot project allows identifying shortcomings early and avoiding them when moving to a larger scale application.

It is also noteworthy that several other projects benefited in the meantime from the experience gained. For instance, two conferences were videotaped and a set of CD-ROMs published (reference). As well a number of other teaching events have been recorded and are made available for use in teaching on campus and off campus (HEALNet, 2000; IMIA WG4, 2000).

These are all positive side effects indirectly related to the effort undertaken here. These positive effects complement the CD-ROM and the publications and communications which resulted from this project (Berenji, Moehr , & Green, 2001; Berenji & Moehr, 2000; Berenji, Moehr, & Green, 2001).

Future research

Time and budget were two important factors in our project. Spending more time and having a bigger sample and spending more time on the evaluation method are helpful to have a better understanding of effectiveness of educational technologies.

Using other instructors and colleagues' input can improve the evaluation method.

Having more distance education students is also another important goal for future studies.

Emerging technologies and improvements in networking and Internet connections will bring new questions about the effects of these changes on education and particularly on teaching health informatics.

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Appendix A- Questionnaire

HINF 460- Instructional Technology Evaluation, Fall 2000[1]

This questionnaire is part of our effort to improve HINF 460 by using new technology. Thank you for your participation.

1. The Video material on CDROM/Web met my needs in the completion of my project.
   Agree ☐ Disagree ☐ No Opinion ☐

2. The Video material on CDROM/Web led me to imitate examples that turned out to be wrong.
   Agree ☐ Disagree ☐ No Opinion ☐

3. The Video material on CDROM/Web narrowed my perspective of available methods.
   Agree ☐ Disagree ☐ No Opinion ☐

4. The Video material on CDROM/Web was helpful for preparation of the CQI sessions in observation room.
   Agree ☐ Disagree ☐ No Opinion ☐

5. The Video material on CDROM/Web improved my learning in the course.
   Agree ☐ Disagree ☐ No Opinion ☐

6. The video material from the observation room (VHS Tapes) was helpful in my preparation for the presentations in class.
   Agree ☐ Disagree ☐ No Opinion ☐

7. Watching the observation room video tapes (VHS Tapes) improved my learning in the course.
   Agree ☐ Disagree ☐ No Opinion ☐

8. Overall, the new approach of using videos on CDROM/Web and VHS tapes was useful and improved my learning in the course.
   Agree ☐ Disagree ☐ No Opinion ☐

9. The printed output from last year was useful for my work.
   Agree ☐ Disagree ☐ No Opinion ☐

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[1] Second part of the questionnaire adopted from: Doyle, K. O. (1983). Evaluating Teaching. Lexington, Mass.: LexingtonBooks

To have a better understanding of students' interaction with new technology, we would like some personal information. This information will remain anonymous and confidential.

10. My age is: Under 20 20-24 25-40 Over 40

11. I am: Female Male

12. In which year in HIS are you?

Third Fifth or more Graduate

Fourth Unclassified

13. Which of the following best describes your typical grades?

Almost all A's Mostly B's and C's

Mostly A's and B's Mostly C's or lower

14. What grade do you expect to receive in this course?

Higher than I usually get Lower than I usually get

About the same as I usually get

15. How do you feel when things are getting out of control in your life?

Very Uncomfortable Comfortable

Uncomfortable Very Comfortable

16. How would you summarize your overall feelings toward HINF?

Very Negative

Negative

Positive

Very Positive

17. From the following statements choose the one that best describes you:

I enjoy school; I'm persistent and want to do my best.

I find school boring, futile; I prefer to be by myself.

I'm very energetic, a "driver"; I enjoy pressure.

I hate pressure; I try to avoid confrontations.

18. I learn best when: (choose one answer)

the teacher provides the information and I figure out the main connecting themes on my own.

The teacher explains the major themes and I study the information on my own.

19. I learn best when the task is to:
(Please rank these answers from 1-5 with 1 = best, 2 = next best, etc.)
____ show an idea can be applied to an actual situation.
____ master a set of concrete facts or a body of information.
____ closely examine abstract ideas and theories.
____ understand basic principles about a subject.
____ put together several differing ideas into a theory that makes sense to me.

Appendix B-Course outline

SCHOOL OF HEALTH INFORMATION SCIENCE
HINF 460 - (1.5 units)

Health Care Quality Improvement

F 1999

Time and Place:

Lectures and Project Meetings: Tue. and Wed., 4:30 - 6:00 pm HSD A264

Instructor: Dr. Jochen Moehr (Office: HSD A204, phone
Tuesday 2:30pm or by appointment

Overview:

Faced with health care costs rising beyond the li
demands, health institutions resort to quality impro
approach combines management styles with system analysis, a
selection of remedial action, and statistical approach
Canadian Council mandates it for Health Care Facili
health informatics methodology are an integral part

The course introduces the student to the terminc
methodologies of the quality culture in health. Thes
section of the course. Illustrations by practitioners and a
didactic offerings.

Didactic Approach:

The course has three interleaved components: Le
approaches, a project exercise, and guest lectures.

A) Principles and Methodological Approaches:
In this part the student will be introduced to the
improvement and presented with an overview o
management styles, as well as descriptive and analytic n
techniques. The students will also be introduced
B through examples recorded in previous classes

B) Project Exercise:
In this section the students will
apply the methodology presented in part A). Sti
After an introduction to the project, in which all
be carried out by two groups per session. One grou
Quality Improvement team (QI team) and another group will observ
methodological approach taken, as well as the te
order to minimize disturbance, they will work i
observation rooms, with the rest of the class obse
session of the QI TEAM will be video recorded
particular by the assessing group, and subsequent course

The work of all groups will be reported in a written report and presented to the class during a subsequent session. Each student will have an opportunity to serve on a CQI-TEAM, and to contribute to either a report each on methodology or team performance of a CQI-TEAM. The group reports will be graded as part of the students' evaluation. Class members will be supplied with all reports including the instructor's assessment (except grades) via a server. The material may be made available to later classes as example and as a basis for exercises.

C) Case Illustrations

Guest lectures by quality improvement practitioners and case studies from the literature will provide a link to the real world and serve to put the theories and the students' own practical experience into perspective. The experience of the project exercise in Section B) and of the case illustrations in Section C) will be assessed in the Final exam in addition to the contents of Section A).

Course Goal:

To enable the student to initiate and conduct health quality improvement projects.

Course objectives:

Upon successfully completing this course the students will be able to:

1. Describe and explain the philosophy of Continuous Quality Improvement and Total Quality Management.
2. Describe, critically select and apply methods of problem identification, selection and analysis.
3. Select and monitor approaches to remedial action.
4. Describe alternatives for the establishment of Quality Improvement Teams, and function effectively as a member of such teams.

Evaluation:

The grade of the course is based on a Quality Improvement Team (CQI-TEAM) report, two assessments of another group, and the final examination. The CQI-TEAM reports are parts of the overall QI project and form the basis of the work of subsequent groups. The assessments will address the methodology and team performance of a student group acting as CQI-TEAM. Since the grades for methods assessment and team assessment tend to differ systematically, and students can only do one or the other, the average grade achieved for the task not done by a given student will serve as a factor for the evaluation (see below). The final examination will include factual questions of the course material covered in part A and comprehension/judgment exercises in which the student will have to draw on the practical experience in part B) and the case presentations and guest lectures presented in part C).

The weights assigned to the evaluation components are:

CQI-TEAM Project	20%		
Group work Assessment		33%	
Team			50%
Methodology			50%
Written Report		33%	
Oral Presentation		33%	

Methodology Critique	20%	
Written report		50%
Oral presentation		50%
Team Performance Critique	20%	
Written report		50%
Oral presentation		50%

Group Projects:	60%
Final:	40%

GRADING SCHEME:

Numerical Marks	Letter Grade	GP
90 - 100	A+	9
85 - 89	A	8
80 - 84	A-	7
75 - 79	B+	6
70 - 74	B	5
65 - 69	B-	4
60 - 64	C+	3
55 - 59	C	2
50 - 54	D	1

IF GRADES ARE POSTED, THEY WILL BE POSTED WITH THE FULL STUDENT NUMBER, IN NUMERICAL ORDER. STUDENTS' NAMES WILL BE STRIPPED FROM THE LIST. ANY STUDENT NOT WISHING TO HAVE THEIR MARKS POSTED MUST NOTIFY THE INSTRUCTOR IN WRITING PRIOR TO THE FIRST EXAM.

Students missing more than the equivalent of one week of classes without legitimate reason are subject to debarment of writing the final exam. (Refer to calendar.)

All laboratory and/or class assignments must be completed and both the mid-term and final exams written in order to pass the course. Laboratory and/or class assignments handed in late will normally be given a mark of 0 but must be completed to pass the course. The mid-term examination will include lecture and reading material to the date of the exam. The final examination will cover all of the course material.

Any assignments submitted on disk MUST be scanned for computer viruses using the current detection software provided in the HSD Computing Facility IMMEDIATELY PRIOR TO SUBMISSION TO THE INSTRUCTOR. Any assignments submitted containing a virus will be considered late, and will be given a mark of zero.

Students in the program are expected to recognize the value of backing up important computer files. Hardware and/or software failures or disasters will not, consequently, be accepted as valid reasons for missing or late assignments.

In order to pass a course, students must pass the final exam and have a cumulative pass mark in the term's laboratory and assignment work. The final exam of students with missing assignments will not be marked until all work has been turned in. No assignment will be accepted after five working days from the last day of classes. All such assignments will be considered late unless other arrangements have been made with the instructor.

Relevant Journals and Books

Students are encouraged to do their own literature research using the resources available at the University library.

A number of publications are available on reserve reading in the library, including:

Gaucher, E.J., Coffey, R.J.: Total Quality in Health Care. From Theory to Practice. (San Francisco, Jossey Bass Publishers, 1993)

Leebov, W., Ersoz, C.J.: The Health Care Manager's Guide to Continuous Quality Improvement. (American Hospital Publishing, 1991)

Wilson, C.R.M.: Hospital-Wide Quality Assurance (Toronto: W.B. Saunders, 1987)

Brown, S.A.: (Scarborough, Ont.: Prentice Hall Canada, 1992)

In addition students will find it very useful to peruse the material from HINF460/s98 available on the School's web site at:
http://a203-d9.his.uvic.ca/hiscours/h460/cqi-s98.htm

Required Text

Berwick, D.M., Godfrey, A.B., Roessner, J.: Curing health Care: New Strategies for Quality Improvement.
A Report on the National Demonstration Project on Quality Improvement in Health Care. (San Francisco: Jossey Bass, 1991) ISBN 1-55542-294-2

Date 1999	Subject	Part			CQI	Meth	Team
		A	B	C			
W-Sep 8	Introduction, Organization, Quality, Personal Experience w. QA						
T-Sep 14	Definitions, History → QA, CQI, TQM in Health						
W-Sep 15	4 Stage Approach; Problem Definition; Information Acquisition: Observation, Interview, Questionnaire Creative Techniques						
T-Sep 21	**Project 0 (P0): Defining Project Scope (All groups)**						
W-Sep 22	Overview of Group work, reporting and presentations						
T-Sep 28	Teamwork						
W-Sep 29	**P1: Identifying & Selecting Problems**				**1**	**4a**	**4b**
T-Oct 05	Diagnostics, Analytic Techniques						
W-Oct 06	**C1: Reports & Critiques of P1**				1	4a	4b
T-Oct 12	PFDs, Ishikawa diagramming, Pareto diagramming						
W-Oct 13	**P2: Selecting Problems & Team Building**				**2**	**3a**	**3b**
T-Oct 19	Diagnostic Techniques & Validation						
W-Oct 20	**C2: Reports & Critiques of P2**				2	3a	3b
T-Oct 26	Remedial Interventions						
W-Oct27	**P3: Diagnostics**				**3**	**1a**	**1b**
T-Nov 02	Management of Change, Holding Gains						
W-Nov03	**C3: Reports & Critiques of P3**				3	1a	1b
T-Nov 09	Guest lecture: Linda Birdsall: QI Team & Technology Assessment						
W-Nov10	R E A D I N G B R E A K						
T-Nov 16	Guest lecture: Christine Penney: Quality Improvement, the CCHSA and Accreditation in Canada						
W-Nov17	**P4: Remedial Action**				**4**	**2a**	**2b**
T-Nov 23	M. Campbell: Dangers in the Practice of TQI/CQM in Health						
W-Nov24	**C4: Reports & Critiques of P4**				4	2a	2b
T-Nov 30	Questions for Exam, Course Evaluation						
W-Dec 01	**Final Summary Presentation**						

Appendix C- Agreement for Video taping form

Name: _____

I agree to my being video-recorded during lectures or work sessions in the context of HINF 460 F99

_____ _____

Signature Date

VITA

Surname: Berenji Given Names: Gholam Reza

Place of Birth: Mashad, Khorasan, Iran

Educational Institution Attended:

University of Victoria 1999 to 2001
Mashad University of Medical Sciences, Iran 1987 to 1995

Degrees Awarded:

Medical Degree Mashad University of Medical Sciences 1995

Hounors and Awards:

University of California, Irvine Fellowship 2001-2002

LIST OF PUBLICATIONS (PERSIAN)

a) Books

- Manual of Deluxe Paint III for Amiga Computers(translation), 90 pages, 1991
- Booklet on computer applications in Medical Sciences, Published for the Third Iranian Medical Students Seminar, Mashad University of Medical Sciences, 20 pages, 1990
- Co-editor of Clinical Genetics, Astan-e-Ghods Publication, 1998

b) MD Thesis

- Study of Distribution of Allergies in North East of IRAN, 70 pages, 1995

c) Abstracts

1. G.R. Berenji et all, Scabies in 14000 tested patients in Imam Reza Hospital Mashad, Second Iranian Medical Students Seminar, Parasitic Diseases, Isfahan University of Medical Sciences, 25-27 Nov. 1989
2. G.R Berenji: Computerised Multiple Choice Questions about Kidney Disease, Third Iranian Medical Students Seminar-Kidney Diseases, 6-8 March 1990

3. Dr. A. Berenji, G.R. Berenji, Bovine Tuberculosis in the Last 20 Years in Khorasan (NE of Iran), Iranain Congress of Tuberculosis, Mashad University of medical Sciences, Mashad, Iran, October 8-10, 1990
4. Dr. M. Hassanzadeh,G.R. Berenji, Caryotyping using Image Analysis (Computer Assisted Caryotyping), Iranian Congress of Medicine & Image, Mashad University of Medical Sciences, 11-16 Nov 1990
5. Dr. A. Fata, Dr.Elahi, Dr. F. Berenji, G.R. Berenji, Epidemiological Study of Scabies in Mashad, The First Congress of Parasitic Diseases in Iran, Gilan University of Medical Sciences, 11-13 Dec. 1990
6. Prof. M. Balali, G.R. Berenji, Database on Poisonous Plants of NE of Iran (PLANTOX), Second Iranian Congress of Poisoning, Tabriz University of Medical Sciences, 12-14 Oct. 1991
7. M. Monesan, G.R. Berenji, Effects of Organophosphorate Poisoning on Hepatic Function, Second Iranian Congress of Poisoning, Tabriz University of Medical Sciences, 12-14 Oct. 1991
8. G.R. Berenji, K.Sayadpoor, Computers in Medical Education: Acute Abdomen & Its Differential Diagnosis(Video Film), 5th Iranian Medical Students Seminar- GI Diseases, Hamadan University of Medical Sciences, 12-14 Nov. 1991
9. G.R. Berenji, Cardiovascular Effects of SLE, 6th Iranian Medical Students Seminar-Cardiovascular Disorders, Tehran University of Medical Sciences, 25-27 May 1993
10. G.R. Berenji, Common Allergies in Khorasan (NE of Iran), 7th Iranian Medical Students Seminar- Allergy & Clinical Immunology, Mashad University of Medical Sciences, 9-11 Nov. 1993
11. Dr. M. Hassan zadeh, G.R. Berenji, Familial Marriages and Genetic Disorders, Seminar of Disabilities Prevention, Mashad 1993

d) Full Papers

1. An Introduction to Computer Applications in Medicine, Computer (in Persian), Vol. 9, No 4, July 1990
2. Computer Application in Medical Education, Navid: Research and Scientific Quarterly of Student's Research Assembly, Mashad University of Medical Sciences, No 5 & 6, Spring & Summer 1996

LIST OF PUBLICATIONS (ENGLISH)

1. Berenji,G.R., Moehr, J.R.: New Technology for Teaching HINF460 Health Care Quality Improvement. HEALNet Annual Conference 2000, Toronto, Ontario, April 2-4, 2000. Abstract: Conference Program p. 26
2. Berenji, G.R., J.R. Moehr, C.J. Green: Video Streaming Technology for Teaching Quality Improvement. E-health 2001 conference, Toronto, Ontario, May 26-28, 2001. Proceedings CD-ROM.

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Title of Thesis:

Technology Support for Teaching Health Care Quality Improvement

Author [redacted]
Gholam Reza Berenji
July 31, 2001