Towards the Development of a Framework for Integration of an Electronic Medical Record into an Undergraduate Health Informatics Curriculum

by

Jesdeep Bassi
B. Sc., University of Victoria, 2007

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Supervisory Committee

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Abstract

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Information technology (IT) is increasingly being used in the classroom to support instruction. This work addresses the integration of electronic medical records (EMRs) into undergraduate health informatics (HI) education. Such systems have been used to some extent in health professional education but effective integration into HI education remains a gap. This thesis explores the context of integration using the concept of Technological Pedagogical Content Knowledge (TPCK). A structured literature review of previous integration efforts involving EMRs or similar systems in all disciplines was conducted as well as a documentation review specific to undergraduate HI programs to gather insight into current HI education. The findings from these were combined with those of an original qualitative research study done to gather views of instructors and students within one school. This work resulted in an application of TPCK which expands the original framework, describing key findings for the three knowledge bases and adding specific contextual considerations that emerged in terms of when to integrate, instructors, students, courses, technical aspects, system aspects, and overall learning pedagogy.

This thesis is organized into nine chapters, beginning with an introduction which explains the rationale for undertaking this work. Next, theoretical perspectives for IT integration are discussed along with the specific EMR integration challenge being addressed. The two additional literature reviews are presented along with their findings which then leads to the research questions for the original study which was undertaken.

The next two chapters outline study methods and results. The main questions are then revisited and answered with study findings supplemented by the literature reviews. This leads to the discussion of an initial framework as well as theoretical and practical implications and future research directions for work in this area.

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Dedication

I would like to dedicate this thesis to my family: Mom, Dad, Nav and Jas.

To my parents Harinder and Kashmir,

who have always been behind me in whatever I have set out to do including pursuing my Master’s degree:

Your love and support have made all my achievements possible.

Abbreviations

The following abbreviations are used throughout this thesis:

AES: Academic Education Solution (by Cerner Corporation)

AMIA: American Medical Informatics Association

CHIMA: Canadian Health Information Management Association

COACH: Canada's Health Informatics Association

Co-op: Co-operative Education

CPR: Computerized Patient Record

EHR: Electronic Health Record

EMR: Electronic Medical Record

EPR: Electronic Patient Record

HI: Health Informatics

HIMSS: Healthcare Information and Management Systems Society

HINF: Health Information Science

HIP™: Health Informatics Professionalism (by COACH)

HIS: Health Information System(s)

HMI: Health and Medical Informatics (by IMIA)

ICT: Information and Communication Technology

IMIA: International Medical Informatics Association

IM/IT: Information Management/Information Technology

IT: Information Technology

PACS: Picture Archive and Communications System

PCK: Pedagogical Content Knowledge

PDA: Personal Digital Assistant

PITO: Physician Information Technology Office

POC: Point-of-Care

PRS: Patient Record System

TPCK or TPACK: Technological Pedagogical Content Knowledge

UVic: University of Victoria

Chapter 1 - Introduction

Healthcare and education are changing due to advances in information technology. Education in health informatics (HI) will be essential in order to effectively bring health information technology into use throughout healthcare. The electronic medical record (EMR) is an important and emerging type of health information technology that promises to streamline and revolutionize healthcare. EMRs are used by health care providers to store clinical data and support the provision of care. Introducing such systems to future health professionals early on can help prepare them for clinical environments where these systems will be present. However, issues of how to educate health professional students about such technology remain to be addressed. This thesis will explore how such systems can be integrated into health informatics education at the undergraduate level.

1.1 Health Informatics

What is "Health Information Science" or "Health Informatics"? The difficulty in answering this question lies in the fact that it spans other disciplines. In 1998, Haux, Swinkels, Ball, Knaup, and Lun discussed the importance of information processing in healthcare, stating that "information technology offers an enormous potential for health care if it is used properly" (p. 2). Ash, Berg and Coiera (2004) looked at the unintended consequences of implementing patient care information systems and discussed errors associated with information entry, retrieval, communication, and coordination, concluding that there is a need for informatics education and people who can "bridge the gap between the clinical and technological worlds" (p. 110). These two examples highlight the importance of the HI discipline which is defined by COACH: Canada's

Health Informatics Association (COACH), as "the intersection of clinical, IM/IT and management practices to achieve better health" (2009, p. 7). Related terms like medical informatics or biomedical informatics are also sometimes found in the literature and Huang (2007) explains there are overlaps among them in terms of knowledge and skills. This work refers to HI as defined by COACH in the Canadian context. In terms of a career, "health informatics professionals develop and deploy information and systems solutions, drawing on expert knowledge from fields such as computer science, information management, cognitive science, communications, epidemiology, management sciences and health sciences" (COACH, 2007, p. 7). From the above, it is clear that information technology is central to the field of HI.

1.2 Information Technology Trends in Health Informatics

Information and communications technology (ICT) or information technology (IT) has certainly become pervasive in healthcare due to the advancement in the technologies, health information systems (HIS) in particular. Hasman (1998a) states that an "important aim of health informatics is to introduce students to the possibilities, limitations and the use of information systems" (p. 213). One type of system often discussed is the EMR. An EMR "stores clinical data and is owned, accessed, and contributed to solely by the provider (e.g., physician, clinic, hospital)" (Thielst, 2007, p. 75). EMRs capture and allow providers to search and index patient chart information including histories, examination findings, diagnoses, and treatments. They may also offer clinical decision support, entry of provider orders, alerts and warnings for allergies and interactions (Otto & Kushniruk, 2009).

The term EMR is often used interchangeably with electronic health record (EHR), computer-based patient record (CPR), or electronic patient record (EPR) since they all essentially refer to a digital record of a person's encounters with the healthcare delivery system (Young, 2000) as opposed to the traditional paper-based record. However, there are distinctions between these systems.

The definition of an EMR provided by Theist above aligns with that of Canadian author Nagle, who explains that differences in related HIS exist in terms of access, scope, and custodianship. Nagle (2007) defines EMRs as electronic records maintained within a clinic, private practitioner's office, etc. where stewardship is held by the organizational entity and access is limited to authorized users within the 'circle of care' (but data may be exchanged among multiple entities). She distinguishes an EPR from the EMR by describing EPRs as being managed by healthcare organizations but similar to EMRs in terms of stewardship and access. An EHR, however, is a "comprehensive record for a specific individual, one that incorporates selected information from every healthcare encounter" (Nagle, 2007, p. 31).

Canada Health Infoway's vision for a pan-Canadian approach to healthcare through the establishment of an interoperable EHR spanning the entire country will connect numerous HIS (Canada Health Infoway, n.d.). Nagle mentions Canada Health Infoway's blueprint and explains that an EHR will be made up of all data for a patient drawn from EMRs and EPRs (2007). In this way, the EMR is a type of foundation system for the EHR. In British Columbia, the Physician Information Technology Office (PITO) was established to support physician offices in developing and implementing information technology including EMRs which are one of seven essential elements of BC's eHealth strategic framework (PITO, 2009). This highlights a future trend of moving away from traditional paper-based practice.

1.3 Preparing Health Informatics Students for the Future

Considering initiatives such as Canada Health Infoway's pan-Canadian EHR and PITO-supported EMR adoption in physician offices, it is almost certain that future HI graduates will come across them in some way as they go out into the field. There are several organizations which oversee the field of health informatics worldwide. For example, the International Medical Informatics Association (IMIA) has a range of members representing countries, corporate, academic, and international organizations in health and medical informatics. The goals and objectives of IMIA include moving informatics from theory into practice by linking academic and research informaticians with care providers, consultants, vendors and vendor-based researchers and promoting education (IMIA, n.d.). IMIA has several working and special interest groups which provide collaboration among individuals for specific topics. For instance, the Health and Medical Informatics Education Working Group aims to support programs and courses in health and medical informatics and advance knowledge of how informatics is taught to healthcare professionals, computer science/informatics students, and health and medical informatics students (IMIA, 2009).

Canada's official representative to IMIA is COACH. Formed in 1975 by health professionals and vendors, COACH consists of a community of members to advance healthcare through IT (COACH, 2010). The organization supports career development and education in the field and provides services and tools to students and recent graduates. COACH also collaborates with many other HI associations such as the

American Medical Informatics Association (AMIA), Healthcare Information and Management Systems Society (HIMSS), and the Canadian Health Information Management Association (CHIMA).

At the educational institution level, there are a number of programs across Canada offering diplomas, certificates, Bachelor's, Master's, and Doctorate degrees in HI to help prepare students in this growing field. Students in the undergraduate program at the School of Health Information Science at the University of Victoria (UVic) typically receive multiple job offers from public and private sector employers upon graduation (Kushniruk, Lau, Borycki, & Protti, 2006) and therefore must possess the necessary practical HI skills to work with different HIS they may encounter in the workplace.

1.4 Research Need

Although graduates of health professional education programs (e.g. medicine, nursing, etc.) will be expected to know about and adopt complex information technology, currently there is little or no exposure for most students to the technology itself during their training (Otto & Kushniruk, 2009). In addition, although HI graduates are expected to know in detail about such systems, their hands-on exposure to a range of systems may also be limited during academic learning (Borycki, Kushniruk, Joe, Armstrong, Otto, Ho et al., 2009). This thesis will explore the integration of HIS in teaching, focusing on EMRs for undergraduate HI education. In order to understand this unique challenge, this thesis begins by taking a step back to consider technology integration as it has been done in education in general and then gradually moves to the specific context of EMRs and undergraduate HI education.

Chapter 2 – Background and Theory for IT Integration

In this section, a discussion of the types of IT that have been used to support education will be presented, including the benefits and challenges of integration. As well, theoretical perspectives for IT integration will be introduced, including a key conceptual basis for this work. Finally, the specific integration context being studied (i.e. health informatics) will be described including a discussion of the use of EMRs in health professional education.

2.1 IT in Education

Looking back in the literature, the use of technology in education has advanced rapidly through the past few decades (Lai, 2008; Reiser & Dempsey, 2002) across the globe in developed and developing countries (Hinostroza, Labbe, Lopez, & Iost, 2008). Technology in teaching has included tools such as chalkboards to digital computers and software (Mishra & Koehler, 2006; Koehler & Mishra, 2008). This thesis will focus on uses of ICT, or simply IT, defined as “technology involving the development, maintenance, and use of computer systems, software, and networks for the processing and distribution of data” (information technology, 2010). According to Richards (2006), ICTs will increasingly support learning in the future. This may be in part due to student and teacher expectations to have IT present in the learning environment. Oblinger and Oblinger describe the ‘net generation’ as those born between 1982 and 1991 (as cited in Sandars & Morrison, 2007), a group that has grown up in an environment where ICT has become a part of daily life. In a survey of undergraduate medical and psychology students, the results showed that students had a high level of exposure to tools like blogs, wikis, and chat-rooms and generally felt that these types of tools could be useful in their learning (Sandars & Morrison, 2007). Pre-service (i.e. still in training) teachers are also being trained using IT and in ways to incorporate it into their future teaching practices (e.g. Georgina & Hosford, 2009; Sahin, 2003).

2.1.1 Benefits

Overall, the wealth of literature on IT in education indicates that it is here to stay, likely due to the many benefits it has to offer. As Mishra and Koehler state "technologies have constrained and afforded a range of representations, analogies, examples, explanations, and demonstrations that can help make subject matter more accessible to the learner" (2006, p. 1023). Among the findings in Brill and Galloway's study regarding classroom-based teaching technologies was that "many instructors clearly value the use of technology in the classroom, especially for such pedagogical practices as presenting information and examples, maintaining interest, and actively engaging students in more complex conceptual thinking and learning" (2007, p. 101). Similarly, Lai (2008) points out the ability of technology to bring reality into the classroom (e.g. simulations), provide access to information resources, and enable collaborative learning.

2.1.2 Types of IT

The range of IT applications available has evolved and shifted over the past few decades as new technologies have become available. Lai (2008) describes the development of computer-assisted instruction software in the 1970s-80s to incorporation of the Internet in the 1990s to e-Learning, social networking and mobile applications during the 2000s. Similarly, Hinostroza et al. (2008) trace IT use back to the multimedia educational software of the 1980s all the way to recent portable devices and wearable technologies emerging around 2006. These advances through the years have resulted in numerous types of IT used for educational purposes.

In reviewing examples, three categories seem to emerge. The first consists of general IT applied to the learning environment such as e-mail (Brill & Galloway, 2007) or the Internet (Brill & Galloway, 2007; Richards, 2006; Hinostroza et al., 2008). Richards (2006) mentions the use of online resources and discussion forums by students. At a higher level, examples include general use of computers, laptops, and personal digital assistants (PDAs) (Hinostroza et al., 2008). The next category consists of tools designed specifically to support learning. Terminology for this type of technology includes computer-aided instruction (Berman, Fall, Maloney, & Levine, 2008; Dev, Hoffer, and Barnett, 2001), instructional technology (Lewis, Watson, & Newfield, 1997), educational technology (Mishra & Koehler, 2006), computer-assisted learning (Dev et al., 2001), computer-based education (Dev et al., 2001), and e-learning (Childs, Blenkinsopp, Hall, & Walton, 2005). For example, the software may be a specific training simulation tool or a packaged e-learning management platform like WebCT (Richards, 2006; Brill & Galloway, 2007). The third category, which will be referred to as "real-world technology" in this thesis consists of technologies from the actual field introduced in the classroom. For example, undergraduate computer science students may complete programming assignments using Java, a programming language which is actually used by professionals. A similar categorization is described by McCrory (2008) for science-related technology. The author's categories consist of technology that is unrelated to science but used for science (e.g. word processing software), technology designed for teaching and learning science, and technology designed and used to do science (e.g.

microscopes). A classification helps to organize the multitude of IT that can be used for education but it is important to note that a single type of IT can fit into more than one category based on its use.

2.1.3 IT Use in Education

> No instructional ICT is a technology comparable to fire, where one only has to stand near it to get benefit from it. Knowledge does not intrinsically radiate from computers, infusing students with learning as fires infuse their onlookers with heat. (Dede, 2008, p. 56)

Many researchers have explored the use of various technologies in education and their previous work offers important insights into the benefits of IT for education as well as some of the potential challenges that it can present. The above quote demonstrates a view that several authors share which is that IT is only one piece or tool that can be used to aid the educational process, not a replacement for instruction (Lai, 2008) and that just adding technology to instruction will not ensure successful outcomes (Koehler & Mishra, 2005; Mishra & Koehler, 2006; Angeli & Valanides, 2009; Guzman & Nussbaum, 2009). Both Lai (2008) and Hinostroza et al. (2008) explain that research evaluating the impact of IT on student achievement hasn't been conclusive in terms of a definite negative or positive effect. The reason for this lies in the range of ways IT can be employed, leading to mixed results. Richards (2006) points to an assumption that technology is something to be added in to existing pedagogy and vice versa which has led to difficulties. This aligns with the argument presented by Hinostroza et al. (2008) which states that IT is an element that has to fit into a coordinated approach that involves the curriculum, pedagogy, assessment, teacher development and the school's culture. In other words, a single type of IT can have positive or negative outcomes depending on how it is implemented. Jefferies presents the challenge educators face in that they “not only need to be aware of some of the constraints and/or opportunities that are manifested by use of the technology itself, but also need to take into account the variety of issues related to the appropriate use of these new technologies” (2003, p. 35).

2.2 The Integration Challenge

The underlying concept is the *integration* of technology into teaching practices, described by Mishra and Koehler (2006) as a complex and ill-structured problem. Okojie, Olinzock, and Okojie-Boulder explicitly define technology integration as “a process of using existing tools, equipment and materials including the use of electronic media, for the purpose of enhancing learning, involves managing and coordinating available instructional aids, involves selection of suitable technology based on the learning needs of students as well as the ability of teachers to adapt such technology to fit specific learning activities” (2006, p. 67). This definition contains several key points about integration.

The first is that there are perspectives to consider when integrating IT into education: specifically those of the instructor and student. Students can be thought of as the end-user when it comes to IT in education and as mentioned in the above definition, students have learning needs. For example, Miller and Wolf (1996) studied the introduction of computers and IT into medical school curricula and found that the most popular programs with students were the ones that allowed them to take practice tests to work at their own pace on problems. Similarly, Hege, Ropp, Adler, Radon, Masch, Lyon, et al. (2007) found students were motivated to use e-learning cases which had exam relevance.

The instructor perspective must also be considered. In their papers, Berman et al. (2008), Miller and Wolf (1996), Lewis et al. (1997), Brill and Galloway (2007), Mishra and Koehler (2006), and Childs et al. (2005) all discuss instructor support for use of IT in teaching. Common barriers for incorporation of IT include perceived disruption of traditional teaching practices and lack of time and support to integrate (Mishra and Koehler, 2006). In addition, Lewis et al. (1997) suggest that difficulties in implementing technology may be related to a lack of understanding of the potential of the technology to support instruction.

Another part of the definition is managing and coordinating available instructional aids, which would include non-IT teaching aids. Some authors have explored approaches for managing different types of instructional aids in the same setting. For example, Childs et al. (2005) performed a systematic review on effective e-learning and found that "blended learning" was the preferred approach. It refers to incorporating IT with traditional teaching methods. As well, Berman et al. (2008) suggest that computer-aided instruction be added to traditional teaching methods such as lectures.

2.3 Perspectives and Theory for IT Integration

While many different approaches can be employed, a clear message from the literature regarding technology integration is that it can't be treated as a separate entity, distinct from the teaching context with student and teacher needs. Before delving into how to integrate technology in education, it is important to take a step back and consider the purpose of technology integration for learning which is influenced by theories and perspectives. Okojie et al. state that "technology integration not only involves the inclusion of technical artifacts per se, but also includes theories about technology integration and the application of research findings to promote teaching/learning" (2006, p. 66). Other authors agree that to integrate technology effectively, an understanding of learning theory is required (Lai, 2008; McLeod, 2003; Richards, 2006).

In exploring views on learning with regards to technology integration, three different perspectives are often discussed: behaviourism, cognitivism, and constructivism (Dede, 2008; McLeod, 2003). While these are not theories per se, they constitute collections of principles and theories that align with key assumptions about learning that some authors refer to as schools of thought (Dede, 2008, Hung, 2001). Each has important implications for IT integration as discussed below.

2.3.1 Behaviourism/Objectivism

At one end of the spectrum is the behaviourist perspective, most often regarded as the traditional "transmission" model of learning where knowledge is transmitted from instructor to learner (Lai, 2008; Dede, 2008; Jefferies, 2003). According to Marshall and Cox (2008), behaviourists believe that knowledge is a copy of reality. It is derived from the stimulus and response approach where the goal is for the learner to produce an ideal response when presented with a stimulus (Hung, 2001; Dede, 2008; Bradley & Postlethwaite, 2003; McLeod, 2003). In terms of teaching, the emphasis is on manipulating environmental factors to alter student behaviours to produce the correct response. Learning occurs when the student responds with the expected behaviour which is indicated through feedback to the student. Reiser and Dempsey (2002) equate this to a fact-based learning model and another author agrees that in this model students use memorization, identification, and association to understand what they need to know (McLeod, 2003).

Such a view may work well for well-defined problems and specific goals that the learner has to achieve but it is dependent on repetition and reinforcement of stimuli to ensure the correct behaviour. This approach can also result in low-level, surface learning that may limit student engagement. Technologies associated with the behaviourist perspective include computer-aided instruction and learner management systems (Lai, 2008). As well, instructional design using IT needs to be organized in pre-determined steps (Marshall & Cox, 2008, p. 988).

2.3.2 Cognitivism

Whereas behaviourism focuses solely on the environment to essentially guide student behaviours for learning, cognitivism considers the learner's mental constructs as an important facet of learning. In this view, the student develops knowledge by processing new input based on a pre-existing knowledge structure in their memory (Dede, 2008; McLeod, 2003). Therefore, teaching emphasizes helping students to develop these mental constructs, taking into consideration the learner's characteristics, needs, and interests (McLeod, 2003).

Like behaviourism, this approach also requires well-defined content to be taught but can be more complex in terms of learning outcomes (Dede, 2008). However, as McLeod (2003) notes, a weakness lies in the fact that the learner needs to possess prerequisite knowledge to be able to build on existing knowledge, which will likely differ from student to student. For IT applications, the cognitivist perspective is the basis for intelligent tutoring systems (Lai, 2008; Dede, 2008) but other types of tools can incorporate aspects of it.

2.3.3 Constructivism

Moving even further into a learner-centered perspective is constructivism. In this view, the learner constructs their own knowledge based on developing meaning from their experiences rather than acquiring it through transmission (Dede, 2008; McLeod, 2003; Hung, 2001; Jonassen, Peck, & Wilson, 1999). The constructivist view of learning is considered to result from activity is linked to authentic learning environments (Jonassen et al., 1999). According to Richards (2006), "the most effective learning is not just a translation of information or skills, but a transformation through performance in context in order to link practice and thought, to discover the interdependence of parts and wholes, to provide new insights and to realize potentiality in actuality" (p. 250). The important idea here is what the learner does to create knowledge (Biggs, 2003, p. 12). Examples of constructivist approaches include active learning, experiential learning, student-centered learning, or self-directed learning.

Similar to cognitivism, the learner's prior knowledge is important but the content, methods, and expectations are more open-ended (McLeod, 2003; Dede, 2008). This allows a range of knowledge and skills to be taught using a variety of methods (Dede, 2008). The instructor acts as more of a guide and students are encouraged to reflect on their own experiences (Dede, 2008; Reiser & Dempsey, 2002). However, without having concrete knowledge and skills to be learned, measuring learning can be difficult as students will have different interpretations of the content (McLeod, 2003).

The type of constructivism described above is largely individual. A form of constructivism which emphasizes interaction and collaboration in social contexts for cognitive development is termed 'social constructivism' (Hung, 2001; Bradley & Postlethwaite, 2003). A belief is that positive effects of social interaction during learning stimulates activity and motivation (Jefferies, 2003). In terms of technology integration, this view advocates use of IT to facilitate collaboration in learning (Richards, 2006; Lai, 2008).

2.4 Conceptual Basis for IT Integration

All the views presented above in conjunction with the many uses of IT in education demonstrate the complexities when it comes to exploring IT integration. Not only can IT serve different purposes but its use can be adapted according to underlying theoretical perspectives of learning. Unfortunately, “there is no blueprint for technology integration” (Okojie et al., 2006, p. 69) and according to Mishra and Koehler (2006), developing a theory for integration is difficult because it requires an understanding of complex relationships that are bound by context.

Therefore, to explore and understand the integration context, it is helpful to view it as conceptual pieces. Maxwell describes a conceptual framework as “the system of concepts, assumptions, expectations, beliefs, and theories that support and informs research” (2005, p. 33) which may be represented visually or textually. He goes on to explain that the function of the conceptual framework is to inform research design and justify the research being undertaken. Previous authors have mentioned conceptual elements for IT integration. For example, Richards (2006) discusses pedagogical and technological elements and Hinostroza et al. (2008) present four elements for IT use in teaching and learning: contextual factors, pedagogical approaches, range of activities, and IT options. Similarly, Dede (2008) looks at the roles of content, pedagogy, assessment, explaining that a particular technology can influence more than one of these aspects of the curriculum simultaneously.

While many conceptual frameworks exist that incorporate these elements, one that represents IT integration as a form of teacher knowledge is Technological Pedagogical Content Knowledge (TPCK, also referred to as TPACK) developed by Mishra and Koehler (2006).

2.4.1 Technological Pedagogical Content Knowledge (TPCK)

TPCK is an extension of Shulman's pedagogical content knowledge (PCK) idea for teaching that was introduced in 1986 to understand how content is organized, adapted and represented for instruction (Mishra and Koehler, 2006, p. 1021). Shulman (1986) expressed that the focus in teaching tended to be on either content or pedagogy and therefore proposed a new body of knowledge he termed "pedagogical content knowledge" which implies a transformation of the subject matter for teaching. Angeli and Valanides (2009) explain that many researchers have explored extending Shulman's PCK concept to specifically address teaching with technology and that TPCK is the term that has become most used most in the literature.

2.4.1.1 Components of TPCK

TPCK is depicted graphically by three overlapping circles representing the knowledge bases of content, pedagogy, and technology as well as knowledge at the intersections between each of these (see Figure 1).

Content knowledge refers to the subject matter to be learned or taught and "includes knowledge of concepts, theories, ideas, organizational frameworks, methods of evidence and proof as well as established practices and approaches toward developing such knowledge in a particular discipline" (Shulman as cited in Harris, Mishra & Koehler, 2009, p. 397).

Pedagogical knowledge pertains to the processes and practices of teaching and learning which includes "knowledge about techniques or methods used in the classroom, the nature of learner's needs and preferences, and strategies for assessing student understanding" (Harris et al., 2009, p. 397).

Technological knowledge, the newest piece added for technology integration, evolves with new technological developments. As Mishra and Koehler explain, "the addition of a new technology is not the same as adding another module to a course. It often raises fundamental questions about content and pedagogy that can overwhelm even experienced instructors" (2006, p. 1030).

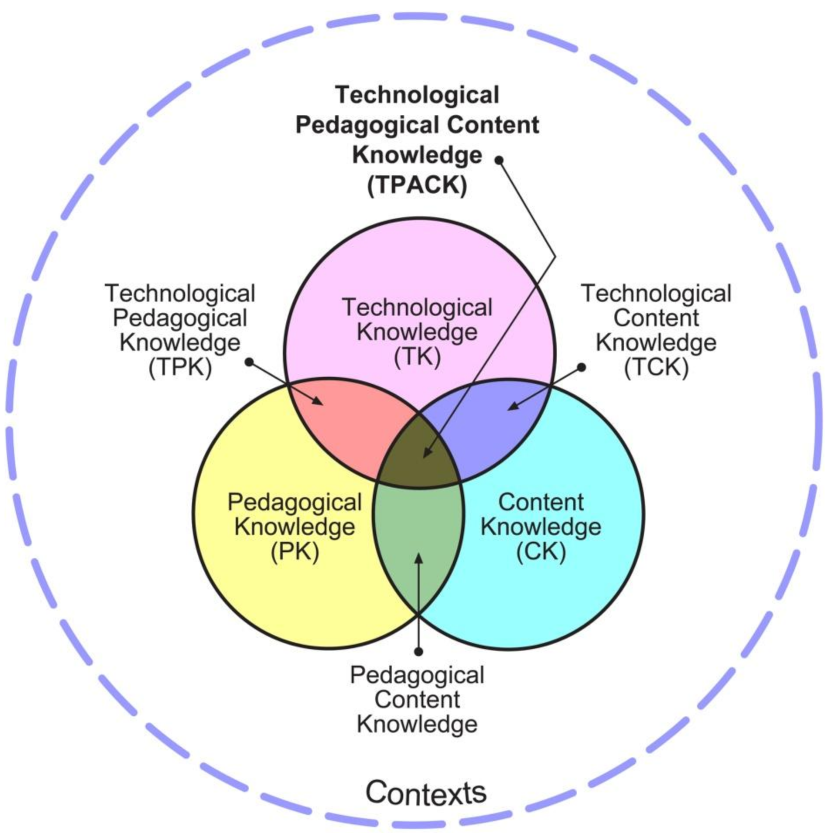

Figure 1 – Technological Pedagogical Content Knowledge (TPCK)
(Source: http://tpack.org/)

The many intersections of TPCK, e.g. technological pedagogical knowledge or technological content knowledge, emphasize the importance of understanding the interactions among the components. For example, technological content knowledge requires an understanding of how technology and subject matter relate and how the content can be changed when using technologies. This also works in the opposite direction i.e. how content shapes use of technologies. The center intersection represents a new body of knowledge where all three pieces come together for integration. Mishra and Koehler summarize that "TPCK is the basis of good teaching with technology and requires an understanding of the representation of concepts using technologies; pedagogical techniques that use technologies in constructive ways to teach content; knowledge of what makes concepts difficult or easy to learn and how technology can help redress some of the problems that students face; knowledge of students' prior knowledge and theories of epistemology; and knowledge of how technologies can be used to build on existing knowledge and to develop new epistemologies or strengthen old ones" (2006, p. 1029).

The entire TPCK concept is heavily influenced by contextual factors (Mishra & Koehler, 2006; Harris & Hofer, 2009). Angeli and Valanides (2009) expressed that TPCK doesn't currently take other factors into consideration but upon closer inspection of the diagram in that particular paper, the outer "contexts" circle is missing. Interestingly, this is not the only paper where it is not explicitly shown. However, for this thesis, the outer "contexts" circle encompassing all factors of the specific learning environment will be highly important and is considered to be a core part of TPCK.

2.4.1.2 Previous Applications of TPCK

As mentioned above, TPCK is a considered to be body of knowledge that instructors need to develop in order to integrate IT for teaching. To help translate the concept into practical teaching, authors have introduced the use of curriculum-specific, technology-enhanced learning activity types and building blocks for instructional planning (Harris & Hofer, 2009). There has also been previous work in exploring how pre-service and in-service teachers can develop TPCK. The most common approach has been to engage teachers in learning by design activities (Koehler & Mishra, 2005; Koehler, Mishra, & Yahya, 2007; Angeli & Valanides, 2009; So & Kim, 2009). Studies involved having groups of teachers collaborate to design instruction using technology and collecting participant views regarding the process. In doing so, the investigators also examined how the participants' knowledge in terms of TPCK changed over time. In all cases, the findings indicated that teachers were able to see the three knowledge bases as co-dependent constructs for integration.

2.5 Integrating EMRs into Health Informatics Education

As discussed above, the literature offers numerous examples of IT integration as well as underlying perspectives and general strategies which may be employed. We will now move into the specific context being addressed in this work. The use of technology like EMRs for HI holds great promise. A preliminary search found some papers regarding technology use in medical education; however, even the literature from medical education suggests little discussion of integration of technologies such as EMRs into educational programs. According to a paper by Keenan, Nguyen, and Srinivasan, "little is known about how EMR technology is currently used for medical learners" (2006, p. 522). Fischer, and Grunwald and Corsbie-Massay note that "the evidence base for best practice guidelines for an appropriate integration of computerized teaching methods in medical education is small" (as cited in Hege et al., 2007, p. 791). The same sentiments are echoed by Otto and Kushniruk (2009) in a recent paper on medical informatics in undergraduate medical education: "the ability of EMR's [sic] to automatically present contextual information offer great potential as an educational tool, but data to support their effectiveness in education is not yet available." While the above literature refers to medical education, there appears to be even less evidence of use of this type of IT in HI education. Otto and Kushniruk (2009) express there is a need for graduating physicians with core competencies in medical informatics and information technologies. A parallel statement can be drawn for HI with a need for graduating students possessing core competencies in HI and IT.

Clearly there is a gap here that needs to be addressed. A new technical artifact, the "educational EMR" (i.e. the EMR as used for educational purposes), has the potential to help undergraduate HI students achieve core competencies in a variety of their courses if integrated effectively. The literature does not appear to include applications of integration models in areas like HI, particularly with regard to systems like EMRs. Since "there is no general solution to a teaching problem for every context, every subject matter, every technology, or every classroom" (Koehler & Mishra, 2008, p. 20) the TPCK concept will be used to explore this specific integration context (see Figure 1) to determine what might be necessary to integrate this type of IT into the HI curriculum.

2.5.1 Technology – Educational EMRs

In the real-world, EMRs are used daily by physicians, nurses, and other healthcare professionals in the provision of care. They are tools to help clinicians manage patient care (Carter, 2001). While the exact features and capabilities of EMRs vary from system to system, there are some general technical components that should be present. A foundational piece is the back-end database which allows storage and retrieval of information within the EMR (Carter, 2001). Common database software includes products such as Oracle® or SQL Server. Related to the database is some mechanism for data entry, typically drop down menus or free text entry. Systems with poor interfaces for data entry and retrieval often result in human-computer interaction issues at implementation. Therefore, the design component, including programming and testing of the system is critical. According to Carter (2001), presentation functions drive the EMR concept, allowing data to be looked at in different ways unlike the paper chart. This has an impact on clinical decision-making. Some systems specifically contain decision-support features using the information within a patient's record to help guide care. For example, some systems may produce alerts or reminders that are triggered when clinical values fall out of normal range or after a set period of time. Because health data are highly sensitive, the security component of a system needs to ensure that only authorized users are able to access information they are entitled to see. Passwords are a common mechanism to prevent unauthorized access but new methods using biometrics have also been explored (Carter, 2001). Often EMR systems are set up on several workstations or terminals in a local area network or through the Internet for more remote access.

And as the health system moves toward a pan-Canadian EHR, it is clear that individual EMRs and other HIS will need to communicate at a larger scale to facilitate information sharing across of the spectrum of healthcare. Therefore, common messaging and classification standards also need to be incorporated into EMRs. For messaging, perhaps the most widely accepted current standard is HL-7 (Health Level 7) which is used to move clinical and other types of data between systems (Carter, 2001). In terms of coding and classification, examples include SNOMED CT (Systematized Nomenclature of Medicine – Clinical Terms) and ICD (International Classification of Diseases).

Beyond the technical components are the organizational and clinical features. EMRs are implemented within a larger organizational context that contains people and workflow processes. Clinical decision-support is one featured already mentioned but there are many more. Some major clinical care processes include administrative support (e.g. scheduling and billing), documentation, laboratory tests and imaging ordering and results retrieval, prescribing, data analysis and reporting (Carter, 2001). Alerts may be also be imbedded within these functions (e.g. allergy alerts during prescribing).

It is clear that EMRs and similar HIS are very complex in the clinical environment, but what role would such a system play in a HI classroom? In using this type of technology for learning purposes we need to understand the technology itself and how it can be leveraged for learning in the educational context.

For example, the UVic Interdisciplinary Electronic Health Record Educational Portal (hereafter referred to as the 'UVic EHR Educational Portal') was recently developed, allowing users direct and remote access to several types of HIS (Borycki et al., 2009) including OpenVista® system and OpenMRS®, an EMR used throughout the world. One accessible EMR is the Digital Health Design EMR® created by Dr. Ron Joe. The EMR is fully functional but has added capabilities designed to accommodate learning, therefore it can be placed into two categories of technology used for education as discussed above:

real-world technology and technology designed specifically to support learning. This EMR is described further in Chapter 6.

2.5.2 Pedagogy

Pedagogy refers to the practice of teaching which more practically breaks down into teaching activities, methods, strategies or approaches employed by instructors in the classroom and beyond. Weston and Cranton (1986) developed a summary of instructional methods. They group methods into four categories: instructor-centered, interactive, individualized, and experiential learning methods. The following definitions are based on the authors' descriptions. Instructor-centered methods generally consist of activities where the instructor passes on information to students. Interactive methods facilitate learning through communication between instructor and student and among students. For individualized learning, the student works at their own pace individually. Finally, experiential learning often takes place in natural or simulated settings. As well, Weston and Cranton (1986) note that they can also be instructor-centered, interactive or individualized. Figure 2 is based on Weston and Cranton's main categories with the addition of assessment spanning all categories. In integrating the educational EMR, we need to determine which methods (in any category) are currently used and could possibly be used with an educational EMR.

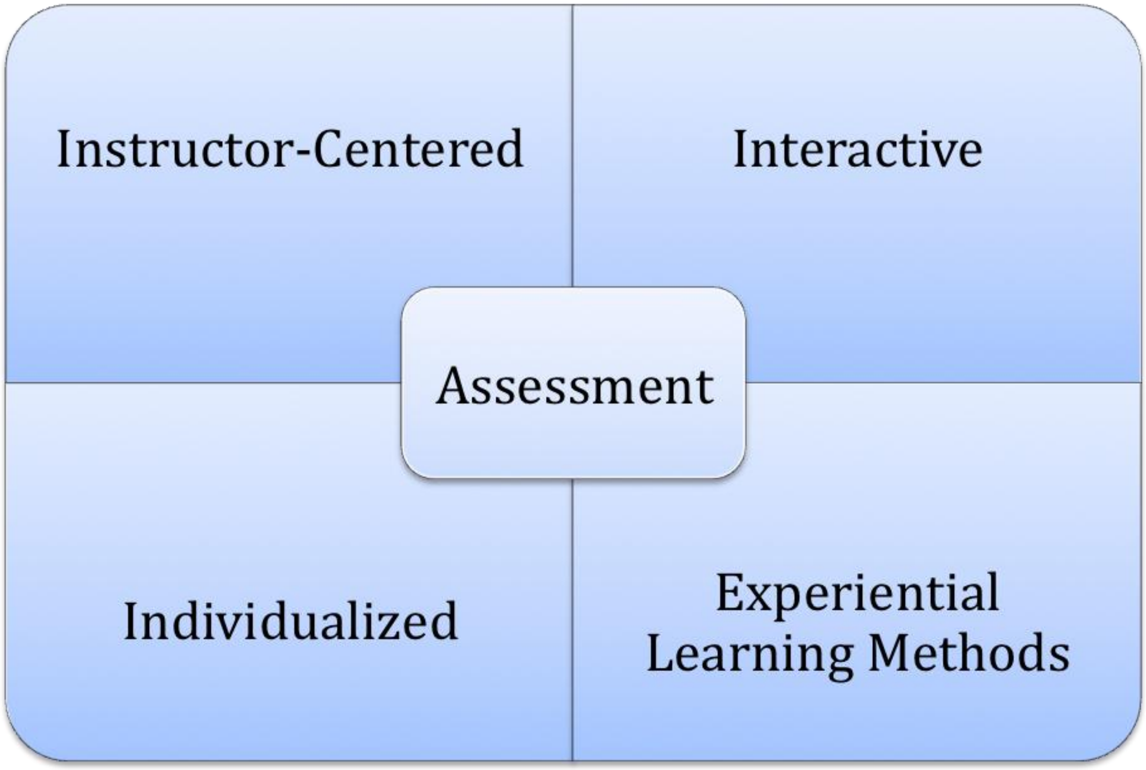

Figure 2 – Main Categories of Teaching Approaches (based on Weston and Cranton's Summary of Instructional Methods (1986, p. 265))

2.5.3 Content – Competencies and Topics in Health Informatics

Looking at the TPCK diagram (Figure 1), we see that we also need to know what content needs to be taught to HI students. Some previous work has been done to determine what competencies a health informatics professional should have. For example, Moore and Shaw-Kokot (2000) explored information literacy competencies for students in health professional education programs, coming up with a list of key informatics competencies for graduates. For HI, Hasman (1998b) described a set of guidelines developed for education and training in health informatics under the IT-EDUCTRA project. The guidelines are broken down into eight sections with each summarizing topics that could be discussed in a course to help with course planning. Ten worksets with learning materials developed based on the guidelines were created under the IT-EDUCTRA project. As well, Huang (2007) conducted a systematic review of global curriculum development to create a framework for graduate competencies in health informatics, medical informatics, and biomedical informatics. Some of the competencies are regarded as suitable for undergraduate programs as well.

In terms of work by organizational bodies, IMIA produced a first version of recommendations for education in HI and medical informatics in the form of a 3D framework in 2000 (IMIA, 2000), containing educational needs learning outcomes. According to IMIA: "the aim of all dedicated programs in health and medical informatics is to prepare graduates for careers in health and medical informatics in academic, healthcare or industrial settings" (2000, p. 274). For the bachelor level, they stated that the curricula should be application-related to directly prepare students for future professional activity. Those preparing for careers in health and medical informatics were referred to as HMI (health and medical informatics) specialists. Learning outcomes were categorized and define the levels of knowledge and practical skills needed according to three domain areas: methodology and technology for the processing of data, information and knowledge in medicine and healthcare; medicine, health and biosciences, health system organization; and informatics/computer science, mathematics, biometry. In 2001, there was a call to update the recommendations (Douglas & Hovenga, 2002) and most recently in March 2010 a first revision was published (Mantas, Ammenwerth, Demiris, Hasman, Haux, Hersh, et al., 2010) which mentions competency work done by other individuals and organizations including COACH.

In Canada, COACH has produced the Health Informatics Professionalism (HIP™) Competency Framework. The framework was selected to be used in this work as it applies to the Canadian context and is specific to health informatics. COACH describes competencies as "the knowledge, skills, attitudes, and judgments required to perform safely and effectively in a broad range of environments and practice settings" (2009, p. 8). The HIP™ Core Competencies® Framework (see Figure 3) is made up of three source practices that form the core body of knowledge: health sciences, information sciences, and management sciences. These break down into seven subcategories that contain a set of specific competencies for the HI professional (there are 46 competencies in total). However, how are these competencies addressed in actual courses? That is, what specific topics are taught that help students attain the competencies? These will need to be explored, specifically those that relate to EMRs.

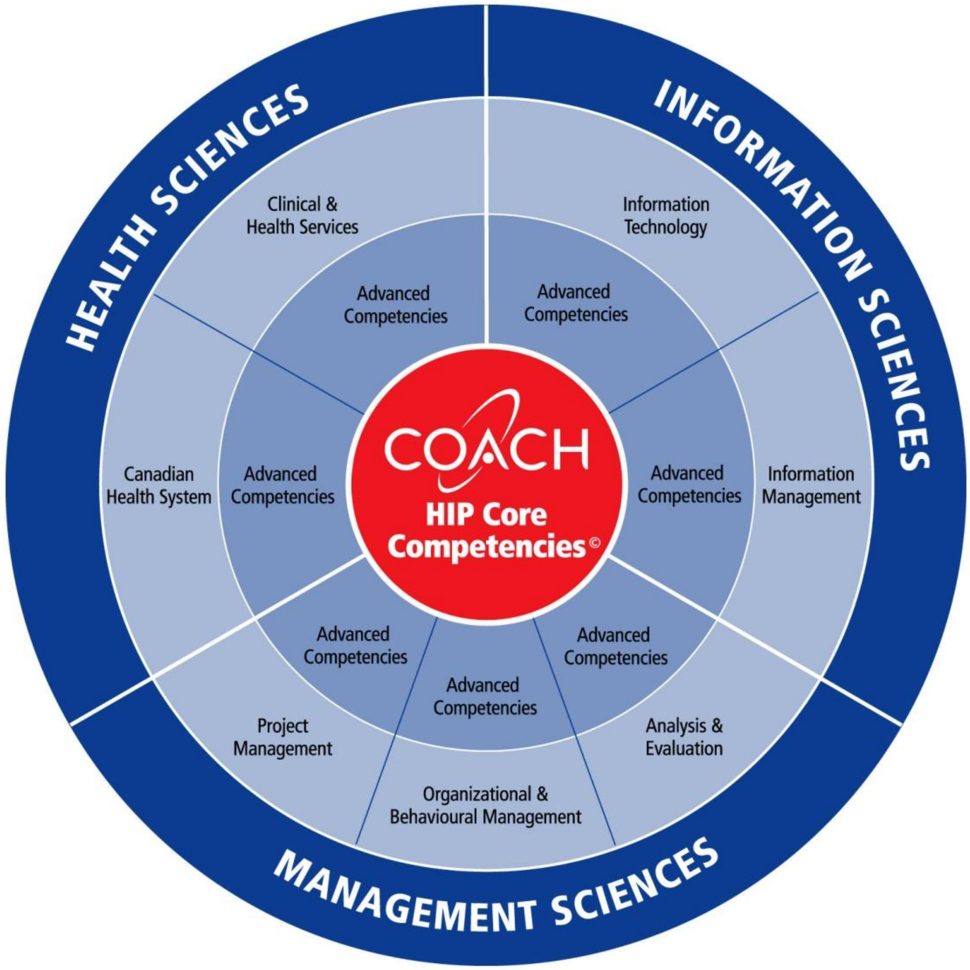

Figure 3 - COACH's HIP™ Competency Framework (COACH, 2009, p. 9)

2.5.4 Intersections

Adding to the complexity of integration are the relationships between these three types of knowledge that also have to be considered. For example, we need to determine how the EMR can be applied to the subject matter students need to learn including topics and competencies. Also, related to content is the relationship between pedagogy and content, i.e. the pedagogical content knowledge. How are topics currently taught without the educational EMR and how might that change when the EMR is used?

2.6 Previous Integration Work

While work into effective integration strategies has generally been limited, EMRs and similar systems, such as EHRs and EPRs have been used by health professional students to some extent for learning (e.g. Speedie & Niewoehner, 2003; Lea, Pearson, Clamp, Johnson, & Jones, 2008). As mentioned above, some systems may differ from EMRs but they do share some fundamental characteristics in terms of allowing health professionals to maintain and work with electronic or computerized versions of patients' medical records. Therefore any previous integration efforts, specifically the methods and results involving these types of systems will be important to consider.

As well, some of the individual systems accessible through the UVic EHR Educational Portal have already been introduced to medical, nursing and HI students with promising early results (Borycki et al., 2009; Joe, Kushniruk, Borycki, Armstrong, Otto & Ho, 2009). The very first application was done with 4th year medical students by the University of British Columbia (three sites) (Borycki et al., 2009; Joe et al., 2009). At this point the EMR system wasn't actually a part of the portal; the software was installed on several laptops for students to use (Joe et al., 2009). Throughout the course of a week, students worked on a fictitious patient case where exercises included entering an encounter, performing disease coding, populating a problem list, requesting a consultation, and retrieving imaging results and a hospital discharge summary (Joe et al., 2009). Informal feedback from students and educators was good. Later on, nursing students at UVic received hands-on experience with an EPR through the UVic EHR Educational Portal. Students explored the software prior to class, where they participated in lectures and discussions surrounding the system (Borycki et al., 2009).

The portal has also been recently introduced to some undergraduate and graduate students in HI in isolated instances. Borycki et al. (2009) mention that undergraduate students reviewed systems in the portal and suggest that it can be used to develop health informatics competencies. The need for an integration framework for integrating these types of systems into health professional education has already been recognized. One perspective taken by Kushniruk, Borycki, Armstrong, Joe, and Otto (2009) proposed a continuum of loose to tight coupling in terms of the extent to which a system is used with teaching approaches. For instance, the use of the system in demonstration is considered to be an example of loose coupling whereas hands-on assignments delving into design activities is tight coupling. Building on these early experiences, this work aims to take integration further for HI education by exploring all the contextual pieces surrounding integration as a whole in an effort to provide more structured guidance for such efforts.

Chapter 3 – Structured Review of EMR Use in Health Professional Education

A literature search on EMR integration into education found a few examples of previous efforts. A systematic search was conducted to determine what has been done already in terms of integrating EMRs and similar systems in HI education and/or related disciplines and, more importantly, what was discovered. This chapter presents the methods and results of a structured literature review.

3.1 Methods

3.1.1 Search Strategy

Although this thesis is focused on HI, use of EMRs in education delves into the medical/health, educational, and technical fields as well. Therefore four key databases were searched: MEDLINE, CINAHL, ERIC, and Computer Science Index. MEDLINE is a comprehensive database created by the National Library of Medicine (NLM) which indexes many journals including those pertaining to medicine, nursing, dentistry, veterinary medicine, the healthcare system, and pre-clinical sciences. CINAHL, the Cumulative Index to Nursing & Allied Health Literature, provides indexing for nursing and allied health journals including subjects of biomedicine, health sciences librarianship, behavioural sciences, consumer health, health management, and education. The ERIC database is a key educational journal index. The Computer Science Index covers the areas of software engineering, computer engineering, and computer science. (Descriptions of databases are available on the UVic Library Website: http://library.uvic.ca.)

A set of terms were identified for EMR and education to construct the following Boolean query: (((electronic OR computerized) AND (medical record OR health record

OR patient record)) OR (EMR OR EHR OR EPR)) AND (learning OR education OR teaching). (Note: terms for other systems were included since, as explained in the background, several terms are used to describe EMRs. Limiting the search to “EMR” would possibly exclude relevant papers and integration experiences of similar systems were relevant for this work.) The query was limited to English language papers published from 1990 to 2010 (March 25).

3.1.2 Selection

In order to be included, articles had to discuss some aspect of EMR integration for student education in the classroom. They could be formal research studies, case studies, or descriptive papers. Only papers meeting all of the following selection criteria were selected:

1) Pre-service education: The educational setting had to be pre-service, that is, not a real clinical environment. Typically this would be an educational institution where students learn prior to going out in the field (e.g. university classroom or lab).
2) EMR (or similar) focus: The focus of the article needed to be on EMRs (or similar HIS).
3) EMR (or similar) used: An EMR had to actually be utilized in the article. For example, just a mention of EMRs would not constitute usage.
4) Educational setting: The EMR needed to be used within the classroom or at least part of course learning activities.
5) Student/teacher use: The EMR had to be used by students or teachers for learning in some way.

All retrieved results were reviewed twice by the investigator. In both passes, the investigator scanned titles and abstracts of all citations and where possible, determined if each criteria item was met. If it wasn't clear whether an item was met, the result was flagged to review the full text. Final decisions were made based on full text review of all selected articles.

3.1.3 Data Collection

For all selected papers, the full articles were retrieved through the university library. Each paper was read carefully and the following information was extracted into a Microsoft® Excel spreadsheet:

- Author(s)
- Title
- Year of Publication
- Document: article, abstract or proceeding
- Type: descriptive or study
- Discipline: Which discipline the students using the system were in i.e. health informatics, medicine, etc.
- Purpose: What the paper was describing
- Setting: Where the system was used
- IT Type: What the system was referred to as in the paper e.g. EMR, EHR, EPR plus any other IT used as well
- IT Description: What the system entailed i.e. vendor, features, setup, etc.
- Topics: What topics were addressed through use of the system
- Teaching Activities: How the system was used as part of teaching

- Findings: Any general findings or recommendations for integration

This spreadsheet served as the main raw data to be used in focused tables for synthesis and discussion.

3.1.4 Data Synthesis

In order to enable comparison, data from the main spreadsheet described above was divided into categories for content (using the seven categories in COACH's HIP™ Competency Framework (see Figure 3)), teaching approaches (categorized by the four high-level groups in Weston and Cranton's Summary of Instructional Methods (see Figure 2)), and IT use. COACH's categories were used regardless of the discipline to determine what areas related to HI have been addressed with systems in general for potential mappings to HI. Due to the wide range of systems termed as "EMR" found in the literature, it was necessary to describe the system in the article as much as possible and note the differences for discussion.

3.2 Results

The search strategy resulted in a total of 1392 references being returned. Of these, there were 34 duplicate results and 5 papers were specifically about the UVic EHR Educational Portal. Since the focus of this activity was to explore how other EMR (or similar) systems have been integrated into classroom learning, these 5 papers were put aside to be incorporated into the background section on the UVic EHR Educational Portal.

For the remaining 1353 citations, many different types of papers were found, some of which were completely irrelevant e.g. medical or educational concepts which also have the abbreviation of EMR or use of EMR for study data. A wide application of the term "electronic medical record" was used during selection and included any systems that were described as electronic or computerized versions of medical records such as EHRs, CPRs, and EPRs. A large number of papers pertained to some aspect of EMRs or related HIS but did not address learning. Other papers were excluded because they involved staff training on the system or medical resident training where the learning did not occur within a pre-service environment. The most difficult selection decisions surrounded papers that did address pre-service student learning of EMRs but were not used in a classroom setting, by students, or were not focused on the EMR or HIS.

As well, a variety of different types of papers were returned including articles, abstracts, proceedings, reports, and dissertations. All of these were included during selection.

3.2.1 Selected Papers

After two rounds of careful review of all citations, the list of relevant citations was narrowed down to 25. Of these, two papers were dissertations. Only one was found through a library search and it turned out that it was written by the same author as another selected article and addressed the same work. Therefore, the dissertation was rejected. This resulted in a total of 24 selected papers (see Figure 4).

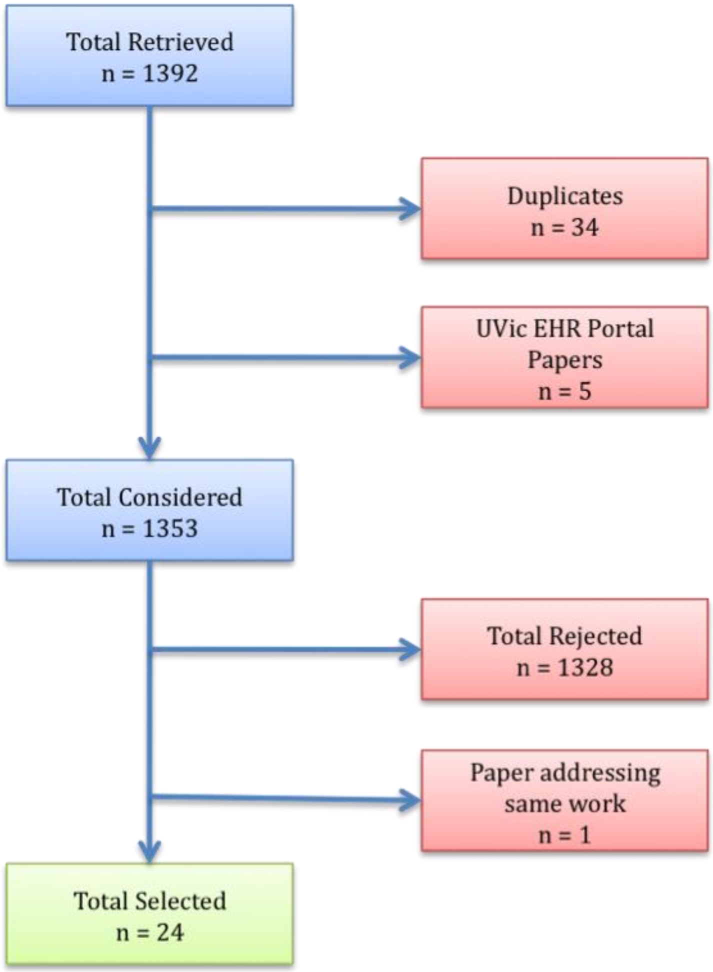

Figure 4 - Paper Selection Flow Diagram

See Appendix A for general characteristics for each paper. Of all the papers, the majority addressed learning in the clinical disciplines of medicine or nursing. Dentistry was also present. However, most interesting for this thesis was the fact that while some papers addressed informatics for clinical health professionals, only two papers specifically focused on HI (Okada, Yamamoto, & Watanabe, 2007) or health information management (Dimick, 2008). This suggests either a lack of integration in this field or a lack of reported research on integration in this field.

The majority of the papers were descriptive in nature. 18 papers were complete articles, of which 5 presented a study and 1 dissertation, which reported on a study. There were also 3 abstracts (one on a study) and 2 conference proceedings. While these didn't offer in-depth detail on integration, they did provide some information on instances of integration. In fact, all selected papers varied on the degree of detail offered so an attempt was made to extract as much as possible on the three categories of interest: IT use, teaching approaches, and topics. Many papers described projects undertaken to incorporate systems into the classroom. For example, four papers (Bani-Issa, 2005; Connors, Warren, & Weaver, 2007; Kennedy, Pallikkathayil, & Warren, 2009; Weber, 2004) referred to the Simulated E-hEalth Delivery System program (SEEDS), which integrated an EHR into several health professional curriculums. Another common occurrence was a partnership or collaboration established between the academic institution and system vendor or clinical setting to use a real product such as in the case of the SEEDS project and a few other papers (Barger & Das, 2004; Fauchald, 2008; Melo & Carlton, 2008; Nickitas, Nokes, Caroselli, Mahon, Colucci, & Lester, 2010).

Seven studies evaluated different aspects of using HIS in learning including impact on clinical knowledge (Cholewka & Mohr, 2009); experience and knowledge about information systems (Gassert & Sward, 2007); experiences and behaviours learning the nursing process (Kennedy et al., 2009); teaching beliefs and practices of educators using EHR in the classroom (Bani-Issa, 2005); EHR-specific communication skills (Morrow, Dobbie, Jenkins, Long, Mihalic, & Wagner, 2009), problem solving skills using an EPR (Muma & Niebuhr, 1997); and student attitudes and self-reported skills regarding practice management, coding and clinical documentation (Stephens & Williams, 2010).

Regardless of the focus and purpose of the selected papers, each offered important insights into integration.

3.2.2 Topics Addressed

Virtually all the papers addressed clinical disciplines such as nursing or medicine. However, there were a few which discussed integration into multiple disciplines (Connors et al., 2007; Fauchald, 2008; Stahl, 2000) and while some were for the clinical fields, they aimed to teach informatics concepts (e.g. Curran, 2008; Litt & Loonsk, 1992; Naeymi-Rad, Trace, Moidu, Carmony, & Booden, 1994). Therefore, an attempt was made to categorize any topics specifically mentioned in the papers into the seven subcategories of COACH's HIP™ Competency Framework. The subcategory "Canadian Health System" was modified to "Health System" because many papers were not for the Canadian context. It is important to note that only the data presented in the papers was extracted and additional topics that were addressed in teaching may not have been mentioned in the paper itself.

As Appendix B shows, most of the topics fell into the "Clinical and Health Services" or "Information Management" categories as the systems discussed were mainly used to support clinical processes. Documentation of clinical information and patient care was the most common topic addressed. In some papers, specific information technology concepts were also addressed, mainly features of IT to support care including security (Gassert & Sward, 2007; Okada et al., 2007; Speedie & Niewoehner, 2003) and strengths and weaknesses of systems (Lea et al., 2008; Nickitas et al., 2010).

A few papers also mentioned organizational and behavioural management topics such as practice management (Gassert & Sward, 2007; Stephens & Williams, 2010) and roles or workflows within clinical environments (Fauchald, 2008; Lea et al., 2008; Stahl, 2000).

None of papers seemed to address teaching project management concepts to students. Interestingly, one of the two papers focused on HI (Okada et al., 2007) mentioned concepts that fit into all categories of COACH's framework except project management.

The review of topics showed that EMR or similar systems have been used to teach many concepts relevant to HI. The next section describes how some of these topics were actually taught in the classroom.

3.2.3 Teaching Approaches

In order to understand teaching approaches that have been used and specifically, how EMRs and similar systems have been integrated into them to support learning, descriptions of teaching activities were extracted from the papers and categorized using the four main groups in Weston and Cranton's Summary of Instructional Methods (see Figure 2) plus assessment (see Appendix C).

All papers described various forms of experiential learning methods, typically cases, scenarios or simulation where students experienced hands-on use of the systems. Some difficulties were encountered in one paper (Nickitas et al., 2010) where the intent was to have students use a real EHR but due to access constraints only faculty were able to access the system and then they guided the students.

In general, interaction during learning was encouraged (Connors et al., 2007; Lea et al., 2008; Morrow et al., 2009; Stahl, 2000; Weber, 2004). Students shared their work with peers or did role-plays using the system. Four papers discussed interaction with the instructor during system use (Bani-Issa, 2005; Fauchald, 2008; Kennedy et al., 2009;

Stahl, 2000). In Stahl (2000), students and teachers simulated clinical shifts by taking turns logging into the system to review and enter data for a case. Similarly, Bani-Issa (2005) described how students and teachers logged on to the same case. In simulations using the academic EHR, Fauchald (2008) explained that faculty could manipulate the case information to include unexpected outcomes to stimulate critical thinking.

In contrast to these interactive teaching methods, two papers discussed more individualized approaches. In Gassert and Sward (2007), to learn data security and confidentiality concepts, students were warned that faculty could track where they had been in the system and whether they had looked at fellow students' charting. The EPR laboratory described in Okada et al. (2007) was designed for self-learning using test, fail, review cycles. In most papers, purely instructor-centered approaches were rare but there was integration of the system with traditional methods like lectures (Speedie & Niewoehner, 2003; Weber, 2004) and it was sometimes used for case presentation (Connors et al., 2007; Muma & Niebuhr, 1997). One paper was unique in that it presented approaches for system integration for two very different pedagogical views (Bani-Issa, 2005). Instructors subscribing to an objectivist perspective employed mostly instructor-centered approaches whereas those whose teaching was more in line with constructivist theory used mostly experiential and interactive methods. However, cases were used by both groups. In most papers, cases were developed for student use and typically involved students completing specified tasks. In Gassert and Sward (2007), students were given freedom to chart anything for play patients in order to become familiar with the system.

Perhaps most relevant for this research were uses described in Dimick (2008) and Okada et al. (2007) which addressed HI education. Both explored coding and in Dimick (2007), health information management students looked at the inside of the EHR application.

3.2.4 EMR and Related IT Use

While the focus of the review was on EMRs and similar health information systems being used for student learning, other types of general IT such as PDAs (Cholewka & Mohr, 2009; Curran, 2008) and applications like Microsoft® Excel, Lotus 123, WordPerfect, Microsoft® Word, Dbase, Hypercard, Oracle® SQL (Naeymi-Rad et al., 1994), and Microsoft® PowerPoint (Taylor, Valenza, Spence, & Baber, 2007) were mentioned as well. Some systems also provided links to resources (e.g. Bani-Issa, 2005; Speedie & Niewoehner, 2003). Several systems were set up within laboratories that had computers, screens, and projectors as well as other clinical equipment. For example, in Taylor et al. (2007) a clinical space was set up with cameras, DVD and VCR players as well as a mannequin/torso with dentoform for dental students. A few schools offered learning environments with a variety of health IT in addition to the health information system. The HIM Virtual Lab discussed in Dimick (2008) offers six health applications, in Melo and Carlton (2008) students were exposed to examples point-of-care (POC) wireless devices, and the curriculum in Naeymi-Rad et al. (1994) uses many decision support programs (e.g. Dxplain and Illiad). See Appendix D for types of IT mentioned and descriptions provided in the papers.

In most cases, papers discussed simulated EMR or similar systems with fictitious patients. Many schools developed partnerships or collaborations with vendors to use real-life systems for learning. For the SEEDS project (discussed in Bani-Issa, 2005; Connors et al., 2007; Kennedy et al., 2009; Weber. 2004), the system was Cerner's PowerChart® adapted for academic use. Cerner has an Academic Education Solution (AES) version of their system that was adapted by a few schools. In Gassert and Sward (2007), it was called UCARE (Utah Clinical Academic Record Excellence) and two other papers (Dimick, 2008; Fauchald, 2008) referred to the use of an adaption called ATHENS. A common set-up approach was through the Internet, allowing students and instructors remote access through laboratories or other locations.

In some cases, the system being used by students was actually physically located in a hospital. In Nickitas et al. (2010), an academic-clinical partnership between a university and hospital was established to allow students to use the hospital's real system. And in Lea et al. (2008), a live system students will meet on their clinical placements was selected for student use with fictitious patients. Another paper (Barger & Das, 2004) described the use of a training module within a medical center's computerized medical record system that contained real-life data for abstracted patients.

Many of the papers described ways in which systems supported learning. The Cerner AES had an academic overlay. Bani-Issa (2005) mentioned that the system had components added by educators to design nursing care plans for selected virtual case studies. In Kennedy et al. (2009), the modified EHR provided visual prompts to students. Two papers described systems designed specifically for learning (Litt & Loonsk, 1992; Okada et al., 2007). Litt and Loonsk (1992) described a set of browsers written in Microsoft® Visual Basic and a "Medical Desktop" created to allow access to many medical reference tools through the same interface. In Okada at al. (2007), the EPR laboratory system showed students which questions weren’t answered correctly and guided them to relevant materials.

The review of IT showed that many schools recognize the need to have students use technologies within the learning environment, both as a supporting tool and to expose them to real-world systems. Whether schools choose to use established systems or develop their own with additional tools, they have implemented some innovative approaches.

3.2.5 General Integration Considerations

The papers discussed many aspects of integration to consider. The following is a summary of the key items mentioned, organized into the categories of course, student, instructor, system, technical, and other related considerations.

3.2.5.1 Course Considerations

As explained in the previous section on teaching approaches, cases or scenarios were often used to incorporate the system. Accordingly, case development was an important consideration in the majority of papers. In many papers the cases were linked to specific competencies, objectives and content (Connors et al., 2007; Curran, 2008; Fauchald, 2008; Gassert & Sward, 2007; Lea et al., 2008; Morrow et al., 2009). For example in one paper (Curran, 2008), faculty would be asked to provide assignments for their students to learn each informatics competency required and to test them out. In another (Stahl, 2000), cases were developed but were expected to change through use. The general features would be set by the teacher team but the course of events would be improvised during interactions between students and teachers.

In Dimick (2008) and Weber (2004), educators recognized that learning in a hybrid paper-electronic environment was still necessary. As Dimick (2001) states, not all healthcare facilities use electronic systems so instructors must still teach paper practices for health information management. At the institution discussed in Weber (2004), students are also sent to healthcare environments with paper charts, hybrid, and with other systems in use. In terms of system use within the classroom, in one paper (Curran, 2008) cases were outlined on paper and supporting data and documentation entered into the system.

Within a course, cases were often followed over time (Litt & Loonsk, 1992; Madden & Hanberg, 2009; Okada et al., 2007; Speedie & Niewoehner, 2003; Stahl, 2000). However, integration was often not limited to a single course or program. In many institutions an effort was made to have coordination at a higher level to allow activities to be used more widely (Fauchald, 2008; Gassert & Sward, 2007; Lea et al., 2008). In Gassert and Sward (2007), during planning faculty decided to tie the learning activities of three courses more closely together and adjust timing so students were learning the same concepts in all three classes. And Lea et al. (2008) discuss sharing forms among schools which will standardize some of the language used to teach concepts to undergrad students across schools of nursing.

A gradual or step-by-step approach to integration was also suggested in a few papers (Curran, 2008; Fauchald, 2008; Gassert & Sward, 2007; Stahl, 2000) using various methods. In one paper (Stahl, 2000), the author describes how cases were presented in segments with the progression controlled by teacher. At a higher level, integration started with a target of one course per program per semester in Fauchald (2008) and similarly in

Gassert and Sward (2007), a decision was made to implement the system one semester at a time.

3.2.5.2 Student Considerations

For student-related concerns addressed during integration, the most commonly mentioned was consideration of student level such as current year of the program (Connors et al., 2007; Fauchald, 2008; Gassert & Sward, 2007; Lea et al., 2008; Morrow et al., 2009; Naeymi-Rad et al., 1994), knowledge (Curran, 2008) or technical competency (Lea et al., 2008; Litt & Loonsk, 1992). In two papers, the level of difficulty for activities could be set (Okada et al., 2007; Stahl, 2000). Closely related to this was recognition of individual learning needs (Bani-Issa, 2005; Stahl, 2000; Stephens & Williams, 2010). For example, Lea et al. (2008) found that some students were overwhelmed and found entering clinical data difficult and challenging. Stephens and Williams (2010) also included information on some difficulties experienced by students when using the system.

This leads to another consideration for students: support in using the system. In many papers, resources that students could refer to for help were provided (Connors et al., 2007; Fauchald, 2008; Litt & Loonsk, 1992) while other papers described how instructions or assistance were provided along with the system (Gassert & Sward, 2007; Kennedy et al.,2009; Nickitas et al., 2010). For instance, in Connors et al. (2007) there were manuals and the systems in Fauchald (2008) and Litt and Loonsk (1992) had associated help centers. In Gassert and Sward (2007), instructions were provided in course syllabi, students received an orientation and there were assistants available in the lab to help. In Lea et al. (2008), while students reported higher technology skills and knowledge and greater ability to find and manage information, they also wanted more guidance and direction using the system.

One paper also mentioned how students played a more active role in highlighting their needs for integration. In Weber (2004), students pilot-tested the system and were able to recommend adjustments for academic needs.

3.2.5.3 Instructor Considerations

For instructors incorporating the systems into their teaching, perhaps a large consideration is achieving acceptance so that the system will even be used at all. This was mentioned as a challenge in Brown and Waite (2009). Active encouragement for integration was described in Cholewka and Mohr (2009) and Curran (2008). One paper (Curran, 2008) mentions faculty were encouraged to collaborate and provide support among themselves as well as from project staff.

Once instructors had committed to integration, there were several additional considerations mentioned. Integration requires a great deal of preparation e.g. developing lesson plans, materials and/or activities (Dimick, 2008; Okada et al., 2007) and setting up cases with data (Litt & Loonsk, 1992; Madden & Hanberg, 2009; Melo & Carlton, 2008; Morrow et al., 2009) in the system. Instructors also need to have some degree of technical competency with the system (Bani-Issa, 2005; Kennedy et al., 2009; Nickitas et al., 2010; Stahl, 2000).

For students, the need for learning support was highlighted. Similarly, instructors need teaching support. Thirteen of the papers reviewed described how support was provided to instructors. A need for resources was often identified (Brown & Waite, 2009; Connors et al., 2007; Okada et al., 2007; Stahl, 2000) and in some papers training and assistance were provided to instructors (Cholewka & Mohr, 2009; Curran, 2008; Dimick, 2008; Fauchald, 2008; Gassert & Sward, 2007; Melo & Carlton, 2008; Nickitas et al., 2010). In Curran (2008), faculty were introduced to the system the year before students to allow time for them to become proficient and in Melo and Carlton (2008), instructor education was developed. Nickitas et al. (2010) summarize instructor considerations quite nicely in stating that significant time and resources are needed to support integration.

An interesting consideration that came up in a few papers (Bani-Issa, 2005; Curran, 2008; Kennedy et al., 2009; Stahl, 2000; Weber, 2004) was the role of the instructor with use of the system. Bani-Issa (2005) explains that the constructivist approach to teaching is learner-centered with the teacher becoming a facilitator. This type of learning-centered environment was mentioned in Curran (2008) and Kennedy et al. (2009). In Stahl (2000), the teacher role was more of a guide and in Weber (2004), there was total change for faculty to learn to facilitate rather than dictate learning.

3.2.5.4 System Considerations

The actual systems used by instructors and students varied as described in the section above on IT use. In many cases, the institution worked with a vendor to adopt or use their system for learning (e.g. Bani-Issa, 2005; Fauchald, 2008; Gassert & Sward, 2007; Melo & Carlton, 2008) and therefore relied on the vendor to provide support and updates (Connors et al. 2007; Melo & Carlton, 2008).

Students needed to have access to the system (Dimick, 2008; Gassert & Sward, 2007), which was especially a consideration where a live-use system was involved (Barger & Das, 2004; Nickitas et al., 2010). Typically, there would be some kind of an authentication process involving passwords (e.g. Gassert & Sward, 2007). In a few papers the systems were accessible remotely, allowing students to use them outside the classroom (e.g. the Virtual Lab in Dimick (2008)).

The cost of implementing a system for student use was another major consideration in several papers (Cholewka & Mohr, 2009; Dimick, 2008; Fauchald, 2008; Melo & Carlton, 2008; Nickitas et al., 2010). Some institutions had to pay to purchase and setup the system. Others who were using systems implemented elsewhere needed to pay for licensing or subscription costs to use the software. For example there was a subscription cost associated with the Virtual Lab described by Dimick (2008). In Fauchald (2008), there was an initial grant to implement the system but student user fees were later introduced to cover sustainability costs. Vendor donated licensing to install the system alleviated some costs in Melo and Carlton (2008).

A few papers also recognized that students will encounter a variety of systems in the workplace and that this has implications for learning (Dimick, 2008; Lea et al., 2008; Stahl, 2000). The Virtual Lab (Dimick, 2008) offered many applications and Stahl (2000) stated that later it should be possible to use other HIS and EPR software based on the same concept so the students would have the possibility to compare different products.

3.2.5.5 Technical Considerations

Closely tied to the system itself are technical considerations surrounding implementation and use. The design of the system was mentioned in a few papers (Bani-Issa, 2005; Gassert & Sward, 2007) and even in cases where an established system is used, it may need to be customized to meet specific integration needs. For example, there may be hardware requirements (Fauchald, 2008; Melo & Carlton, 2008) and if the system will be used in a lab, the room may need additional technology such as projector to enable the instructor to demonstrate use (e.g. Connors et al., 2007). According to Kennedy et al. (2009), a strong technological infrastructure created a positive learning experience. Once the system is ready, the implementation process also needs to be considered (Brown & Waite, 2009; Cholewka & Mohr, 2009; Lea et al., 2008). Interestingly, the system discussed in Gassert and Sward (2007) was implemented differently at three different schools.

EMRs and other health information systems contain personal information which needs to be kept secure and confidential. Some schools implemented systems with fictitious or scrambled patient data (e.g. Nickitas et al., 2010; Stahl, 2000) to avoid any potential risks. In Fauchald (2008), the system contained real patient data for clinical cases that alumni, faculty, students, or family member had consented to have replicated in the EHR from their paper-based medical records with all personal identifying information removed. Others which allowed access to live systems had to take additional measures to ensure patient information was kept confidential when connecting through networks (Melo & Carlton, 2008; Nickitas et al., 2010). For example in Melo and Carlton (2008), students were provided access based on semester terms, were subject to the hospitals' routine privacy and security audits, and were required to complete the same confidentiality agreement as hospital employees.

Finally, in addition to instructional and learning support, technical support was also required (Curran, 2008; Dimick, 2008; Melo & Carlton, 2008), sometimes provided by an appointed individual or staff. This reflected the fact that systems will likely require maintenance and updates after implementation. Cholewka and Mohr (2009) mentioned the need for ongoing technical support and in Connors et al. (2007), the school received the most-up-to-date releases of the software so that students would be aligned with the most current technology.

The technical aspects of the system underlie integration. A few papers discussed technical difficulties experienced (Nickitas et al., 2010; Stahl, 2000) and therefore require careful consideration early on.

3.2.5.6 Other Considerations

There were a few additional items surrounding integration which came up in the papers. Virtually all the papers discussed a team or collaborative approach to integration. Some institutions formed partnerships with vendors (Bani-Issa, 2005; Connors et al., 2007; Gassert & Sward, 2007; Melo & Carlton, 2008), among faculty (Curran, 2008; Dimick, 2008; Fauchald, 2008; Gassert & Sward, 2007; Lea et al., 2008; Speedie & Niewoehner, 2003; Stahl, 2000), IT support (Curran, 2008; Dimick, 2008; Gassert & Sward, 2007; Melo & Carlton, 2008), healthcare facility personnel (Brown & Waite, 2009; Melo & Carlton, 2008) and a few formed collaborative teams with individuals from a few of these areas. In Lea et al. (2008), where the system was introduced at more than one school, the schools formed a consortium to share ideas. In many papers, the integration of a system in learning was described as a project (Bani-Issa, 2005; Cholewka & Mohr, 2009; Connors et al., 2007; Curran, 2008; Fauchald, 2008; Stahl, 2000) and some even had established project managers or leaders (Curran, 2008; Fauchald, 2008).

Many of the institutions also aimed to incorporate multi- or inter-disciplinary use, sometimes with other programs or schools (Connors et al., 2007; Fauchald, 2008; Lea et al., 2008; Melo & Carlton, 2008; Stahl, 2000; Weber, 2004). Interestingly in Connors et al. (2007), work by nurse practitioner students was reviewed by health information management students.

Three papers also commented on the issue of students learning the technology rather than the concept or process (Connors et al., 2007; Kennedy et al., 2009; Lea et al., 2008). Connors et al. (2007) state that the goal was to help students adapt to the automated healthcare environment while keeping the technology transparent to the pedagogy and not simply teaching the technology. Similarly, Lea et al. (2008) mentioned a general concern that technology can detract from learning so educators need to be aware of this when teaching.

3.2.5.7 Findings

Individual findings with respect to integration varied according to paper purposes. In general, many positive experiences and benefits were discussed such as help to prepare students for the workplace (Barger & Das, 2004; Connors et al., 2007; Litt & Loonsk, 1992; Madden & Hanberg, 2009; Weber, 2004), student satisfaction with use of the system for learning (Brown & Waite, 2009; Connors et al., 2007; Kennedy et al., 2009; Morrow et al., 2009; Muma & Niebuhr, 1997; Stephens & Williams, 2010), improved student performance (Cholewka & Mohr, 2009; Naeymi-Rad et al., 1994), and realistic features of the system and/or data (Curran, 2008; Dimick, 2008; Fauchald, 2008; Speedie & Niewoehner, 2003; Stahl, 2000). Dimick (2008) lists many benefits of the Virtual Lab and mentions that in some cases it is the only hands-on experience students get with the EHR products prior to graduation.

At the same time, some authors reflected on the difficulties or negative experiences encountered as well. There were some technical issues as mentioned above. In terms of learning, in Lea et al. (2008), faculty responses were mixed after the first semester. Some reported feeling only moderately comfortable with how to use the system, while others didn't appear to grasp the purpose of learning to use an electronic record and didn't recognize the importance of teaching information management concepts. In Stephens and Williams (2010), student feedback was also mixed with some expressing negative attitudes towards use of the system for documentation and clinical care. The structured literature review provided valuable insight into previous integration efforts and generated a wealth of information that can be applied to future integration initiatives.

Chapter 4 – Review of Selected Health Informatics Programs

The structured literature review covered many disciplines at an international level. To narrow the focus to HI in Canada, a high-level documentation review was undertaken by looking at publically available course material for HI programs across Canada. The context of this thesis is undergraduate education in HI. Therefore the investigator began by looking at programs at Canadian universities. Following this, a detailed review of course outlines for the Health Information Science (HINF) program at UVic was done since this would be the setting of the research study to be undertaken. The methods and results of the documentation review are presented in this chapter.

4.1 Methods

4.1.1 Data Collection

Since the context of this research is undergraduate university HI education, only those that offered a Bachelor's degree in HI were included. An online search was done to find Canadian universities offering HI programs. For the first stage of the review, course requirements from each selected school's website were pulled. Only specific core or mandatory courses were included as additional courses, typically electives, will vary from student to student. For each required course at each school, descriptions were extracted from the school's website. The same basic information was also collected for HINF program courses at UVic by reviewing course descriptions available from the online university calendar.

The second stage of the documentation review was a detailed review of course outlines for the UVic HINF program. The most recent course outlines were obtained from the school's website.

4.1.2 Data Synthesis

All information available from school websites on course topics, teaching methods and IT use was extracted into a Microsoft® Excel spreadsheet. The topics were organized by the same seven categories in COACH's HIP™ Competency Framework (see Figure 3). Any teaching approaches mentioned were categorized by the four high-level groups in Weston and Cranton's Summary of Instructional Methods (see Figure 2). For IT use, all specific examples mentioned were listed under the three general types of IT (i.e. general, real-world, and learning-specific). The same method was used to synthesize data from course outlines for the UVic HINF program.

4.2 Results

In addition to UVic, three other universities offering undergraduate degrees in HI were identified by a Google search using the terms "health informatics" and "university", limited to pages from Canada. The search led to a current listing of Canadian universities offering health informatics education. Each school's website was visited individually to confirm those that specifically offered a Bachelor's degree in health informatics. These schools were University of Waterloo, York University, and Conestoga College, which also offers a Bachelor's degree. These are the same three schools (plus UVic) which were identified as having a Bachelor's program in a paper by Covvey, Kushniruk, and Fenton (2006) on the state of HI education in Canada.

For the first stage of the review, each school had a list of program requirements available on their website. Overall, an average of 35 courses were reviewed for each program. For the second stage, a total of 21 HINF courses and 8 associated labs were reviewed. The results for each stage are presented here.

4.2.1 Health Informatics Bachelor's Programs in Canada

The programs varied in structure but typically had some core required courses and then options for other requirements and electives. The descriptions generally listed topics covered and sometimes teaching approaches and/or uses of IT.

4.2.1.1 Topics Addressed

Some of the core courses reviewed were from other departments within the various schools but addressed one of the seven categories in COACH's HIP™ Competency Framework (see Figure 3). For example, biology courses included clinical and health services topics. Other common topics for clinical and health services included anatomy/physiology, clinical decision making, health and illness/disease, and evidence-based practice. For the Canadian health system, courses addressed areas such as health policy, governance, legal issues (e.g. privacy and technical aspects), international comparisons, societal issues, and service delivery in general. Each COACH category was covered by at least one topic at each school except project management. Two schools didn't have any specific project management concepts listed in course descriptions. Those that did, usually touched on aspects of project managements such as requirements gathering. For organizational and behavioural management, several of the topics which came from non-HI courses were more business-oriented e.g. finance. Other examples included organization and management theory, power/politics, workflow, communication, ethics, and decision making. Similarly for analysis and evaluation, some courses were for general mathematics and statistics. Those more specific to the field addressed epidemiology, health information system/program evaluation methods, quality, and research methods e.g. qualitative and quantitative. In terms of the information sciences, information management topics were generally related to standards, health information collection, storage, retrieval, and processing. Information technology had the most concepts across all programs including design (programming principles), implementation, maintenance, database applications and repositories, applications for problem solving, types of information systems (e.g. decision support systems, health records, departmental systems), networks, usability/human aspects of system use, systems theory, and security.

4.2.1.2 Teaching Approaches

Teaching approaches were not mentioned for all courses in the descriptions. In terms of instructor-centered approaches, only two out of the four schools stated lectures in at least one course description but it would probably be safe to assume this method is used in more courses to some extent. Interactive teaching methods were mentioned in descriptions for 3 of the 4 programs, mainly in the form of team or group projects and discussions. For many of the activities mentioned, it wasn't always clear if they were done individually or in an interactive manner. Readings, assignments and exercises could be either. Across all schools, experiential learning methods were mentioned most frequently such as labs or case studies. For example, one school particularly emphasized practical application of concepts through case studies and hands-on activities.

4.2.1.3 IT Use

Specific uses of IT in courses were rarely mentioned in the course descriptions. However, 3 of the 4 programs stated examples of general IT use like computers and the Internet. There was only one mention of specific IT which could be considered to support learning: digital images. All programs also had at least one example of real world IT such as databases and spreadsheets.

Although this stage of the documentation review was a preliminary look across HI programs at Canadian universities (as it was based only on publically available information on the Internet), it did show that the current state of HI education appears to be similar in many programs. Many of the same topics and references to similar teaching approaches were found across programs. Interestingly, information technology topics including health information systems seemed to be quite prevalent across programs but very few examples of such types of IT use in learning were mentioned in course descriptions.

4.2.2 BSc. in Health Information Science Program at UVic

4.2.2.1 Model Program

The undergraduate model program at UVic consists of required HINF courses, required courses from other departments, and electives chosen by students. These are also accompanied by three mandatory Co-operative Education (Co-op) work-terms where students apply for and work with employers in the field to gain real-world experience. See Figure 5 for the September 2009 model program. In order to graduate, students must obtain a minimum of 60 units of credit.

4.2.2.2 Topics Addressed

Considering only the UVic HINF courses offered to students, a wide range of HI topics are addressed. Appendix E presents all topics extracted from course descriptions and course outlines, organized by the seven COACH categories for competencies. Every category is covered and addressed in multiple courses. The category with the highest number of course that has topics which fall into it is information technology. Courses touch on many aspects of information technology from design principles to specific applications. Databases appear to be frequently addressed in first and second year courses. Students are introduced to many types of health information systems including electronic health records, departmental systems, decision-support systems, computerized provider order entry systems. Related information management principles such as data modeling and standards also appear.

Topics related to organizational and behavioural management also appear in a number of courses and include healthcare professional workflows and communication theory. Decision-making and issues surrounding IT selection and implementation from the organizational perspective is also covered. As in the cross-program review, project management appears in the fewest number of courses but has one entire course dedicated to it.

Model Program

September 2009
Note: former course numbers appear in brackets

First Year: Health Information Science **15.0 Units**		
SEPT. - DEC.	JAN. - APR.	MAY - AUGUST
CSC 110 ENGL 115 or 135 HINF 130 (172) *EPHE 141 or BIOC 102 or BIOL 150A (or B) or BIOL 190A ELECTIVE	CSC 115 ENGL xxx HINF 140 (240) MATH 151 ELECTIVE*	NONE

Second Year: **15.0 Units**		
SEPT. - DEC.	JAN. - APR.	MAY - AUGUST
HINF 200 (300) HINF 230 STAT 252 ELECTIVE ELECTIVE	HINF 201 (301) HINF 265 HINF 280 ELECTIVE ELECTIVE	WORK TERM #1

Third Year: **15.0 Units**		
SEPT. - DEC.	JAN. - APR.	MAY - AUGUST
CSC 375 HINF 320 HINF 335 HINF 350 HINF 381	WORK TERM #2	HINF 310 HINF 330 HINF 345 (445) HINF 351 (451) HINF 371

Fourth Year: **15.0 Units**		
SEPT. - DEC.	JAN. - APR.	MAY - AUGUST
WORK TERM #3	HINF 410 HINF 420 HINF 450 HINF 461 HINF 470	*SENIOR ELECTIVE SENIOR ELECTIVE SENIOR ELECTIVE SENIOR ELECTIVE SENIOR ELECTIVE

B.Sc. DEGREE REQUIREMENTS

HINF Core Courses	43.5
SENIOR ELECTIVE Courses	7.5
ELECTIVE Courses	9.0
Undergraduate Degree (units)	60.0

Figure 5 - School of Health Information Science Undergraduate Model Program for September 2009

(Source: http://hinf.uvic.ca/programs/undgrad/modprog.php)

4.2.2.3 Teaching Approaches

A variety of teaching methods are used in the School of Health Information Science including "integration of case studies from real life situations, group projects with local health care organizations, and introduction of students to real world work contexts and issues" (Kushniruk et al., 2006, p. 4). Appendix F shows teaching approaches described in course outlines for undergraduate HINF courses. Most courses have a traditional lecture component but in many cases a guest speaker may be invited to a class to share experiences. The majority of courses emphasize an interactive class environment; students are frequently required to participate in in-class activities such as group discussions. Some courses are even structured around a large group project. For example, in HINF 320 – Project Management, students are members of a project team throughout the term where they use all the tools presented in class to complete the project, produce status reports and present it at the end. One student from each team takes on the role of a project manager to lead the group. Another example is HINF 351 – Information Technology Procurement where the class simulates a healthcare organization with teams of students representing systems for an IT selection committee. In terms of experiential learning methods, many courses describe hands-on exercises and case studies. The programs also have a significant technological component (Health Information Science University of Victoria, 2008), most notably in the labs. Currently, eight courses have a lab which usually require students to complete hands-on exercises and sometimes a project.

4.2.2.4 IT Use

A variety of educational tools are currently in use within the School. Appendix G lists IT used in courses as described in course outlines. Many general software packages are used including Microsoft® Excel, Project and Visio. Virtually all courses make use of the Internet in some way, typically for additional online resources for students or specific websites for activities. There are also many uses of real-world IT within courses. In the courses which address database, students often have an opportunity to work with database applications (e.g. Microsoft® Access or Oracle®) in labs. Also, a specific type of software for statistical analysis is used in the lab for HINF 381 – Epidemiology, Population Health and Public Health. However, there currently appear to be limited uses of EMRs. The lab for HINF 310 lists EHR software "MEDCIN" as a tool, HINF 335 lists several clinical tools which may be related to EMRs, and HINF 350 generally mentions online tools.

Chapter 5 - Research Questions

Both the structured literature and documentation review produced interesting insights into the current state of health information system integration into health professional and more specifically, health informatics education. It is clear that there is currently limited hands-on use of specific health information systems (e.g. EMRs) in HI courses. Therefore, the overall objective of this thesis was to explore first-hand the integration of EMR technology into undergraduate HI course work. To the investigator's knowledge, such a specific framework does not exist. However, Mishra and Koelher's TPCK framework could serve as a basis for technology integration in HI by helping to identify what needs to be considered at a generic level. In fact, the TPCK framework was used to help organize the results of both reviews according to technology, pedagogy, and content and would therefore be applicable in this work. The main research question was then: How can the TPCK framework be applied to help in integrating educational EMRs into undergraduate health informatics curricula in order to teach topics and core competencies related to EMRs?

The key piece of the framework which needed to be explored in detail was the context surrounding integration in order to determine what effective integration should entail for HI. Based on the data gathered from the above reviews and TPCK, several key questions needed to be addressed in the specific integration context being studied:

1. What HI topics and competencies are currently taught to HI students which are related to EMRs?

2. How are EMR-related topics and competencies taught in HI programs and what methods are applicable for use with the educational EMR?
3. In what ways can EMR technology be integrated into a HI curriculum?

The above three questions stemmed from the three main knowledge bases of TPCK: technology, pedagogy, and content. The goal was to look explicitly at each of the knowledge areas to determine what they mean in the context of educational EMR integration into HI education. These questions address both the current state and potential future state. That is, they imply a need to explore what is currently done in teaching/learning and what could potentially be done based on what is known.

The first question corresponds to the content piece of TPCK. Before we can determine how to incorporate the technology into lessons, we need to know what the learning goals are. For this, we need to understand what topics are taught and how they may relate to the technology. The COACH HIP™ Competency Framework (2009) introduced above may be helpful to organize content topics.

The second question addresses the pedagogy knowledge base. For this question we need to explore how students learn content in terms of the methods and tools used. It will be necessary to understand how material is taught with or without IT, and also how it could be taught with an educational EMR. Weston and Cranton's Summary of Instructional Methods (1986) described in section 2.5.2 may be helpful in classifying the approaches discovered.

The third question delves into the technology aspect. This involves looking at many types of IT used but with a specific focus on EMRs and similar systems. Angeli and Valanides (2009) expressed a need to explicitly look at the role of tool affordances in learning. Especially in this case where the tool is a real-world IT that is being adapted for learning, it is important to find out what the tool can offer in terms of learning support and what needs to be considered when using it.

Using the above questions as a starting point for exploration, the investigator aimed to find out what a framework for this specific context may consist of. In terms of methods, according to Sofaer (1999), qualitative methods are helpful for the creation of conceptual frameworks and “have a clear role in the development of methods and materials” (p. 1108). To narrow the scope of integration to undergraduate health informatics education, an original research study was undertaken to gather primary data from instructors and students on EMR integration in one HI program (i.e. one specific integration context).

Chapter 6 – Study Design and Methods

An original research study was undertaken to determine what components should be included in a framework for integration of an educational EMR into HI education by understanding the integration context and learning environment within a single HI program. According to Lai (2008), this includes student and teacher characteristics, student-student, and student-teacher interactions as well as learning activities and materials, rules and regulations. A qualitative exploratory approach was used in this study to gather both instructor and student feedback to generate items and groupings for integration of an educational EMR into HI education. This chapter describes how the study was conducted.

6.1 Overall Study Protocol

The study used a combination of data collection methods with analysis activities. Figure 6 provides an overview of the study phases and activities that are described in detail in this chapter. The study was conducted in three main phases where the results of phases 1 and 2 fed into phase 3 so that the items (plus their larger groupings) and themes were developed based on analysis and refinement. Each phase is summarized below and described in detail in sections 6.5 to 6.7.

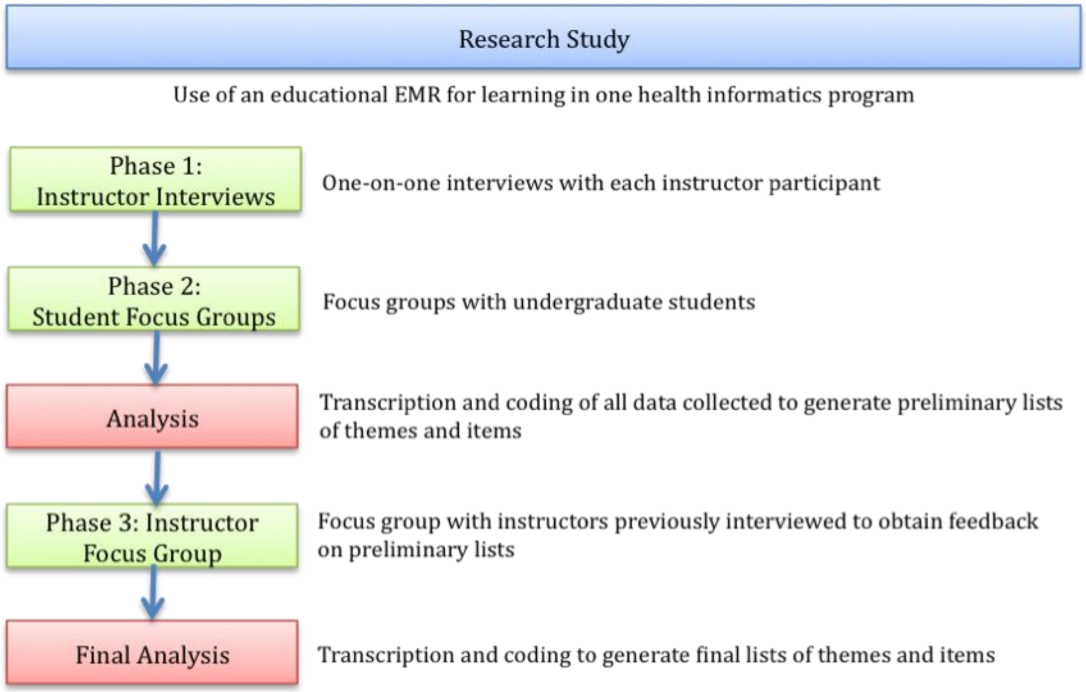

Figure 6 - Research Study Protocol

6.1.1 Phase 1: Individual Instructor Interviews

Each instructor was interviewed individually by the investigator to obtain information about their past teaching experiences and thoughts about the integration of EMRs into HI education. The questions were structured but open-ended, allowing participants to freely express their views in-depth.

6.1.2 Phase 2: Student Focus Groups

To obtain student views, several focus groups were conducted with students currently enrolled in an undergraduate health informatics program. The focus groups were transcribed and then coded along with the individual instructor interviews to produce a list of items grouped into categories for presentation in the next phase.

6.1.3 Phase 3: Instructor Focus Groups

The instructors that were interviewed in phase 1 were also asked to later participate in a focus group to review the key items that were identified by all participants for integration of an educational EMR into HI education up to that point and provide more feedback through discussion with colleagues. This focus group served as a form of validation of previously collected data (i.e. items for integration of an educational EMR into HI education) and further refinement based on input from several instructors at once. The focus groups were transcribed and combined with data collected from worksheets and presentation slides to refine the key set of items and categories for an initial framework. All coded data was then used to report results.

6.2 Setting

The setting of this study was the School of Health Information Science at UVic. Founded in 1981, the school offers several HINF courses in HI ranging from the undergraduate to the doctoral level (Kushniruk et al., 2006). Educators in the school have experience working in various industry roles and use a variety of teaching methods that include “integration of case studies from real life situations, group projects with local healthcare organizations, and introduction of students to real world work contexts and issues” (Kushniruk et al., 2006, p. 4).

6.3 UVic EHR Educational Portal - Digital Health Designs EMR®

All participants were shown a demonstration of an educational EMR through the UVic EHR Educational Portal which is briefly described here. The portal provides widespread remote access to several applications to client viewers over the Internet using a client-server solution. There are three main components in the architecture (Armstrong, Kushniruk, Joe, & Borycki, 2009):

1. “Internet” or Remote Access Layer: remote user computer systems

2. “Perimeter Network” or Middle Firewall Security and Authentication Layer: sits between an internal and external firewall. It allows the remote users to login to a remote desktop and use applications (e.g. EMRs) running on it via the Remote Desktop Protocol using a secure socket layer.
3. “HINF EHR Network” or Internal Network: the secured network where the terminal servers, database server, user account server, and web server are located.

Users can be running different operating systems and are provided with their own desktop and user file space on the server when interacting with applications. A requirement during design was that it be scalable to allow up to 1000 concurrent users (Armstrong et al., 2009, p. 94). Users begin by visiting the portal home page (see Figure 7). Clicking on “Resource Links” takes users to the page seen in Figure 8 which provides links to a variety of HIS including the EMR used in this research, the Digital Health Designs EMR®.

The Digital Health Designs EMR® is an example of an educational EMR. It was designed and built specifically to be used by students for learning. Beginning with a generic object-oriented EMR, the developers added additional features (Joe et al., 2009). The system has two user modes: one for students and one for instructors. Instructors are able to create fictional patients in the EMR and control when information appears in the patient’s record for particular events. Students can subscribe to patients created by instructors in the system and work with them in their own private workspace. Other special features allow instructors to compare and evaluate student work within the system while still having a generic look and feel of a commercial EMR system (Joe et al., 2009). For example, it allows events to be triggered by student actions.

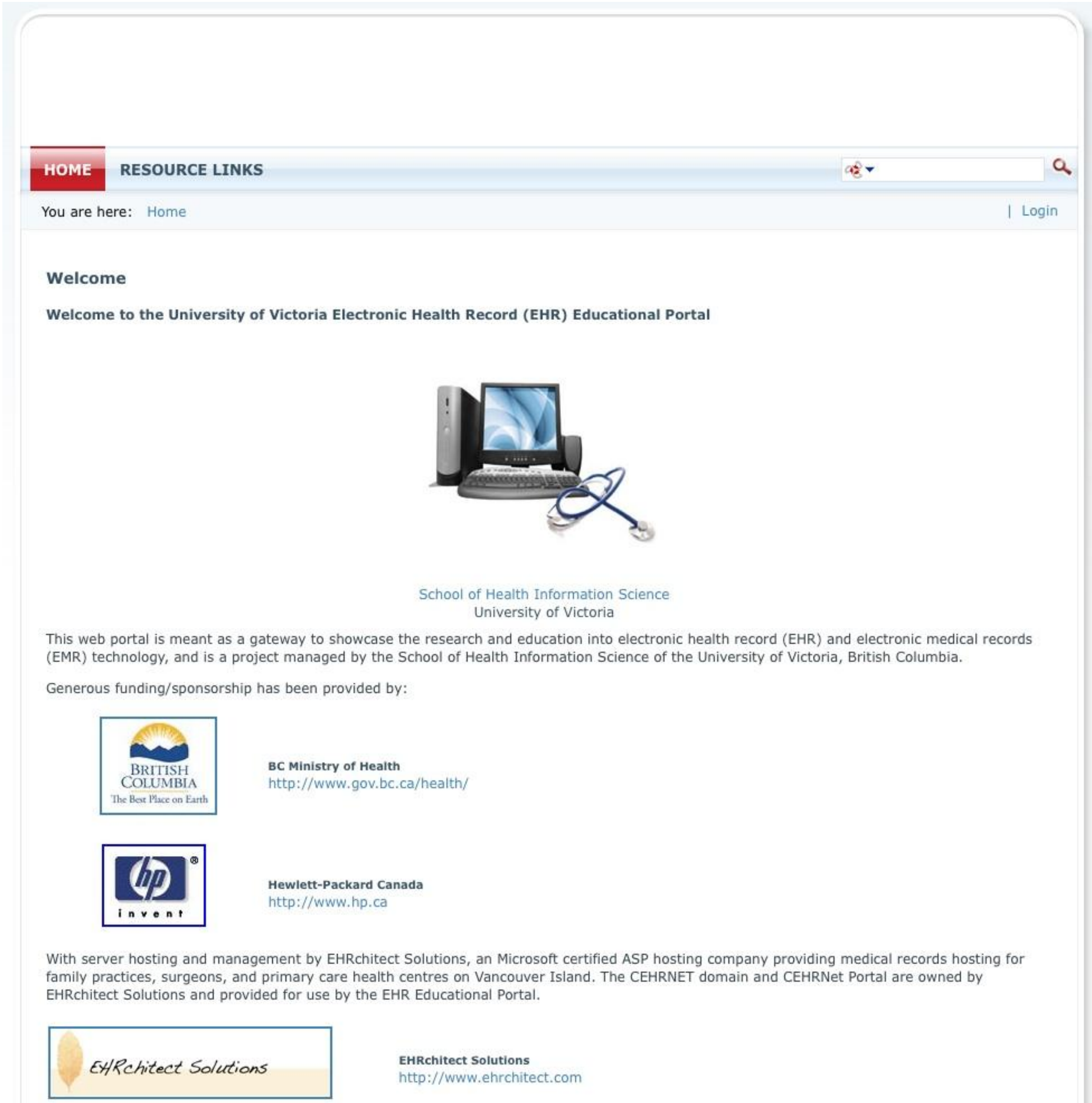

Figure 7 - EHR Educational Portal Home Page

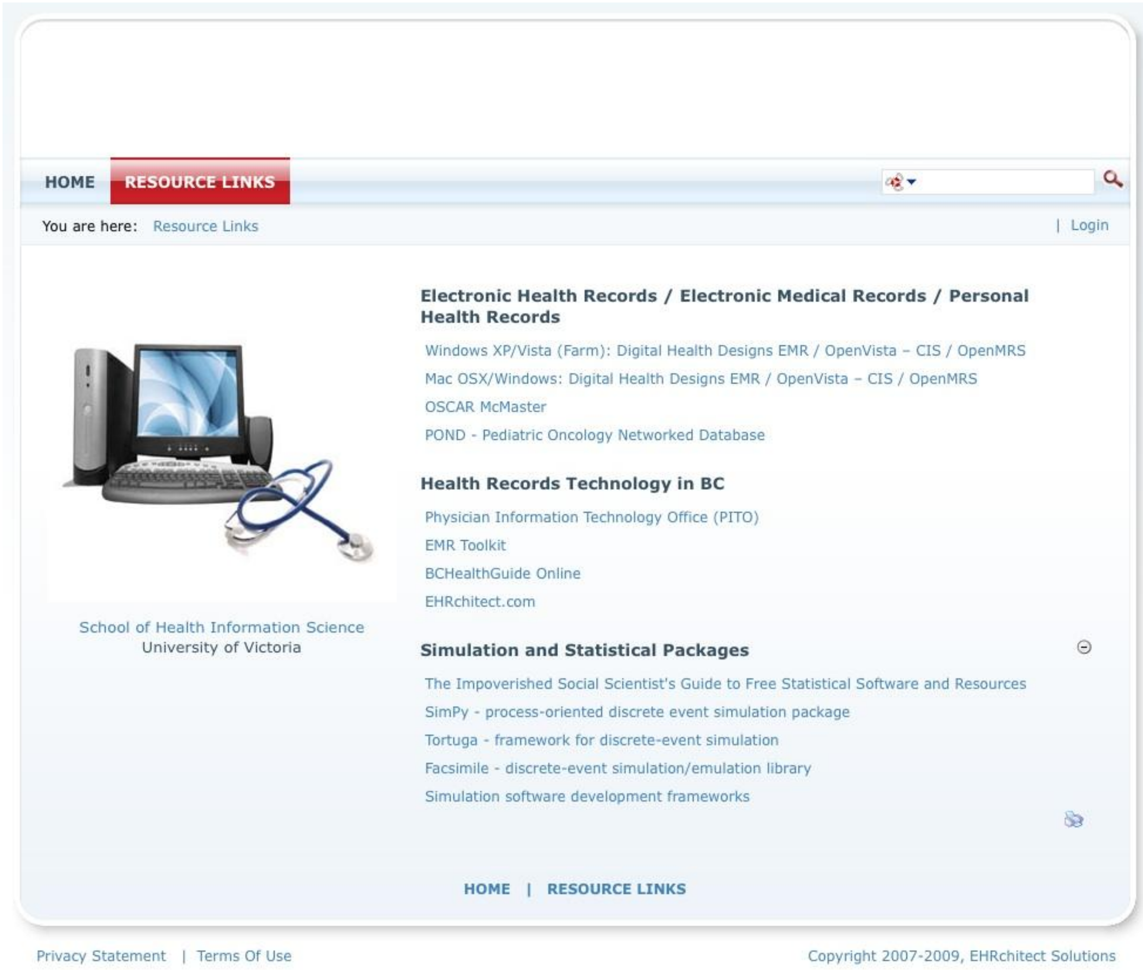

Figure 8 - Links to EMRs and Other HIS within the EHR Educational Portal

In summary, the portal is one way to allow students to obtain access to an educational EMR such as the Digital Health Designs EMR®. This educational EMR has additional capabilities that are specifically designed to support student learning. It was used in the study to demonstrate what an educational EMR is.

6.4 Methodological Background

Qualitative research seeks to explore perspectives, feelings and experiences of people (Holloway & Wheeler, 2002) through immersion into the data to uncover new perspectives, linkages, understandings and theories (Liamputtong & Ezzy, 2005).

Researchers aim to identify significant concepts and explore relationships and are not concerned with quantifying results (Strauss & Corbin, 1998; Edmunds, 1999). “Qualitative research” is an umbrella term which can be broken down into methodologies such as grounded theory and methods like interviews.

For this research, the goal was to explore and understand the integration context of undergraduate HI education to develop a preliminary framework for integration of an educational EMR into HI education. Therefore, a qualitative exploratory methodology was chosen using qualitative data collection methods of interviews and focus groups. Crouch and McKenzie (2006) explain that exploratory studies generate propositions and make indications rather than to make verifications or conclusions. However, they stress the importance of rigor in such studies. As well, to provide construct validity for findings discovered in the research, there is a need to have pre-existing theoretical knowledge and draw from earlier concepts during analysis and interpretation. In this research, the components for an initial framework were based on prior literature combined with the findings of the study. The study itself was guided by elements of TPCK.

Another unique facet of qualitative research is that the investigator isn’t completely divorced from the phenomenon under study (Holloway & Wheeler, 2002). In fact, they are often a part of the setting and know it intimately but should question their own assumptions and act like strangers. As a Bachelor’s degree graduate, Master’s student, and instructor in the School of Health Information Science, the investigator in this study was very familiar with the setting which enhanced her understanding of the data collected.

6.4.1 Data Collection

According to Sofaer (1999), qualitative approaches have a clear role in the development of methods and materials. Data collection activities are based on various types of conversations between researchers and respondents (Crouch & McKenzie, 2006). Several authors point to individual interviews and focus groups as common data collection methods in qualitative research (Stewart, Shamdasani, & Rook, 2007; Sofaer, 1999; Barbour & Kitzinger, 1999). And many also advocate for using these methods in combination for a single study. For example, Barbour and Kitzinger (1999) state that “interviews are more effective for tapping into individual biographies, but focus groups are invaluable for examining how knowledge, ideas, story-telling, self-presentation and linguistic exchanges that operate within a given cultural context” (p. 5). Both of these methods were used in this research.

Interviewing is a one-to-one data collection method where the respondent answers a researcher’s questions (Powell & Single, 1996). Interviewing is a well-established method for qualitative research which Liamputtong and Ezzy (2005) describe as a good conversation where the focus is the experience of the interviewee. In-depth interviews can produce rich material and the scope of inquiry can broaden or even shift in response to the emergent material (Crouch & McKenzie, 2006). In a previous study by Brill and Galloway (2007) to examine instructors’ use and attitudes towards classroom-based teaching technologies, six instructors were interviewed using open-ended questions to follow-up and expand on survey responses.

While interviews are normally conducted on a one-to-one basis, focus groups bring together several individuals at once to stimulate ideas based on shared perceptions of the world (Holloway & Wheeler, 2002). Some common uses for focus groups include generating hypotheses that can be further tested, generating new ideas and concepts, and looking for a range of feelings that people have about something (Stewart et al., 2007; Krueger and Casey, 2000; Holloway & Wheeler, 2002). As Morgan (1996) explains, they are more than the sum of separate individual interviews because participants can ask each other questions and explain themselves to each other. They are commonly used in exploratory research (Stewart et al., 2007; Edmunds, 1999). Typically, a few focus groups are held with individuals that have similar characteristics or shared experiences which are important for the research (Holloway & Wheeler, 2002; Barbour & Kitzinger, 1999). The sampling frame only needs to be a good approximation of the population of interest because it is inappropriate to generalize far beyond the groups (Stewart et al., 2007). In this case, the sampling frame was limited to instructors and students within the school. A unique strength of holding focus groups is being able to observe the extent and nature of participants' agreement and disagreement (Morgan, 1996).

Pope, Ziebland, and Mays (2000) explain that "qualitative studies are not designed to be representative in terms of statistical generalizability, and they may gain little from an expanded sample size except a more cumbersome dataset" (p. 115). A general rule for building theory is theoretical saturation which refers to having saturated categories where no new or relevant data seem to emerge (Stauss & Corbin, 1998). This is important for methodologies like grounded theory, in which theory is derived from the observations and insights gathered from empirical research. However, Mason (2010) states that the point of saturation might be considered arbitrary. Although this study did not employ grounded theory, saturation is a common concept for qualitative research. Therefore, the goal of this study was to gather sufficient data to reach reasonable saturation.

Similar qualitative methodologies with multiple data collection methods have been used previously for exploratory research in education and technology. For example, Churchill (2006) explored teachers' private theories for technology-based learning using a multi-case approach. Four teachers were initially interviewed to generate themes and then again a few weeks later to discuss reflections and changes after participating in a designing activity.

6.4.2 Analysis

A search of the literature revealed many approaches to analyzing qualitative data. The principles of data analysis for focus groups and semi-structured interviews are similar (Holloway & Wheeler, 2002). According to Breen (2006), interviews and focus groups should be recorded and transcribed, which can produce vast amounts of data. The analysis process often begins during data collection (Pope et al., 2000). The data already gathered are analyzed and fed into further data collection, allowing the researcher to refine questions. In this study, analysis occurred throughout the phases.

As mentioned above, although this study did not aim to develop a grounded theory, the principles of analysis commonly associated with grounded theory were used to code and analyze the data. Strauss and Corbin (1998) mention that a study may use some methods of grounded theory but not necessarily follow the entire methodology and according to Draper (2004) most analyses use the basic approach of grounded theory in terms of identifying themes or concepts that emerge from the data but beyond this, different techniques can be used to develop codes and look at inter-relationships. In this study, open coding and axial coding techniques were used in analysis along with established categories from the literature where appropriate. In open coding, "the analyst searches for differences and similarities between events, actions, and interactions and applies conceptual labels to these, grouping them into categories" (Liamputtong & Ezzy, 2005, p. 268). The next stage of coding is axial coding to refine the codes and groupings. Here, the codes are grouped into larger categories.

A big part of qualitative research is comparison. In a study by Brill and Galloway (2007), interviews were transcribed and coded using a constant comparison method to iteratively identify and categorize themes. Boeije (2002) describes steps of a constant comparative analysis procedure that was used in their own study. A comparison approach was employed in this study and is described in the analysis methods of phase 3.

6.5 Phase 1 – Instructor Interviews

6.5.1 Participant Recruitment

Several methods were used to recruit instructors in three rounds. The target participants in the school were regular faculty, adjunct faculty, sessional instructors or lab instructors, having had taught material related to EMRs. The intent was to gather individuals who had past or current experience teaching undergraduate HINF courses and could provide perspectives on educational EMR integration. An invitation memo was distributed to all instructors by e-mail and a copy of the memo was placed in the HINF mailboxes of instructors. A follow-up e-mail was sent a week later. Instructors were asked to e-mail the investigator if interested. They were then sent a response with a letter of information and consent to sign and return. To conceal participation status, they were asked to place the signed consent in a designated mailbox outside the HINF office for the investigator to pick up. Envelopes were provided in the mailbox for their use.

According to Crouch and McKenzie (2006), interview-based studies involving a small number of respondents are becoming more common in the social sciences. In a study by

Guest, Bunce, and Johnson (2006), 36 codes were developed and out of these, 34 were generated based on the first 6 interviews. They concluded that for studies with a high level of homogeneity among the respondents, a sample of six interviews may be sufficient for generating meaningful themes and useful interpretations (i.e. to reach saturation). Considering the small pool of instructors within the school to recruit from, a small sample of instructors was expected. Using the concept of theoretical saturation as a guide, additional rounds of recruitment were completed to ensure no major new concepts were emerging. After the first two rounds of recruitment, it was determined that more instructors were needed to reach saturation. The same recruitment method as outlined above was carried out again with the addition of a snowball sampling approach (Fossey, Harvey, McDermott, & Davidson, 2002). In the snowball sampling approach, recruited instructors were asked to recommend colleagues for participation.

6.5.2 Preparation

6.5.2.1 Materials

An interview script for the instructor interviews was developed with the guidance from the supervisory committee as part of the proposal stage. The questions were strategically written to expand on the three main research questions stated in Chapter 5 (to explore HI content, teaching approaches, and EMR technology) as well the main question on integration as a whole. Devers and Frankel state that for more exploratory studies, “a very open-ended protocol is appropriate to consider” (2000, p. 268). All questions were open-ended except for one which asked instructors to go through a list of COACH’s HIP™ core competencies and indicate whether they felt each competency was directly related to EMRs in their teaching. This activity addressed the content aspect of integration. The order and types of questions are described in section 6.5.4 and the full script is in

Appendix H. In preparation for the interviews, participants were also asked to bring along any course outlines to refer to.

6.5.2.2 Equipment

The following equipment was used to collect data during the interview sessions:

- a laptop with screen capture software HyperCam™ installed
- a microcassette recorder
- a projector
- note paper

The investigator had access to all necessary equipment. To access the portal and an educational EMR example (described in section 6.3) for the demonstration, the investigator contacted the portal's architect and was provided with a username and password.

6.5.3 Set-up

A room on the university's campus was booked to conduct the sessions, which made attendance convenient for the participants. In each session, the participant sat to the left of the investigator with the microcassette recorder pointed towards the participant. The laptop running HyperCam™ was also used to audio record the session and capture the screen. The interview script and plain note paper was placed on the table between the investigator and participant.

For the demonstration portion of the session, the laptop was connected to a projector to be able to project the educational EMR onto the screen. It could also be viewed on the laptop screen itself. See Figure 9 for a diagram of the set-up. Prior to conducting sessions with participants, the investigator tested the set-up, recording equipment, and EMR demonstration in a mock interview session with a test participant.

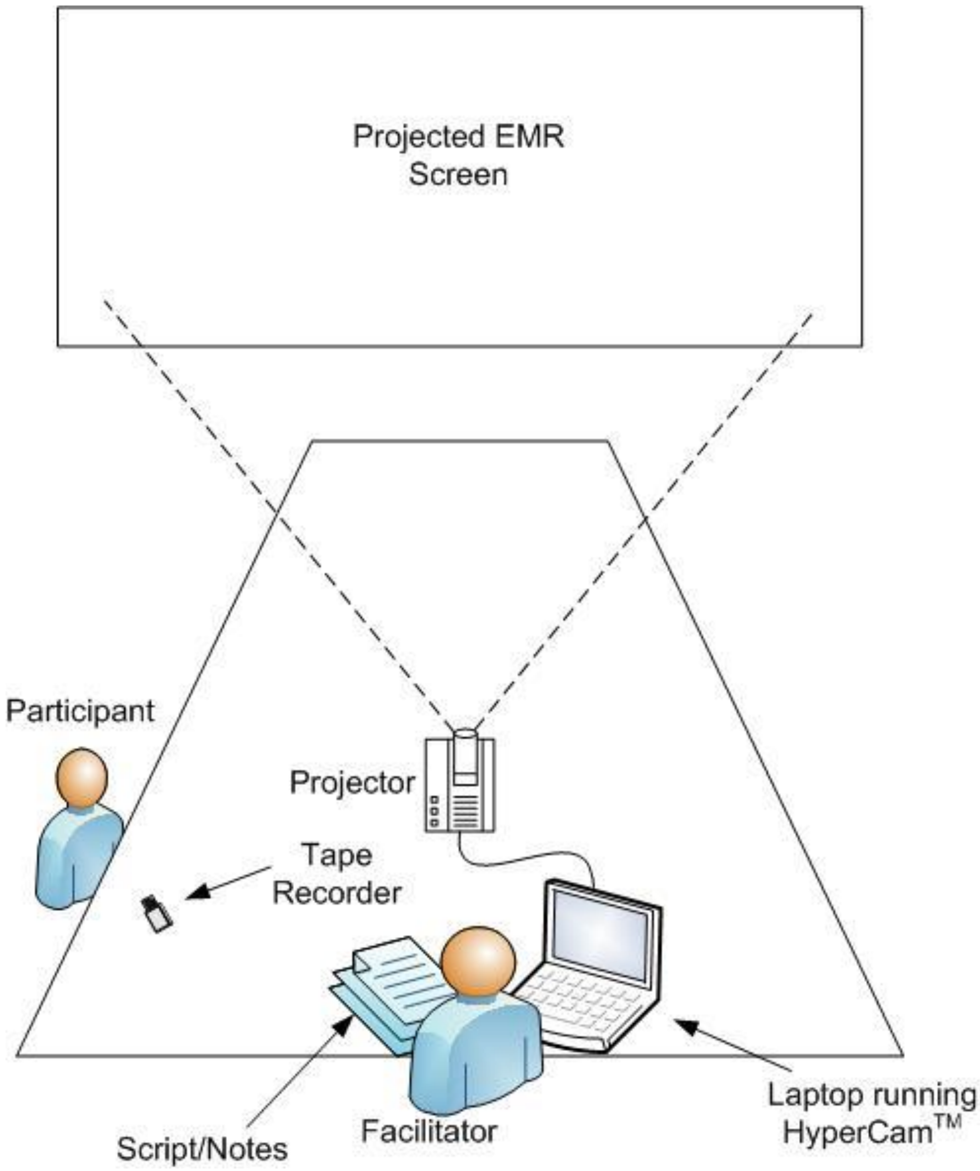

Figure 9 - Instructor Interview Setup

6.5.4 Data Collection Procedure

The sessions began with questions pertaining to the instructor's position and background in health informatics (see Appendix H for the instructor interview script).

They were then asked how they would describe an EMR. This question was asked to determine their understanding or view of an EMR. As previously mentioned, the term EMR is often used interchangeably with similar terms and may mean something different to different people. Once a response was provided, the investigator read the definition used in this thesis to ensure a common understanding for subsequent questions. The next few questions aimed to uncover courses taught which included EMR-related content, learning activities or approaches used and any prior hands-on use of technology in the classroom, specifically with electronic record systems.

The next portion of the interview delved deeper into the content taught in courses through identification of competencies. The aim was to determine 1) which HI competencies the instructors addressed in their teaching and 2) whether they felt that the competencies, and therefore the topics they covered, were related to EMRs. The list of competencies shown to instructors in this research were developed by COACH as part the HIP™ Competency Framework which addresses three key areas for HI: health sciences, information sciences, and management sciences. The investigator went through each of COACH's 46 core competencies one by one with the participant and recorded their response for whether each competency was something they addressed in their teaching and if it was related to EMRs in some way. (See Appendix M for the full list of competencies.)

At this point, the instructor participant was openly asked whether they would consider having students use specific EMR technology and why. They were then shown a demonstration of one example EMR system accessible through the UVic EHR Educational Portal. The demonstration quickly went through the some main screens and features of the EMR, highlighting educational features. After this, the investigator posed a series of questions regarding integration of such an EMR into teaching beginning with general thoughts on using it and if positive, how they would incorporate it and considerations for integration into education, or if negative, factors influencing their decision. The instructors were provided with time at the end for any additional comments or questions.

6.5.5 Analysis

The investigator began analysis of instructor interviews by completely transcribing the audio recordings and adding in observational notes that were made during the interview session. An initial spreadsheet was created using a Microsoft® Excel to record extracted data. The first column listed items representing responses or concepts from the transcripts and each subsequent column represented one source of data collection (i.e. an interview).The investigator went through each transcript line by line and performed open coding to extract data pertaining to thoughts or ideas. As items were identified and added to the spreadsheet, the investigator noted the line numbers of where the item was mentioned and added this to the spreadsheet. When a portion of the transcript was coded in the spreadsheet, it was highlighted to ensure nothing was missed. Each transcript was reviewed completely and any new items that came up were added to the first column of the spreadsheet. (See Appendix I for analysis steps.)

6.6 Phase 2 – Student Focus Groups

6.6.1 Participant Recruitment

Three rounds of recruitment were done to gather student participants. The intent was to gather individuals who had experienced learning in undergraduate HINF courses and could provide perspectives on educational EMR integration. An invitation memo was distributed through the undergraduate student HINF e-mail listserv. During the same week, the investigator visited some HINF courses in progress and read the memo aloud with permission from the instructor. A follow-up reminder e-mail with a deadline was distributed a week later. Students were asked to e-mail the investigator if interested. They were then sent a response with a letter of information and consent to sign and return. To conceal participation status, they were asked to place the signed consent in a designated mailbox outside the School of Health Information Science office for the investigator to pick up. Envelopes were provided in the mailbox for their use.

The literature contains many guidelines for size and number of focus groups. Barbour and Kitzinger (1999) state that statistical representativeness is not the aim of most focus group research and that it is useful to develop a topic-specific sampling strategy. Suggestions for focus group size appear to range from 3 to 12 (e.g. Barbour & Kitzinger, 1999; Stewart et al., 2007; Edmunds, 1999; Kruger & Casey, 2000; Holloway & Wheeler, 2002). The appropriate size depends on the topic, type of participants, and level of detail required in the discussion (Hennick, 2007). Smaller groups are sometimes referred to as mini-focus groups. According to Krueger and Casey (2000), smaller groups are becoming popular due to easier recruitment and more comfort for participants. Morgan (1996) explains that they are more appropriate for high levels of participant involvement, giving each participant more time to discuss their views and experiences. Groups of three participants are referred to as triads and are often used in market research (Edmunds, 1999). Other advantages of having such small groups is allowing more ground to be covered in less time, more in-depth probing, and less opportunity for group think to occur (Edmunds, 1999). Barbour and Kitzinger (1999) mention that several contributors to their book prefer to work with groups of five or six, or as small as three. Further Holloway and Wheeler (2002) commented that a colleague found the optimal number was three. Limitations include less variety of opinions so the range of experiences will be limited and more groups need to be conducted (Edmunds, 1999).

The number of groups to be conducted depends on the research question, segmentation of the study sample, and resource limitations (Barbour & Kitzinger, 1999; Hennick, 2007). Similar to interviews, most new information tends to emerge in the first one to three groups (Hennick, 2007). Many authors agree that more than one group is needed (Stewart et al., 2007; Edmunds, 1999). Hennick (2007) states that conducting even two focus groups per sub-group will allow for stronger grounds to identify core issues for that sub-group. For one research project, about three or four focus groups are common (Holloway & Wheeler, 2002; Stewart et al., 2007). Morgan (1996) states about four to six groups are needed for saturation. In a previous study by Breen, Lindsay, Jenkins and Smith, a focus group approach was used to gather undergraduate students' views on information and communications technology-based learning methods and each group was made up of four to six students (2001).

Considering a limited population of students to recruit from and the comfort level of students who might not have too much experience in the field yet, the goal in this study was to obtain as much rich information as possible from the participants by strategically using multiple smaller or mini-focus groups of students. This would allow them to be with peers and discuss the questions amongst themselves, reflecting on their own experiences. Four participants per focus group were desired. Unfortunately, there were not enough students recruited for more than one focus group after the first round of recruitment. At this point, the target population and recruitment methods were revisited and modified to extend the participant pool and offer a compensation payment to students for any inconvenience associated with their participation. The second round of recruitment was conducted in the same manner with the addition of posters. In case students hadn't read the e-mail invitation or been present in classes the investigator had visited, posters were put up on information boards for HI students near the School of Health Information Science's main office as another way an undergraduate student to become aware of the opportunity to participate. A third round of recruitment was conducted in the same manner as round two with the addition of a snowball sampling approach. Students who had already participated were asked to forward on the invitation to any classmates they thought might be interested in participating but they were under no obligation to do so.

6.6.2 Preparation

6.6.2.1 Materials

A script for the student focus groups was developed with guidance from the supervisory committee members as part of the proposal stage of this research. The questions were strategically written to expand on the three main research questions stated in Chapter 5 (to explore HI content, teaching approaches, and EMR technology) as well the main question on integration as a whole. All questions were open-ended and generally paralleled those asked to instructors in order to obtain a student perspective (see Appendix J for the student focus group script). Some differences were necessary to reflect the level of knowledge of students compared to instructors. For competencies, students were just asked what they think they should know about in the areas of health, information, and management sciences instead of being shown a list of COACH's competencies. The order and types of questions are described in section 6.6.4.

6.6.2.2 Equipment

The following equipment was used to collect data during the focus group sessions:

- a laptop with screen capture software HyperCam™ installed
- a microcassette recorder
- a projector
- a video camcorder
- note paper

The investigator had access to all necessary equipment. To access the portal and educational EMR example for the demonstration, the investigator used the same username and password as for the instructor interviews.

6.6.3 Set-up

The same room on campus was booked to conduct the focus groups as was used for the instructor interviews, which made attendance convenient for the students. The participants sat facing each other at the front of the room with the microcassette recorder in the center. The investigator sat at the back, facing everyone. Several authors such as Edmunds (1999) and Barbour and Kitzinger (1999) described the advantages of videotaping focus groups for transcription and analysis. A video camcorder was set up at the far back corner of the room to capture participants and the screen. This allowed the investigator to capture expressions and visual responses e.g. participants nodding in agreement to comments from other participants. A laptop running HyperCam™ was also used to audio record the session and capture the screen. The interview script and plain note paper was placed in front of the investigator. For the demonstration portion of the session, the laptop was connected to a projector to be able to project the educational EMR onto the screen. See Figure 10 for a diagram of the set-up. Prior to conducting sessions with participants, the investigator tested the set-up, recording equipment, and EMR demonstration in a mock interview session with a test participant.

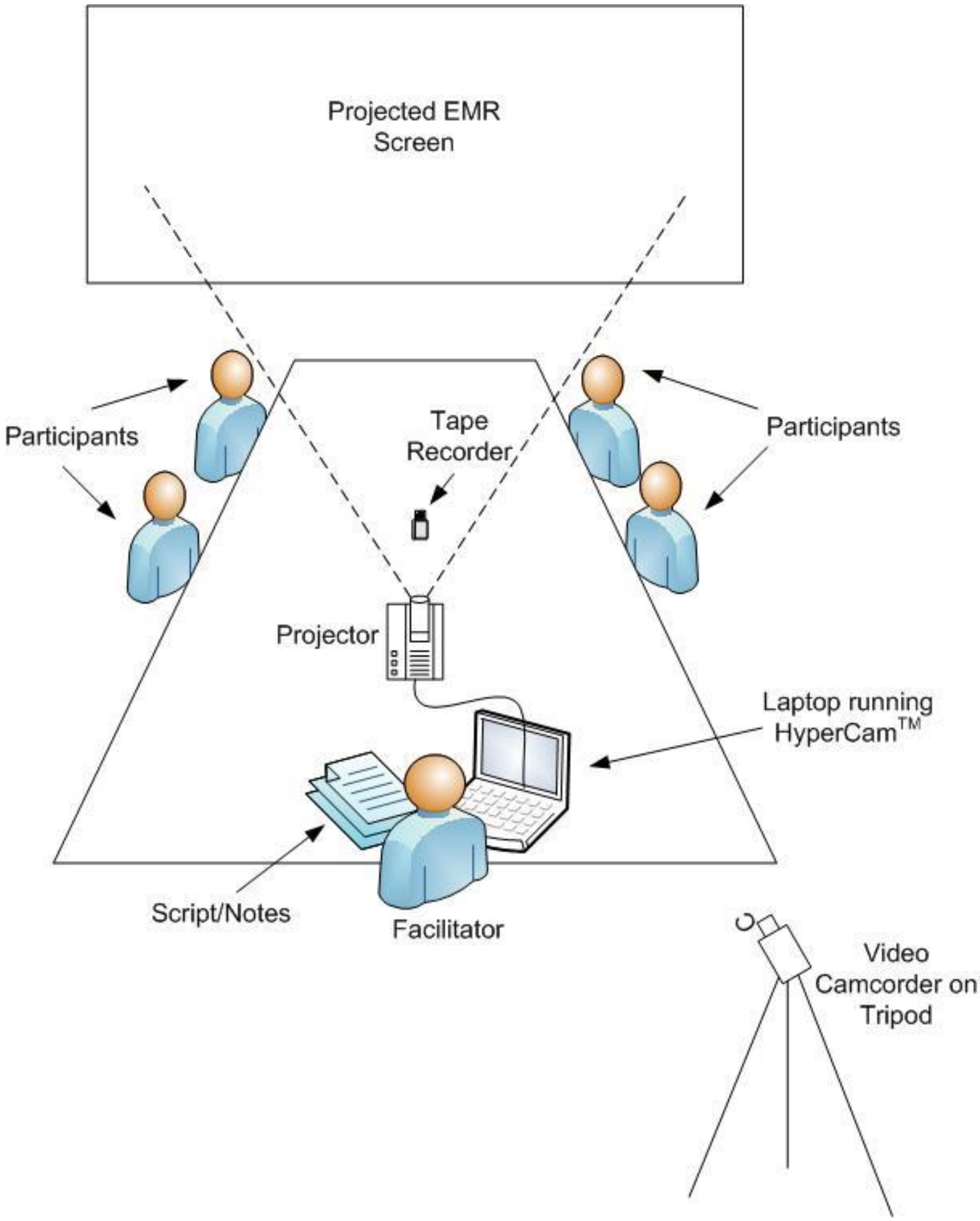

Figure 10 – Focus Group Set-up

6.6.4 Data Collection Procedure

As students arrived, a brief background questionnaire to collect general demographics and prior EMR experience was given to them. The session was conducted in an orderly fashion but participants were able to freely converse; every time a question was asked, the investigator went from participant to participant in a circle to ensure every participant had an opportunity to answer. The direction of asking participants to answer questions was reversed after each question. As with the instructor interviews, questioning began with students being asked to describe an EMR and then being provided with the same definition used in this research. Students were also asked about learning activities or approaches used and any prior hands-on use of technology in the classroom, specifically with electronic record systems. In terms of content related to EMRs, students were asked open-ended questions about the competencies they felt were important to learn regarding EMRs in same areas addressed by COACH's core competencies: health sciences, information sciences, and management sciences. Students were then given the same demonstration walkthrough of one EMR system as the instructors. After the demonstration, students were asked to provide their general thoughts on using the educational EMR for learning, suggestions for how and when it could be used, and any potential benefits or concerns. Additional time was provided at the end for any comments or questions.

6.6.5 Analysis

The investigator transcribed each student focus group word for word from the recordings. Physical actions or responses from the video recordings were also noted. For example, if a participant nodded yes while another provided a response, this was added to the transcript. (See Appendix I for sample transcript excerpt.) Next, the investigator added to the initial spreadsheet created in Microsoft® Excel after the instructor interviews to combine the data. The first column listed items representing responses or concepts from the transcripts and each subsequent column represented one source of data collection (i.e. an interview or focus group session). The investigator went through each focus group transcript line by line and as items were identified and added to the spreadsheet, the investigator noted the line numbers of where the item was mentioned and added this to the spreadsheet. When a portion of the transcript was coded in the spreadsheet, it was highlighted to ensure nothing was missed. Each participant's mention of agreement with an item was also coded in the spreadsheet. For example, if one student expressed an idea and another nodded in agreement, the line numbers where this occurred were entered into corresponding cells of the spreadsheet for both participants. Each transcript was reviewed completely and any new items that came up were added to the first column of the spreadsheet. This step produced a preliminary list of all items mentioned by participants. The items were grouped into categories based on the data collected in an axial coding pass. (See Appendix I for a sample portion of the spreadsheet).

6.7 Phase 3 – Instructor Focus Groups

Once an initial set of categories with items pertaining to EMR integration were created (based on data collected from instructor interviews and student focus groups), the instructors that were previously interviewed individually were brought together in a focus group to discuss emergent items as a group. Key integration items for using an educational EMR in teaching were presented to them as they (i.e. the instructors) would be the ones to use the results of this research to plan integration of an educational EMR into HI education. This served as a form of data validation as well as refinement and comparison (a similar method was used in Kerr, Murray, Stevenson, Gore, and Nazareth

(2006) in which focus group participants were sent some results for feedback after initial analysis). It allowed the investigator to determine which items stood out, where views and opinions differed, and also allowed the investigator to confirm whether items previously mentioned were relevant to hands-on EMR use by undergraduate HINF students.

6.7.1 Participant Recruitment

The instructor focus groups were made up of the same instructors who had previously participated in the individual interviews so no new recruitment was done for this phase. The instructors were grouped together based on when they were interviewed (e.g. in the first round) to form multiple focus groups.

6.7.2 Preparation

6.7.2.1 Materials

The materials for the session were developed based on the analysis that took place after phase 2. All the data previously collected up to this point was coded. A set of worksheets and corresponding PowerPoint® slides were created. According to Barbour and Kitzinger (1999), group exercises are sometimes useful in focus groups and a common one is to give participants statements to rank or assign to different categories.

The main categories of integration items for using an educational EMR in HI education were selected for presentation and put into worksheets. General views on integration of an educational EMR in HI education (e.g. perceived benefits) and program experiences were not shared in the session because the focus was on specific components for integration of an educational EMR into HI education and all general views would be considered separately in the discussion. All items mentioned by instructors or students in the selected categories were listed, regardless of how many participants had commented on them i.e. if it was mentioned, it was listed. This gave the instructors a chance to consider items they may not have thought of previously. The worksheets asked them to use a Likert scale to indicate agreement for each item: 5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree. Columns were also added for them to indicate if they felt the item was relevant to undergraduate students or graduate students since previous comments collected sometimes pertained to experiences associated with teaching graduate-level courses. The worksheets were filled out in the same way for each category.

6.7.2.2 Equipment

In addition to the script and worksheet, the following equipment was used to collect data during the focus group sessions:

- a laptop with screen capture software HyperCam™ installed
- a microcassette recorder
- a projector
- a video camcorder
- note paper

The investigator had access to all necessary equipment.

6.7.3 Set-up

The same room was set up in the same manner as for the student focus groups (see Figure 10) using the same recording equipment.

6.7.4 Data Collection Procedure

As instructors arrived, a brief background questionnaire with demographics and EMR experience was given to them to fill out. (Note: similar information was collected in individual interviews too so this served as validation.) To begin, the investigator quickly introduced the main integration categories that emerged. A slide for each major grouping was put up on the screen and the instructors were asked to go to their worksheets for that category and fill in the columns to indicate their agreement with regards to the importance of each item for integration of an educational EMR into HI education (see Appendix K for the instructor focus group script). Participants could also provide comments if they wished.

The next portion of the session aimed to engage instructors in further discussion about the items presented in the focus group including if and how items fit together logically in an effort to integrate an educational EMR into HI education. The investigator presented a set of slides which took the same items under each category but visually grouped them into some preliminary groupings based on the previous axial coding. After showing each slide on the screen, instructors were asked what they thought. Did the groupings align with their thoughts? How did the items relate? Were labels clear? Was something missing? As the instructors provided their views, the investigator edited the slides in front of them on the screen according to what was said e.g. moving pieces around, renaming, and adding links and boxes. The visual aspect of the session allowed participants to see all the data as a whole and allowed the investigator to ask participants if the picture on the screen captured the instructors' collective views.

6.7.5 Analysis

The investigator transcribed all the audio and video recordings from the focus group and extracted all responses from the background questionnaires and worksheets into separate Microsoft® Word documents. This session was unique, however, in that there was also a screen recording of data on how the slides were edited during the session. This had to be described by the investigator during transcription and added along with any other observations made. The investigator also had a set of new Microsoft® PowerPoint slides for each category which had been modified during the session with input from instructors. These were also referred to while transcribing. (See Appendix L for a sample transcript excerpt.)

With the added sources of data and need to analyze all data collected up to this point, the investigator created codes for all the items that were previously identified and presented to instructors in the focus group. Then all the new data collected from the instructor focus group was coded, revising and adding codes (items/groupings) as necessary to reflect the feedback obtained by instructors (see Appendix L for a portion of the code list during revisions). This resulted in a final set of items and groupings/themes.

At the end of all three phases, an analysis was done with all data collected across the phases to determine the main results with respect to integration. To ensure that all previously collected data was still aligned with the final set of items/groupings and to combine supporting references from all data sources for synthesis, the investigator reviewed earlier transcripts and questionnaires from the instructor interviews and student focus groups. The final code set allowed the investigator to identify items/groupings that were mentioned most often for discussion and also group results by sources for comparison (e.g. instructors vs. students). The comparison approach used for this research study can be described in the same manner using adapted steps from Boeije’s (2002) work (see Table 1). The goal for analysis was primarily two-fold: (1) to identify items to discuss for an integration framework and (2) to determine what different groups of participants thought about them.

Table 1 - Comparison Approach for Analysis

Type of Comparison	Analysis Activities in the Research
1. Comparison within a single interview.	Comparisons within each individual instructor interview and focus group.
2. Comparison between interviews within the same group, that is, persons who share the same experience.	Comparisons among instructors and students.
3. Comparison of interviews from groups with different perspectives but involved with the subject under study.	Comparisons between instructors and students.

6.8 Ethics Approval

The University of Victoria requires ethics approval for research involving human subjects. Therefore an application for ethics approval was submitted to the UVic Human Research Ethics Board (HREB) office prior to beginning. When modifications to the protocol were necessary (i.e. to recruit additional participants with additional methods), these were submitted to the HREB for approval before proceeding.

Chapter 7 - Results

After analyzing all the data from the first round of: (a) instructor interviews, (b) student focus groups, and (c) instructor focus groups, a second round was conducted to ensure that saturation had been achieved. Some refinement or extension to existing items was undertaken but no brand new codes for integration items were generated after the second round of data collection. This suggested sufficient data had been collected to develop a preliminary framework. Both rounds generated a large set of data (i.e. instructor and student background questionnaires, interview transcripts, focus group transcripts, and instructor worksheets.)

There were six types of data in total. The data included:

- 6 Individual Instructor Interview Transcripts
- 13 Student Background Questionnaires
- 4 Student Focus Group Transcripts
- 6 Instructor Background Questionnaires
- 6 Instructor Worksheets
- 2 Instructor Focus Group Transcripts (included transcription of PowerPoint slides modified in the focus group)

This chapter presents the results of each phase of the study. Analyses showed how key findings emerged throughout the study. Phases 1 and 2 collected views from groups of students and instructors individually. Direct quotes from participants are included to illustrate exactly how the items and themes were reflected in the participant's words. The analysis done after phases 1 and 2 of the study generated preliminary lists of items for some integration categories (i.e. considerations for using the educational EMR in an undergraduate HI program). A comparison of the views of students and instructors was undertaken by the researcher. Please note, the lists of coded items were modified as needed after phase 3 and all original transcripts from phases 1 and 2 were re-coded according to a final list of codes. Frankland and Bloor (1999) describe an analytic induction approach for analysis in which new index codes may emerge in later transcripts and the researcher goes back to earlier texts to add codes. Phase 3 provided an additional opportunity for instructors to share views and to comment on the items that were previously generated by analyzing the data. The results from phase 3 are presented with the final overall analysis to show the final items and themes for integration from all participants.

7.1 Participant Demographics

A total of nineteen participants were successfully recruited and took part in the study: six instructors and thirteen students. See Table 2 for a summary of the participants' demographic characteristics. The instructors identified themselves as regular, adjunct or sessional instructors in the school. (There are currently only nine regular faculty in the school and many adjunct and sessional instructors who do not teach on a regular basis.) All instructor participants were male except for one female. Three had been in the field of HI for 1-5 years, one identified 6-10 years and two had been in the field for more than 11 years. In terms of teaching experience, the length of time ranged from less than one year to more than 11 years. Two had been teaching for 1-5 years and another two indicated 6-10 years. The instructors had experience teaching a range of courses from 1st year to 4th year and three instructors had also taught graduate courses (see Table 2 for more detail).

Four focus groups of undergraduate students were conducted consisting of 4, 3, 3, and 3 students respectively. There were 8 females and 5 males in total. Most students fell into the under 20 or 21-30 age groups. At the time of the study, four students were in their 4th year of the program, 3 were in their 2nd year, and 6 were in their 1st year. Throughout the focus groups, they reflected on courses taken in all years of the undergraduate program.

Table 2 - Summary of Participant Characteristics

Characteristic	Instructors (n=6)	Students (n=13)
Sex		
Male	5	5
Female	1	8
Instructor Position*		
Adjunct Faculty	4	
Regular Faculty	1	
Sessional Instructor	3	
Other		
Instructor Years in HI Field		
11+ Years	2	
6-10 Years	1	
1-5 Years	3	
<1 Year		
Instructors Years as HI Educator		
11+ Years	1	
6-10 Years	2	
1-5 Years	2	
<1 Year	1	
Courses Taught		
1st Year	3	
2nd Year	2	
3rd Year	3	
4th Year	2	
5th+ Year	3	
Student Year		
1st Year		6
2nd Year		3
3rd Year		
4th Year		4

*Some instructors identified more than one position

7.2 Prior IT Use

Instructors were asked about their past experiences with using IT for teaching during the individual interviews conducted in phase 1. Similarly students were asked to reflect on their past learning experiences in the program to identify where they had used IT for learning. The results are presented here.

7.2.1 Phase 1 – Instructor Interviews

Three out of six instructors indicated none or limited use of IT in their teaching. Half identified the use of Elluminate®, however this tool is used for distance education courses which are mainly offered at the graduate level. In terms of EMR exposure, instructors indicated some previous familiarity themselves with the systems. Two instructors had used an EMR in their own education but most stated none or limited hands-on use in their teaching:

> "I was sort of looking forward to being able to use…such a record but I didn't, you know, I just really didn't have enough time to invest in finding it and adding exercises and so forth." (Instructor 1)
>
> "I do not use direct experience of umm electronic medical record or practice of actual electronic record in any of my courses." (Instructor 2)
>
> "If you're asking whether I actually include a specific EMR system software for people to use in the course, then the answer is no." (Instructor 3)

During the sessions, two instructors indicated that they were aware of the UVic EHR Educational Portal but had not formally used it as part of the curriculum. Some reasons mentioned for little previous integration across all instructors included installation and setup, maintenance resources and support, time, course content, and a lack of opportunity or availability of a sufficient system to use:

> "I have not had the opportunity or the ability to provide an actual EMR system." (Instructor 1)

> "I would think because of the type of course…it's more appropriate they understand what EMRs are as opposed to actually getting hands-on experience." (Instructor 6)

In summary, while instructors had some familiarity with IT, EMRs and the portal, their responses indicated little use in their teaching.

7.2.2 Phase 2 – Student Focus Groups

In terms of hands-on use with real-world IT most examples provided by students, especially those in their 1st or 2nd year, were related to database management e.g. Microsoft® Access, Microsoft® Excel, Oracle®, and XML. Eleven students had been exposed to EMRs in course lectures and six students mentioned seeing them in labs. Three students in their 4th year had been exposed to real systems during Co-op work-terms. A few students indicated seeing them in a physician's office or had done their own exploration online. However, although seven students indicated some previous exposure, several expressed a lack of hands-on experience in the classroom:

> "I think cause we weren't really given too much…like a hands-on experience, I don't think so anyways. Umm we had like lots of examples of it and we did projects on if you chose to use that. Umm, like a more hands-on experience probably in labs would be helpful." (Student 3)

> "[Regarding the portal] This is very exciting and I think, I think what's nice is that we don't have a lot of hands-on experience with systems." (Student 2)

> "I have only learned about it through course materials, and in labs we have done projects on electronic medical records, but I have not had any direct hands-on experience with EMRs." (Student Background Questionnaire)

> "Just have a basic understanding, didn't have a visual idea of what it actually looks like, and how it is used." (Student 11)

Some students were aware of the UVic EHR Educational Portal as well. One student said that it was shown briefly in a class for the benefit of students who had never come across one before during a Co-op work-term but they didn't go into it in detail. Another mentioned having been given the portal website address some time ago but hadn't personally explored it yet.

In summary, students mainly identified database-related IT used in their learning. Regarding EMRs, several had been exposed to them in lectures, labs, and Co-op work-terms but hands-on experience in the classroom was limited.

7.2.3 Phase 1 and 2 Analysis

IT is used on a regular basis in the HI program. Examples mentioned by participants ranged from general IT such Microsoft® PowerPoint to specific examples of real-world technology including EMRs. Examples of education-supporting tools provided by the university were e-mail listservs (which enable instructors to send out information to the class by e-mail), clickers, and Moodle (a learning management system). The full list of items mentioned is in Table 3.

Table 3 - Current IT Use Identified by Participants in Phases 1 and 2

IT Type		Instructors (n=6)	Students (n=13)
General IT	e.g. Microsoft® PowerPoint	2	
IT to Support Learning	Clickers	1	
	Elluminate®	3	
	E-mail Listserv	1	
	Forums	1	
	Learning Management System (e.g. Moodle/Webboard/Blackboard)	2	
Real-world IT	Databases		
	Microsoft® Access		2
	Microsoft® Excel	1	
	Oracle®		1
	XML		1
	LINUX		1
	SAS		1

In summary, only instructors identified examples of IT to support learning such as Elluminate®. For students, a few database-related IT were mentioned. Regarding EMR use, little or no hands-on experience in the classroom emerged as a theme across both types of participants.

7.3 EMR Descriptions

At the start of the instructor interviews and student focus groups, the participants were each asked how they would briefly describe an EMR to someone who had never heard of one. This section presents their understanding of an EMR before the researcher provided the definition being used in this work.

7.3.1 Phase 1 – Instructor Interviews

All six instructors referred to the EMR's content in terms of a "medical chart", "patient record", or "patient information". Half also associated the EMR with a physician office setting (with three describing primary users as physicians). For example, Instructor 3 stated "…within the Canadian context, I would use EMR to specifically refer to physician office electronic medical record systems. Those that are used specifically in uhh physician office practice." A few instructors also identified some of the features and functions such as decision or diagnostic support:

> "I might say that it was a smart medical chart that did some thinking by itself." (Instructor 1)

> "How would I describe an electronic medical record? It's an integration uhh of patient information and umm uhh through time or across time and umm and uhh ability to provide additional information umm that helps decision making." (Instructor 2)

Instructors generally described an EMR as containing patient information and offering additional features to support physician office practice.

7.3.2 Phase 2 – Student Focus Groups

For students, two key items stood out when describing EMRs: their content in terms of patient information and their electronic or computerized format. In addition, seven students also mentioned accessibility aspects. For example:

> "I would probably say umm- one of the- trend is umm now that a lot of paper records are being converted into electronic form and specifically in healthcare a lot of those records, patient records, are gonna be put into a computerized form umm so that umm maybe different hospitals can communicate with each other and patient records can be accessed across different hospitals and healthcare centres." (Student 1)

> "Okay, umm I would say it's just pretty much like a paper record but it's available electronically and so changes and updates can be made via electronic devices. And access to it as well." (Student 7)

> "Umm I would probably tell person that it's just a system that you can have access to check out about your medical history, about what medication you have received in the past, or what what test you had done in the past, yeah. Just basically a record for your health, umm yeah." (Student 11)

To a lesser extent, students talked about some features they were aware of and users but these items were only mentioned, at most, by one or two students. Overall, students mainly described an EMR in terms of containing patient information in an electronic format which made it more accessible.

7.3.3 Phase 1 and 2 Analysis

All participants were asked to briefly describe an EMR in their own words during phases 1 and 2 in order to begin with a common understanding of the technology being studied. Their responses demonstrated a wide range of understanding of the term. The full list of items mentioned by instructors and students in their descriptions of an EMR and the number of participants mentioning each item is presented in Table 4. The individual terms are listed in the second column and have been grouped into higher categories in the first column. The far right columns indicate how many instructors and students mentioned each item as part of their EMR description.

Table 4 - Items from Participant EMR Descriptions in Phases 1 and 2

Grouping	Item	Instructors (n=6)	Students (n=13)
Aspects	Access		7
	Consistency		1
	Integration	1	
	Speed		1
	Time	1	1
Content	Medical Chart, Patient Record or Information	6	11
Features	Billing	2	1
	Communication and Information Sharing		2
	Decision Support	3	
	Searching		1
Setting	Hospital		2
	Physician Office	3	1
Technology	Database	1	
	Electronic Devices	1	1
	Software, Electronic, Computerized	2	11
Users	Other Clinicians		1
	Physicians	3	2

All of the participants, except for one student, referred to the content of EMRs in terms of containing a “medical chart”, “patient record or information”. Secondly, most identified the EMR as being “software”, “electronic”, or “computerized” in some way. Some also referred to aspects of EMRs such as “enabling access to information”. Several students and instructors mentioned administrative or clinical functions an EMR supports such as “information sharing”, “decision support” and “billing”. A few participants discussed the EMR in terms of setting or users. Two students described information sharing between hospitals and healthcare settings but one student and three instructors limited it to the physician office. Similarly, two students and three instructors specifically said the EMR is used by physicians, but one student also indicated use by other clinicians. Many individual descriptions mentioned several items listed in Table 4.

In general, instructors mentioned a wider range of features than students but most responses across both types of participants generally aligned with the definition being used in this research.

7.4 Thoughts on an Educational EMR

During the instructor interviews and student focus groups, participants expressed many general thoughts on using an educational EMR for HI education. This section presents some of the most common themes that emerged regarding the use of such a tool in education.

7.4.1 Phase 1 – Instructor Interviews

All six (i.e. 100%) instructors agreed that an educational EMR would be beneficial to integrate into HI education. Comments included:

> "…the electronic records in practices are uhh create a whole new demand for a lot of people to be able to do some fairly uhh thoughtful analyses and so there's a market there." (Instructor 1)

> "…this is uhh excellent…I mean this is a great opportunity." (Instructor 3)

> "So it would be an exceptionally useful teaching tool." (Instructor 4)

> "So to me this is a really valuable umm teaching tool…" (Instructor 6)

Four instructors alluded to its potential in providing a foundation or context for topics related to EMRs as well as a means to expose or introduce such a system to students:

> "I think the the learning experience of actually working with data and going back and forth between data and theory is uhh rather than exercises in a text, there's something about, you know, working in the actual context." (Instructor 1)

> “I think this will be a foundation almost that would say ‘okay well here’s the system and here’s here’s what you can do with it…’” (Instructor 3)

> “So I think this will give students a better appreciation when we cover electronic medical records, exactly what-what they look like.” (Instructor 5)

Many comments tied the educational EMR to learning and understanding. The following themes were identified by three instructors each: realistic/practical, reinforce concepts, and kinesthetic use. Regarding the last theme, two instructors commented that it is achieved through hands-on use:

> “Maybe there’s something, a lot of learning that is associated kinesthetically…You say well I don’t know, I don’t even remember what it’s called but I know that if you go over in this general vicinity and click several times you find it. Well, that’s, you don’t, wouldn’t normally think that is academic learning but it’s pretty practical to build a body memory of what it’s like to use a medical record umm and to be able to integrate that with your conceptual memory cause umm well I think that’s a huge part of learning that is generally hard to do.” (Instructor 1)

> “I think the concepts only umm gets from that where people learn if they use it. The line...If I hear it, I forget. If I uhh see it, I remember. If I do it, I learn. So fundamentally it would be great for them to use it.” (Instructor 2)

During the interviews, two instructors presented analogies to express their thoughts on the educational EMR and the importance in understanding the role of an EMR within the larger context of use:

> “Let’s just back up a little on the principle so we can see where the EMR fits. Umm it’s kind of like saying that people will turn up one day at a ship yard and build a ship and umm this group is going to do the engines and these are going to do electronics and so on without anybody really understanding what a ship is. They’re all doing their pre-fab bit umm…yet it’s only at the very end of the business where they make it if they’re lucky that they get an

> appreciation of the totality of the object they're working on…Running across those courses though uhh is a need for understanding certain things." (Instructor 4)

> "It's like talking about uhh you know, uhh Microsoft® Office is very important, especially the use of Word. But not actually seeing Word being used as opposed to thinking about a typewriter. Do you know what I mean? Like you need to have that distinction in your mind to know, like to see an electronic medical record so you know what you're talking about." (Instructor 5)

In summary, the instructors had positive views towards using an educational EMR in their teaching. They saw benefits in terms of providing a realistic foundation for learning that would support student learning and understanding for specific topics and in the larger context of use.

7.4.2 Phase 2 – Student Focus Groups

All students across all four focus groups had favourable opinions towards using an educational EMR in their learning:

> "I think it would be really beneficial. Umm even just to have, have that, you know, to refer to." (Student 1)

> "Overall I think it's a pretty good idea and my only regret is that I didn't have a chance to use this when I was studying (Student 9 nods yes)." (Student 8)

> "It would be good to have one of these to work with." (Student 12)

> "I think it would be beneficial because we want to improve the current system…" (Student 13)

The most common benefit, mentioned by eleven students, was exposure or introduction to EMRs. At least one student in each focus group thought that exposure was important, even it were just a basic demonstration in the first year:

> "…demonstration of what it is would've helped. Some- something really like kind of low level not- or high level, not very complex. Just to give umm the students an idea of what it is." (Student 4)

> "I think it's really important to get exposure like that to to something real-world." (Student 5)

> "Like I think it's a good tool to use for like introduction to EMRs. Just seeing it and like working with one…" (Student 12)

Several students, mainly those in their 4th year, commented on HI topics sometimes being abstract or theoretical and saw benefits in application using the educational EMR:

> "Like it's really hard to deal with theory (Student 3: Yeah) when you don't have any experience. Like theory's only really useful I think like after you've had some hands-on experience 'cause then you appreciate it more." (Student 4)

> "It's very easy to get bogged down in the, in the theory sort of thing but what it reminds you, what you're, you know, career, career sort of goal is and where you're actually going with it. I think that's really important. It's the same way when you study science you need to do lab stuff. It reminds you of actually, what science actually is. Umm from a non-academic sort of side. From more app- applicable real-world sort of side." (Student 5)

Seven students felt that it represented a realistic or practical application, something that was from the "real-world" that they could see and use. For example, Student 4 in their 4th year reflected wanting to have "…some actual solid ground to work from instead of always using our imaginations, 'cause we learn more when we can get real examples. When we use our imagination it's more limited." In one group in particular, all three students found that it tied everything together for them, even at their 1st or 2nd year level:

> "It does put together even just theoretical concepts in sort of one place, can see quite nicely how things tie together in real-world applications. That would be useful." (Student 5)

> "Umm and like this is my first year and this my first time seeing an electronic health record [sic] and so this is kind of, ties in everything we've been learning…" (Student 7)

A big draw, so to speak, was the hands-on use aspect. Eight students expressed that they wanted to actually use the system themselves i.e. to work with it and do tasks within it:

> "I think it would be really interesting to actually be able to use the system because it makes it more real life. I mean, that's why, what why we do Co-op right? (Student 10 nods yes) To learn hands-on experience." (Student 9)

For the majority of students in the focus groups, the educational EMR was seen as benefit for providing an introduction to EMRs and its realistic nature. They felt that hands-on use would be valuable.

7.4.3 Phase 1 and 2 Analysis

A fundamental question for this work was whether participants saw any value at all in using such a tool for HI education. Throughout phases 1 and 2, the answer was overwhelmingly positive. Numerous benefits of using the tool were discussed. Most notably, students commented on importance of exposure or introduction to EMRs, integration of concepts they learn, and the realistic nature of the tool. Instructors discussed its ability to provide a foundation or context and contribution to understanding content. Both students and instructors noted that not only does the educational EMR provide a visual representation of a real health information system, it also provides a kinesthetic one (i.e. awareness and learning through navigation within the system). The main thoughts mentioned in phases 1 and 2 are shown in Table 5.

Table 5 - Main Thoughts on Educational EMR after Phases 1 and 2

Item (i.e. the educational EMR…)	Instructors (n=6)	Students (n=13)
Provides exposure or introduction	3	11
Provides foundation or context	3	4
Provides integration of concepts	1	7
Allows kinesthetic use	3	8
Contributes to learning and understanding	4	5
Is realistic/practical	3	7
Reinforces concepts	3	2

In summary, both students and instructors had positive views towards using an educational EMR for learning and teaching. The benefits ranged from it just being a real artifact to see to a tool that can be used.

7.5 Possible Topics Related to EMRs

In addressing the main research questions, one goal of the study was to determine how the educational EMR could link to the concepts taught in HI. Therefore, instructors and students were asked specifically about HI topics that could fit well with use of the educational EMR. Instructors were asked to provide feedback in phase 3 on the items generated after phases 1 and 2. The results are presented in this section.

7.5.1 Phase 1 – Instructor Interviews

In terms of content that would fit with the educational EMR, a variety of topics were mentioned. Instructor 4 commented that "I would see a need for appreciation of an EMR being germane to probably at least 60% of the course work or courses in the curriculum." Usually one to three instructors mentioned a topic but there were a few that received more comments. Five out of six instructors (i.e. 83%) felt that learning about patient and health information and data would fit well with the educational EMR:

> "One of the competencies I tried to instil in was that you don't just take a number for granted. You think about what its uhh meaning is…" (Instructor 1)

> "I highlight the umm information I, my approach is data and information only needed or useful if it's used for decision making." (Instructor 2)

> "I think it's also equally important for them to know about the information content as well so it's more than just the process and the the product. They also have to have the really good understanding about the kinds of data that they're keeping track of in the system." (Instructor 3)

Individually, four instructors also brought up linkages to health care professional roles, expressing a need for students to understand the user perspective and role within the health care system when it comes to learning about EMRs:

> "And the EMR component of it is fundamentally presentation from a practitioner who actually uses an EMR." (Instructor 2)

> "Number one is of the Canadian healthcare delivery system because when you use the words like pharmacist, nurse, doctor, policy analyst, psychologist, that kind of thing, you'll need to have an appreciation of the total system." (Instructor 4)

> [Regarding when students should use the educational EMR] "…once they've gained an appreciation for different uhh clinicians, like different health care professionals that are in the- in the system itself." (Instructor 5)

The only topic which received a negative comment was the appropriateness of using the educational EMR when teaching medical fundamentals. Instructor 2 felt that it wasn't appropriate because the content is very medically-oriented but still thought it might be a possibility.

In discussing competencies for HI students, one instructor summarized the role of graduates in this field as follows:

> "…what makes them unique is from the computer science guys is that umm they understand the environment that they have to work with. What makes them distinct from a

> nursing graduate is that they understand information environment. So that is in my mind, it is the main competency or distinctive competency umm of a health information science student." (Instructor 2)

In the portion of the interview dedicated specifically to HI competencies related to EMRs, all six instructors (i.e. 100%) went through a list of COACH's core competencies and answered the question "Do any of these stand out as being directly related to EMRs in your teaching?" Appendix M shows which competencies the three instructors identified as being addressed in their teaching and related to EMRs. The yes (y), no (n), and somewhat (s) recorded in the columns indicate specifically which competencies each individual instructor identified for their own teaching in either current or previous courses taught. They sometimes mentioned that the COACH competency was something they wanted to have but it wasn't fully there yet. This was counted as a 'yes' because it was something that instructors aimed to have students achieve. 45 out of 46 competencies (98%) were identified as being at least somewhat addressed by at least one instructor and there were six instructors interviewed, referencing about ten courses taught in the program. All instructors felt the following three competencies were at least somewhat related to EMRs in their teaching:

> 1.3: The health informatics professional assesses the key attributes of data and information (e.g., quality, integrity, accuracy, timeliness, appropriateness) and their limitations within the context of intended use (e.g., clinical and analytical uses).
>
> 1.4: The health informatics professional determines appropriate data sources and gaps in data sources in relation to identified business needs.
>
> 3.2: The health informatics professional understands basic clinical terminology and commonly used abbreviations and acronyms.

None of the instructors felt they addressed competency 2.10 in terms of EMRs i.e. "the health informatics professional applies best practices in the operation and maintenance of information systems and technology (e.g., service level agreements, disaster recovery, business continuity and incident management)." During this activity, two instructors commented on the lack of "no's" appearing:

> "It's interesting. The question I'm asking is do you need to have an appreciation for EMR specifically, umm to achieve this competency and I'm surprised at the number that are coming up 'yes'." (Instructor 4).
>
> "Well I mean related to the EMR there's- there's a lot of these that you can see from my tick marks that they're very appropriate." (Instructor 6)

Overall, the instructors felt learning about patient and health information which is contained within an EMR could be supplemented well by use of an educational EMR but identified a variety of topics that would work. When asked about a specific set of competencies and their relation to EMRs, virtually all were seen as having a relationship by at least one instructor.

7.5.2 Phase 2 – Student Focus Groups

Students related many topics in HI to EMRs and discussed ways that they could be taught with an educational EMR. Nine students (i.e. 69%) felt the tool could be used simply to help students see the scope of an EMR, i.e. what it is, especially in the earlier years of the program for those who have no concept of an EMR yet. In one focus group, a student reflected on a past assignment where they thought it would have been nice to see the educational EMR:

> "I think it also benefits like other classes as well 'cause like uhh in our database course umm there are certain like aspects of the record that we're supposed to put into our

> system. (Researcher: Mmhmm.) And then a lot of things we weren't sure of. Like umm like when we were building like a patient system, there's certain things you might not think about like the referrals thing or uhh just like prescribing drugs. You might just concentrate on like the check-in of the patient, the check-out. Maybe like diagnosis or something and that's it, but having this you can kind of learn there's like all these different aspects you have to consider. Umm so it will make learning I think better overall." (Student 12)

The students also frequently brought up its application to learning about patient and health data as well as health care professional roles. In terms of data, eight students wanted to become familiar with patient data that would be stored within the EMR. For example, they mentioned learning about what data goes into the EMR, interpreting the data, being able to distinguish good data from bad data, and learning terminologies:

> "Umm you have to know that umm you can't always rely on electronic medical records. You have to be able to interpret that's the good data." (Student 9)

> "You'd have to know about basic things like, basic things of health and how to interpret uhh electronic data, electronic records." (Student 10)

> "You also have to know the EMR, what it requires. Like the values that you need to put in, like the results. So the restrictions or just the- yeah, the data, the values." (Student 13)

Related to this was the desire to understand how an EMR supports health care professionals in their various roles. Several students not only wanted to know about the data, but how it would be used by health care professionals:

> "...umm learning the different health professionals and their roles and umm, you know, how they would use an electronic medical record." (Student 1)

> "It shows us what the physicians of like doctors are wanting to know about the patient. What kinds of things do they collect, the data that they need." (Student 13)

Seven students thought the educational EMR would be able to help in learning the more technical topics in HI as well, specifically systems analysis and design or interoperability. Many students mentioned that it was important to learn about current trends in healthcare related to EMRs at the national and international level:

> "I think it would be interesting to see how health authorities across Canada are using EMRs." (Student 1)

> "But also interesting if uhh with using this [educational EMR] we also could- were exposed to what they're doing with paper chart so can sort of compare, compare the two." (Student 2)

Regarding topics that the educational EMR might not work well with, there was some uncertainty surrounding medical fundamentals:

> "Student 3: I don't think it'd fit with the anatomy course (Student 1: Yeah, that's true) 'cause we're learning more about actual like anatomy.
> Student 1: Yeah. Yeah, there was no EMRs in that course.
> Student 3: No."

> "Actually no, you know, that might actually fit will 'cause we do in the anatomy/biology course there we do actually have a group project so if it was related, cause there's a lot of medical terminology to learn in that course." (Student 4)

> "Student 6: Might be able to use it in umm medical fundamentals but there's so much physiology and ground to cover in there, I can't see it being addressed very much.
> Researcher: Mmhmm. Okay.
> Student 5: Me either."

One student didn't think it would fit well with learning epidemiology either.

The students in this study identified a range of topics that could fit well with the educational EMR from the more technical (i.e. scope and design) to clinical (data and health professional roles) to beyond (i.e. trends for usage).

7.5.3 Phase 1 and 2 Analysis

Instructors and students identified a wide range of HI topics that could fit well with the educational EMR. A majority of both types of participants thought learning about patient and health information and data would be well-suited to the educational EMR. Students mentioned being able to understand and interpret the data contained within an EMR would be important. Both students and instructors also thought the educational EMR could help students in learning about health care professional roles, in particular how they relate to use of an EMR. Many students also saw potential in simply learning about the scope of an EMR, its design, and the need to explore current trends in the technology (including national and international initiatives).

The only topic that was identified as perhaps not being addressed through use of the educational EMR was medical fundamentals. One instructor and two 4^{th} year students commented that this more clinical area may not be a good fit but another student thought it could link to medical terminology that would be contained within the EMR. A list of all topics mentioned in phases 1 and 2 is in Table 6.

Table 6 - All Coded Topics after Phases 1 and 2

Topics (fit with EMR)	Instructors (n=6)	Students (n=13)
Architecture (System)	1	3
Clinical Decision-Making	1	4
Clinical Methodologies	1	3
Code (Programming)		1
Communication	1	4
Computer Science		4
Current Events and Trends	3	7
Data and Statistical Analysis	1	

Databases		6
EHR	2	
EMR (Scope)	3	9
Epidemiology	2	1*
Health Care Professional Roles	4	8
Health Care System, Organizations, and IT Adoption Primary Palliative	3 2 1	6
Health Information Systems		4
Health Informatics Theory	2	5
HIS Benefits	1	6
HIS Deficiencies	3	5
Organizational Decision-Making and Reporting	1	
Medical Fundamentals	2*	7*
Management		3
Legal Concerns/Legislations/Policies	1	1
Paper Chart		2
Patient and Health Information and Data	5	8
Political and Social Factors	1	2
Privacy/Security	2	2
Procurement	1	3
Project Management	1	
Standards	3	6
Systems Analysis and Design/Interoperability	3	7
System Evaluation	1	
System Vendors	1	3
Usability	1	5
Workflow	3	4

*Includes some negative comments

In going through the list of COACH's competencies, at least one instructor identified each as being related to EMRs in their teaching except for one which pertained to best practices in the operation and maintenance of information systems and technology.

In summary, students and instructors thought that the educational EMR would help in learning concepts around patient and health information and data that is typically contained within an EMR as well the healthcare roles associated with use of the system. However, the relevance of learning medical fundamentals with an educational EMR was unclear for HI students.

7.5.4 Phase 3 – Instructor Focus Groups and Analysis

> "My view- it's like, it's like if you went to a school on automotive engineering and they'd never managed to have a car there. They've only learned about it indirectly and somebody comes and says should we actually have a car there? I would say YES (laughs). Then you get in the issues of well do we use, do we learn it for about- use it for learning to drive? For learning how to repair cars? For learning how to build it in the first place?" (Instructor 1)

Data regarding topics for the content piece of educational EMR integration into HI learning was collected in terms of topics taught/learned in the past, topics linked to the EMR, and thoughts on importance of each topic for integration. It became clear that there were actually two valuable groups of items to consider for this research: all HINF topics and those more appropriate for hands-on EMR teaching. To help distinguish between the two more clearly, the instructor worksheet listed all the topics and asked instructors to indicate their agreement on a scale of 1 to 5 (1=strongly disagree, 5=strongly agree) of whether they thought the topic was directly related to hands-on EMR use.

The resulting list of all items after all data collection activities is in Table 7. The items were originally grouped into preliminary groupings by the investigator prior to the first instructor focus group. During that session, the participants suggested using an established set of categories for HI topics. Therefore items were organized according to COACH's seven categories. This categorization was shown to the second instructor focus group and they agreed. At least one instructor felt each item was relevant to the undergraduate HI program.

Table 7 - Final List of Possible Health Informatics Topics Related to EMRs Identified by Participants

Instruction: Please indicate your level of agreement with each item.			
Grouping	Item	Average Instructor Agreement Score* (n)	Number of instructors indicating relevance to undergraduates
Analysis and Evaluation	Data and Statistical Analysis	2.80 (6)	3
	Epidemiology	3.00 (6)	2
	Research	3.60 (6)	3
	System Evaluation	4.67 (6)	3
	Quality	4.50 (2)	1
Canadian Health System	Current Events and Trends	3.83 (6)	4
	Healthcare System, Organizations (Primary/Palliative)	4.50 (6)	3
	IT Adoption	4.50 (6)	3
	Legal Concerns/Legislations/ Policies	3.00 (3)	2
	Privacy/Security	4.60 (6)	4
Clinical and Health Services	Clinical Methodologies	3.83 (6)	4
	Clinical Decision-Making	3.67 (3)	2
	Medical Fundamentals	3.50 (6)	3
Information Management	Health Informatics Theory	3.50 (6)	3
	Management	2.75 (4)	2
	Paper Chart	4.40 (5)	4
	Patient/Health Information and Data	4.83 (6)	4
	Standards	4.17 (6)	3
Information Technology	Architecture (system)	4.67 (6)	4
	Code	3.50 (6)	3
	Computer Science	3.00 (5)	3
	Databases	3.00 (6)	4
	EHR	4.83 (6)	4
	EMR (scope)	4.83 (6)	4
	Health Information Systems	4.33 (6)	4
	HIS Benefits	3.83 (6)	3
	HIS Deficiencies	4.17 (6)	3
	System Analysis and Design/Interoperability	4.33 (6)	4
	Usability	4.83 (6)	4
Organizational and Behaviour Management	Communication	4.20 (5)	2
	Workflow	4.00 (3)	2
	Healthcare Professional Roles	3.67 (6)	3
	Organizational	4.00 (5)	3

	Decision-Making and Reporting		
	Political and Social Factors	3.00 (6)	3
	Procurement	3.50 (6)	3
	Adoption		
	System Vendors	4.00 (6)	2
Project Management		3.17 (6)	3

*Scale: 5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree. Green indicates modification to items after the first instructor focus group that were presented to the second group. Orange indicates modification to items after the second instructor focus group.

Although many items achieved a score of "agree" or higher, items ranked most important by instructors, on average, were patient and health information and data, EHR, EMR scope, and usability. In teaching about EMR scope, two instructors agreed in the focus group that the amount of time spent on and focus of this topic would depend on the students in the course and how much they already know. For usability, two instructors commented on their worksheets that this topic would highlight significant examples.

Some students (mainly those in their 4th year) and instructors related the EMR to learning about healthcare professional roles from the user perspective. The item "health professional roles" was originally intended to capture various roles and their use of the EMR but during the first instructor focus group, participants felt that workflow and roles should be two different topics so the item "workflow" was added. The second group of instructors agreed it was important in their ranking. The first group also thought that evaluating quality was an important sub-topic of system evaluation and that decision-making could be clinical or organizational in nature so this item was split across two categories.

There was some uncertainty about a few topics and the appropriateness of using the EMR to teach them. Epidemiology, clinical methodologies, medical fundamentals, health informatics theory, and code (i.e. system programming language) all received some mixed or conflicting comments. One 4th year student had mentioned that the EMR wouldn't fit with epidemiology. However, one instructor commented that students can't take the epidemiology course without understanding where all the data came from. This instructor also commented on the worksheet that the topic is only of minor relevance to the EMR. The topics falling under "Clinical and Health Services," specifically clinical methodologies and medical fundamentals were also seen to have limited relevance by a few instructors and students.

One topic in particular remained too ambiguous for some instructors: computer science. Originally, this topic was created to reflect comments by students related to learning the technical aspects related to the EMR. However instructors had trouble with this item being included as one topic under HI for EMRs:

> "I don't understand what, under system design, computer science means." (Instructor 2)
>
> "Are you talking about software engineering? 'Cause I think if I were a computer science prof [sic] I would have difficulty with that. You're putting the entire discipline into that one little tiny box." (Instructor 3)
>
> "Technology – irrelevant perhaps." (Instructor 4)
>
> "Not really relevant." (Instructor 6)

The only modification to the list of topics made after the second instructor focus group was to split "IT Adoption" into its own topic that could apply at two levels: "Canadian Health System" and "Organizational and Behaviour Management". This group also felt that project management related to other items such as adoption, Canadian Health System, and Organizational and Behaviour Management.

After the instructor focus groups, two of the most highly ranked topics for relevance to the educational EMR were those that students and instructors had strong feelings towards during the previous phases: patient and health information and data and EMR scope. Healthcare professional roles was still a popular topic as well but their workflow with the EMR was distinguished as a separate topic. At the end of phase 3, a few of the more medically-oriented topics were still seen to have limited relevance for HI student learning with the educational EMR.

7.6 When to Integrate the Educational EMR into HI Education

Instructors and students commented on when and where they felt it would be good to bring the educational EMR into learning, i.e. integration points. Reflecting on their experiences with courses and current knowledge of the educational EMR, they shared their views, which are presented in this section. Again, the instructors were asked to provide feedback on the results after phases 1 and 2.

7.6.1 Phase 1 – Instructor Interviews

Regarding when in the undergraduate program the educational EMR should be integrated, four instructors talked about bringing it into existing courses for EMR-related topics:

> “The students need to come prepared. They need to have used it for other purposes for other competencies in other courses in the curriculum.” (Instructor 4)

> “I think there are a number of courses that it would be good as a learning experience.” (Instructor 6)

None of the instructors specified a particular year of the program but two strongly felt that it should be integrated throughout the entire program:

> "I think to do something like this properly, you probably need to have a bit more focus around how a tool such as this can be incorporated into a program. What I mean is, I see something like this to really get the most benefit from it is more than just one course. I think it almost has to be imbedded into multiple courses in a way that can leverage different aspects of it. The reason being that you want to lessen the learning curve for the students. And you also want to leverage the benefits you can get out of this particular product." (Instructor 3)

> "But this would be extremely useful if it were made, and we use the word 'integral' part of the total curriculum. It can't be something that just gets referred to in one course because one particular instructor has more of a liking for it." (Instructor 4)

The instructors identified integration of the educational EMR as being most appropriate at the course or program level.

7.6.2 Phase 2 – Student Focus Groups

The majority of students identified 1^{st} year as an appropriate time to introduce the educational EMR but 2^{nd}-3^{rd} year as appropriate points to have hands-on use. For 1^{st} year, they generally felt that a knowledge base is required before actually using it:

> "Umm I think like having just walked us through the electronic health record [sic] a few minutes ago, I think that would be good for first year. Umm but actually for the students to actually use it I think it would be better for second year after we have just already computer science basics. And like having the computer science basics and before the first Co-op work-term. So you tie the tool." (Student 7)

> "Definitely think it's really important to get exposed to that. That's a really important part of the…curriculum because it is the practical application of the…work. I think it's very important to get exposed to that maybe, like I said earlier, second year, something like that. Umm, definitely puts things into perspective." (Student 5)

> "Well I think in the 1st year, or 1st or 2nd years you could just get an introduction and just see what one looks like." (Student 13)

At least one student in each focus group brought up the relationship of exposure to their mandatory Co-op work-terms. Many felt that it would be good to have some exposure prior to the first work-term so that they have some experience first:

> "I went to like interview physicians but it's like I was just mostly trying to gather information but it's not like I can sit there with the physicians and learn their, their, you know, EMR. It's not like they're gonna have the time to teach any students. They should already have…" (Student 4)

> "It might be nice to have a little bit of exposure before going on a first Co-op so that they've seen something that reflected the workplace a bit." (Student 6)

> "I think before going out on our first Co-op, it should be-like, it, it should be umm brought in before the first Co-op term 'cause right now everyone is kinda like confused of what they're expecting…" (Student 13)

Two students expressed the value of being exposed to the EMR before and after a Co-op work-term. Some 4th year students had seen EMRs during Co-op work-terms and commented that this was where they had hands-on experience with EMRs, something that other students had missed out on due to the nature of their own work-term:

> "I didn't really get to see what an EMR did or what it was capable of or even where in the organization it was used until I went on my first work-term in a hospital and actually go to see it and like train users in it. And prior to that I really had no idea who the, who a lot of the major vendors were or really what the context was in the hospital. Umm, or in a clinic even." (Student 1)

> "…'cause not all of us get to go on Co-ops where we get to…like (Student 4: Yeah) I haven't ever worked with them before so it would be nice just so like other students get

> benefited, focus on that more in school work as well."
> (Student 3)

Students in their 4th year mentioned a few courses where they felt hands-on use would work well, specifically the more technical courses that are directly related to EMRs. One idea that two students agreed with was having a project throughout the course addressing different parts of the EMR:

> "Student 3: …I think that'd be good like through the whole course you're working on this project. (All nodding yes)
> Student 4: Yeah, like the case studies being done in…class. It's like we're continually using this one case study and doing different things with it like system design and system evaluation.
> Student 3: Yeah, I think that'd be good cause then you can, yeah look at all aspects of it rather than just one. (All nodding yes)
> Student 2: That's a good idea."

Six students mentioned having a specific course that focuses on the EMR.

The students in the focus groups identified introduction in the 1st year of the program with hands-on use beginning in the 2nd-3rd year. Several noted a link to mandatory Co-op work-terms in that there could be valuable to use the educational EMR before as preparation, after as reflection of the learning experience, or even a replacement for those who didn't see one during their own work-term.

7.6.3 Phase 1 and 2 Analysis

Regarding when to introduce and integrate the educational EMR, students and instructors shared some different perspectives. The majority of students felt 1st year would be appropriate for an introduction and 2nd-3rd year for hands-on use. Rather than specifying a particular year of the program, instructors referred to courses and the entire curriculum which spans all years. Relevance to Co-op work-terms was mainly brought up by students and most felt that the educational EMR should be introduced prior to work-terms. The full list of points to integrate that were mentioned is in Table 8. Descriptions are provided in Table 10.

Table 8 - Points of Integration Mentioned in Phases 1 and 2

Integration Point	Instructors (n=6)	Students (n=13)
1^{st} Year		9
2^{nd}-3^{rd} Year		9
4^{th} Year		1
5^{th}+ Year	1	
After Co-op		1
Before Co-op		8
Courses	4	4
Cross-discipline (e.g. Medical)	2	3
Program/Curriculum	2	5
Specific Course		6

Students identified particular years in the 4-year program for use of the educational EMR. Instructors referred to courses and the entire program when they referred to integrating the EMR into HI education. There was an overlap to some degree as courses span all four years. The main difference was in respect to the link to Co-op terms, which was only mentioned by students.

7.6.4 Phase 3 Results – Instructor Focus Groups and Analysis

Both instructors and students were asked about when it would be appropriate to introduce and use the educational EMR. Their responses grouped into categories with input from instructors are presented in Table 9. In the table, the high-level groupings that emerged were “Co-op,” “courses,” and “program/curriculum.” “Cross-discipline” refers to integration beyond the single HI program. The next column shows how important the instructors thought each item was. For example, on average, five instructors strongly agreed with integration across the program/curriculum. Table 10 provides brief descriptions of each integration point. At least one instructor agreed that each item was relevant to undergraduates.

Table 9 - Final List of Points of Integration Identified by Participants

Instruction: Please indicate your level of agreement with each item.			
Grouping	Item	Average Instructor Agreement Score* (n)	Number of instructors indicating relevance to undergraduates
Co-op	After Co-op Before Co-op Co-op Irrelevant	3.00 (5) 3.83 (6) 2.00 (3)	3 4 3
Courses	 Specific Course	4.20 (5) 4.00 (5)	3 2
Program/Curriculum	 1st Year 2nd-3rd Year 4th Year 5th+ Year	5.00 (5) 3.17 (6) 4.17 (6) 4.33 (6) 4.25 (4)	3 2 4 4 1
Cross-Discipline (e.g. Medical)		4.00 (3)	2

*Scale: 5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree. Green indicates modification to items after the first instructor focus group that were presented to the second group.

Table 10 - Descriptions of Points of Integration Identified by Participants

Item	Brief Description*
After Co-op	After the first Co-op work term
Before Co-op	Before the first Co-op work term
Co-op Irrelevant	Exposure not relevant to Co-op work term
1st Year	Exposure in first year, beginning of program
2nd – 3rd Year	During 2nd to 3rd year of the program
4th Year	During fourth year
5th + Year	Graduate-level courses
Courses	At course level
Specific Course	In specific courses for EMRs
Program/Curriculum	From 1st to 4th year throughout program and coordinated through courses
Cross-Discipline	Beyond the HI program into related disciplines as well

*Descriptions are based on participant responses.

A few students and four instructors had mentioned having a specific course that focuses on the EMR:

> "Possibly an elective? Would be important to have a dedicated course." (Instructor 4)

However, in the first instructor focus group, in response to the "course" item, two instructors felt that it should be introduced more widely:

> "I don't actually care about the courses, specific course part." (Instructor 2)
>
> "I wouldn't say just one course but if you maybe be able to start stringing a couple of courses together then they're on related topic areas." (Instructor 3)

This idea of going beyond a single course to longitudinal integration across entire program or curriculum was very popular among the 4th year students and instructors and was ranked highest among all the items. In fact, a large portion of the first instructor focus group session delved into general approaches for how to integrate an educational EMR across a program of study.

In terms of when during the program it would be best to introduce hands-on use of an EMR, most participants agreed that 2nd-3rd year would be best. While students felt it was important to have basic exposure to the EMR in the 1st year, they also recognized that they needed more of a knowledge base before actually using it and instructors agreed.

There was also some mention of the relevance to medical students and those in related discipline. The item "cross-discipline" was added to the worksheet for the second group of instructors to reflect all earlier comments and two of them felt it was very important but one thought that it might not be practical. The biggest discrepancy that came up for instructors was regarding the relevance of Co-op to EMR integration. Two instructors in the first focus group felt that Co-op was irrelevant to integration:

> "I don't believe that EMR is relevant to Co-ops." (Instructor 2)
>
> "In a way, I think when you're trying to design this type of umm uhh approach to curriculum design, you don't want to

> have too many variables cause it gets too complicated and I see the Co-op piece as just as sort of variable that just uhh complicates things." (Instructor 3)

To confirm whether all instructors felt this way, another item called "Co-op Irrelevant" was added to the worksheets for the second group of instructors and the rankings showed they did see a connection. Comments from the second group included:

> "Important to be acquainted with the principles and the terminology." (Instructor 4)

> "It would depend on the Co-op but there should be some exposure prior to a first Co-op." (Instructor 6)

Overall, students saw a stronger relevance to Co-op work-terms for exposure to the educational EMR than instructors but both types of participants felt that hands-on use would be best starting in the 2nd or 3rd year and use throughout the program or curriculum level would be best.

7.7 Teaching Approaches with the Educational EMR

Another key question for this research was to determine what pedagogical approaches would be appropriate to use with an educational EMR. In the study, this translated to exploring learning and teaching activities which have been used in the past and can be applied to the educational EMR or new ideas from students and instructors that could be tried. This section presents their views and also feedback from instructors gathered in phase 3.

7.7.1 Phase 1 – Instructor Interviews

When discussing past and current teaching approaches, the most common cited by five instructors was the traditional lecture. In terms of specifically teaching about EMRs, a few instructors confirmed how they had introduced them in their lectures:

> "…the closest I get to it I think is a screen shot." (Instructor 1)
>
> "A little bit of class discussion showing some examples on the screen, etc." (Instructor 3)
>
> "It frequently comes up in context of illustration rather than teaching people what it is." (Instructor 4)
>
> "We do present lectures to students based on my own- the instructor's experience with EMRs." (Instructor 6)

Four instructors had also brought in guest lecturers to speak to their classes about their experiences out in the workplace, sometimes related to the context of EMR use.

For teaching approaches to specifically use with the educational EMR, four instructors commented on using it for demonstration purposes. They generally saw it as a good illustration tool that would help give students an idea of what an EMR is. Two instructors noted that the researcher was using HyperCam™ to record the interview and saw that as a way to incorporate it:

> "Well one of the things I would do, I see you have HyperCam™ there. Umm I would probably umm do a movie of the use of the record for one thing and then say 'okay, now here's something similar, you do it." (Instructor 1)
>
> "I think that, using that HyperCam™ like that if you set that up so the students could have an appreciation for that type of umm educational tool would be fabulous." (Instructor 5)

Other ideas were mentioned to a lesser extent and often in conjunction with each other. Ideas involving case studies or scenarios were described by three instructors. For example, Instructor 2 said "I would give them the case, written case. I would umm uhh give, ask them to enter the case into, into the electronic medical record and then umm I would ask them to make decisions." As well, three instructors talked about designing exercises or assignments around the EMR or just allowing students to explore it on their own. For instructors, past approaches for teaching EMR-related topics generally consisted of lectures. They felt that the educational EMR could be a good demonstration tool or used with cases.

7.7.2 Phase 2 – Student Focus Groups

Regarding learning about EMRs in the past, students mainly commented on having seen demonstrations and examples in their courses. A few of the 4th year students mentioned having worked briefly with a system in a 3rd year lab:

> "…kinda used it as an example to be like oh, this is maybe what one would look like. Just for those students who didn't have exposure to EMRs during Co-ops, yeah."
> (Student 1)

However, the students had many ideas for how the educational EMR could be incorporated into their learning. Eight students mentioned simply allowing students to play-with and explore the educational EMR. They agreed it would be helpful to give students a sense of what an EMR is:

> "Student 1: …even just to umm kind of click around it and see the different values that are there. Umm and see the different data that it can capture and how it would be used by a physician. Just kind of exploring it.
> Student 4: Yeah."
>
> "I think it would be interesting to just play around with it."
> (Student 2)
>
> "Student 3: You don't like fully understand until…
> Student 4: You play with it.
> Student 3: Yeah."
>
> "…just browsing around I think could be informative."
> (Student 6)

"Student 13: Like playing around with it.
Student 11: Yeah.
Student 12: Yeah. Would be really helpful."

Eight students also saw value in peer interaction in learning and mentioned ways to integrate with interactive methods:

> "Maybe some more group work and group discussion around umm EMRs would be really helpful because it was sort of structured (Student 3 nods) when we did kind of see an EHR in a lab, it's too structured." (Student 4)

> "Student 3: And I do think umm like group discussions and umm kind of like extra participation or something would be important to learn it.
> Student 1: Yeah.
> Student 3: Cause I do find like when, like in group discussions you get like different ideas of it…"

> "It would fit with class discussion because you're able to talk about it but I think definitely do like smaller groups and then maybe getting back together and discussing in the large group." (Student 9)

> "Umm have the instructor give like, like a project or maybe something either to individuals or like a team." (Student 12)

Many responses from both students and instructors referenced the use of several activities in conjunction for integrating an educational EMR into HI education. For example, students had mentioned using cases in the past and thought they would fit well with the EMR, within the group work or individually:

> "Student 4: Yup. And doing case studies and maybe a presentation based on a case study (Student 3: Yeah) like with EMRs."

> "Student 3: But do you know the assignments did really help to like know what they are.
> Student 1: Yeah.
> Student 4: But it'd be cool if they related it back to the organizational context (Student 3: Yeah), you know, so that

> you could see like…
> Student 3: Maybe have their write-ups deal with that and then (Student 4: Yeah), and then cause you know you had the write-up with the answers and whatever. (Student 1: Yeah) Like if the answers were like hands-on and the write-up was to do with why do we use this."

A few students had seen some brief demonstrations and examples of EMRs in classes but thought that free exploration and use of an educational EMR would be good. They also expressed a desire for peer interaction in activities (e.g. group discussions).

7.7.3 Phase 1 and 2 Analysis

A part of pedagogy is the methods used to teach (Harris et al., 2009). Students and instructors identified a wide range of activities that have been used to teach HI concepts in HINF courses in the past as well as ideas for how to incorporate the EMR into some of them. Table 11 lists all approaches that have been used in the past.

Table 11 - Teaching Approaches Used in Past HI Courses

Item	Item
Analyses	Lab
Business Cases	Lecture
Case Study/Scenario	Mockups
Demonstrations and Examples	Online (e.g. Elluminate®)
Exercises and Assignments/Quizzes	Papers
Group Work and Projects	Role-play
Guest Lectures	Student Presentations
Instructor Presentations	Student Research
Integrated Activities	Video
Interactive Class Discussions	Website Review

In terms of specifically learning about EMRs, students mainly commented on having seen demonstrations and examples in their courses and a few instructors confirmed how they had introduced them in their lectures. A few of the 4th year students mentioned having worked briefly with a system in a 3rd year lab.

From the instructor interviews and student focus groups, two approaches involving the use of the educational EMR were identified frequently by both types of participants. The first was allowing students to play-with and explore the educational EMR. Participants felt simply allowing students to use the EMR on their own could be a valuable part of the learning experience. Second, the use of case studies and scenarios was deemed to be an appropriate method of working with the educational EMR. Many students also thought group work and projects involving the educational EMR would be good. Plus a few instructors thought they could use an educational EMR for demonstration purposes and design exercises or assignments with it. The full list of teaching approaches specifically linked to the educational EMR by participants in phases 1 and 2 are in Table 12 with descriptions in Table 14.

Table 12 - Teaching Approaches for the Educational EMR Identified in Phases 1 and 2

Teaching Approach	Instructors (n=6)	Students (n=13)
Analysis	1	
Business Bases	1	
Case Study/Scenario	3	7
Comparisons	1	3
Demonstrations and Examples	4	6
Exercises and Assignments	3	6
Group Work and Projects	1	8
Guest Lectures		3
Instructor Presentations	2	2
Integrated Activities	1	2
Interactive Class Discussions		4
Lab	1	6
Lecture	2	
Online (Elluminate®)		1
Play With and Explore	3	8
Role-play	1	5
Student Designed		3
Student Presentations		1
Student Research	1	2
Student Use in Class	1	3
Video	2	

Overall, playing-with and exploring the educational EMR as well as cases or scenarios were found to be the most appropriate teaching approaches involving the educational EMR. Many students also thought group work and interaction with peers would be good.

7.7.4 Phase 3 – Instructor Focus Groups and Analysis

All participants had many ideas for how the educational EMR could be incorporated into teaching activities in the future. The final list categorized by the high-level groups in Weston and Cranton's Summary of Instructional Methods are shown in Table 13 with brief descriptions of the items in Table 14. There was at least one instructor who agreed that each item was relevant to the undergraduate program.

Table 13 - Final List of Teaching Approaches Identified by Participants

Instruction: Please indicate your level of agreement with each item.			
Grouping	Item	Average Instructor Agreement Score* (n)	Number of instructors indicating relevance to undergraduates
Instructor-Centered	Lecture	3.67 (6)	4
	Demonstrations/Examples	4.33 (6)	5
	Guest Lectures	4.67 (6)	4
	Instructor Presentations	4.17 (6)	4
	Video	2.83 (6)	4
Interactive	Group Work/Projects	4.00 (6)	4
	Interactive Class/Discussions	4.33 (6)	5
	Student Presentations	4.17 (6)	4
	Online (e.g. Elluminate®)	3.83 (6)	4
Individualized	Analyses	3.50 (6)	3
	Comparisons	4.00 (6)	5
	Papers	3.00 (6)	4
	Website Review	2.83 (6)	4
	Student Research	3.83 (6)	3
	Self-Directed	1.67 (3)	2
Experiential Learning Methods	Lab	4.83 (6)	5
	Business Cases	3.83 (6)	5
	Case Study/Scenario	4.17 (6)	4
	Exercises/Assignments/Quizzes	4.00 (6)	5
	Mock-ups	3.50 (6)	4
	Play-with/Explore	4.17 (6)	4
	Simulation (e.g. role-play or serious game)	3.33 (6)	4
	Student Use in Class	4.17 (6)	4
	Student Designed	2.00 (3)	2
	Integrated Activities	4.33 (6)	4

*Scale: 5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree. Green indicates modification to items after the first instructor focus group that were presented to the second group.

Table 14 - Descriptions of Teaching Approaches Mentioned by Participants

Item	Brief Description*
Analyses	Perform analyses with data from EMR
Business Cases	Students write business cases for EMR applications
Case Study/Scenario	Scenarios or story behind EMR activity
Comparisons	Compare some aspect of EMR
Demonstrations and Examples	System used in walk-through, screen shots, etc.
Exercises and Assignments/Quizzes	Small tasks for students to do with EMR
Group Work and Projects	Students work in groups on EMR project
Guest Lectures	System used by guest lecturer
Instructor Presentations	Instructor presentations with system
Integrated Activities	Use many approaches in combination
Interactive Class Discussions	Q&A, student participation about EMR
Lab	Use EMR in computer lab part of course
Lecture	Traditional lecture
Mockups	Students create mockups of EMR
Online (e.g. Elluminate®)	Remote sessions
Papers	Students write papers
Play-with and Explore	Students explore EMR
Self-Directed	Students decide how to use EMR for learning
Simulation, role-play or serious game	Simulate EMR use
Student Presentations	Student presentations with system
Student Research	External research surrounding EMR
Student Use in class	Students hands-on use in class e.g. laptop
Video	Videos based on EMR
Website Review	Students search websites

*Descriptions are based on responses collected from participants.

The most highly ranked items were labs, interactive class discussions, and instructor presentations. The most frequently mentioned activity across all participants and during the first instructor focus group was allowing students to play-with and explore the educational EMR. During the focus group, the participants felt it would be important to allow students to have a chance to explore the tool themselves.

> “…starting with their personal experience and playing and exploring would be the very first thing.” (Instructor 1)
>
> “I really think umm play-with and explore should be everywhere and it’s going to be, needs to be the basis and then all of these other methodologies, whatever the

> methodology grouping is, needs to be used as needed basis." (Instructor 2)
>
> "Instructor 2: …play with (Instructor 1: explore) and explore is an underlying (Instructor 3: Yeah) because in order to do an analysis you need to actually play with and explore. In order to do comparisons (Instructor 1 nods yes) you need to compare system, play with system one and play with system two to be able to compare. If you're going on paper and say here are the features of the system one (makes hand motion of lists), here are the features of system two, that's great, the features match. Sit in front of it, one of them is extremely user friendly, the features link together and flows well. The other one, features is [sic] there but you have to type your password every time you change a feature. (Instructor 1 nods yes) So it's a significant difference."

Two additional related items came out after the first instructor focus group was conducted: "self-directed learning" and "student-designed activities". To find out what other instructors thought, these were added for feedback for the second group of instructors and they agreed that there would be limited value to have these at the undergraduate level. Many common suggestions for using the education EMR fell under experiential learning methods, especially with cases i.e. realistic scenarios and data. Instructors and students mentioned using cases already and thought they would fit well with the EMR. As mentioned above under current approaches, students commonly see demonstrations and examples of EMRs in their classes and students in all focus groups plus four instructors felt the educational EMR could be used as another way to facilitate this. There were a few items that instructors ranked as neutral or lower on average. For example, regarding videos, there was support for demonstration purposes but an instructor also commented that use needs to be interactive for students to be fully exposed and another instructor commented that videos would have limited value. Many responses from both students and instructors referenced the use of several activities in conjunction.

This was captured by the item labelled "integrated activities" which is listed in Table 13 as a separate category. Both instructors' and students' comments supported the integration of activities to meet course objectives:

> "I don't- actually I think all of these are useful but I think the more important thing is all of these are serving, working in a base and also serving to the same objective." (Instructor 2)

In the first instructor focus group, the instructors described ideas for how they would structure their teaching with the EMR and what emerged was the idea of 'simulation' that included the existing item of role-play and a new idea of a serious game. One instructor expressed a difference between integrated activities and simulation:

> "Instructor 3: Yeah, these [list of teaching approaches] all look look right umm I would draw distinction uhh between integrated activities versus simulation. What you guys are taking about in fact is simulation.
> Instructor 2: Probably.
> Instructor 3: As opposed to integrated activities which is taking a bunch of things and, you know, integrating them so that they make sense in independent sequence."

Although they may be viewed differently, both integrated activities and simulation demonstrate that a variety of teaching approaches can be used with the EMR. Some may not involve direct hands-on use of the EMR but they can be used in conjunction with those that do, such as "play-with and explore". Overall, students and instructors expressed several ways to incorporate the educational EMR into current teaching approaches and new ideas that would involve more hands-on use. Playing-with and exploring the tool was popular as well as more structured case studies or scenarios. Other highly ranked items reflected the traditional instructor-centered approach of presentations by the instructor and labs plus class discussions that fit with the students' desire for interaction.

7.8 Using the Educational EMR

The educational EMR is essentially a piece of software that can be configured and used in different ways. In addressing the technology piece of integration, students and instructors commented on aspects of the tool which could be used for learning. This section presents their views and instructor feedback from phase 3.

7.8.1 Phase 1 – Instructor Interviews

When instructors were asked about how they would actually use the educational EMR as a tool, half mentioned using its features. One instructor commented that the educational EMR should be more simplified than an actual EMR for student use: "so there needs to be a way that students can use an EMR that's been uhh perhaps functionality reduced. Oversimplified" (Instructor 4).

Three instructors also suggested having students explore patient data within the EMR, generally pulling it out for course work:

> "I would see if I could export a flat file from this so that it, they would be able to see how data comes out of this and the structure likely for analyzing the rest of it for the course." (Instructor 1)
>
> "I would be looking at this not so much as a data entry tool but rather in terms of exploring the…data content that's in it. Uhh so I would probably need to have a bunch of records already created in there to start with." (Instructor 3)

On the other hand, one instructor explicitly stated that they would have students push data into it:

> "The reason why they'd have to enter the data I think is umm in terms of usability of the application they have to get a sense of it. If data is there they never know how easy or how difficult to enter data into the case. And the other thing is in order for relationship between the data and the umm EMR they have to be able to uhh decode uhh patient information into the components where they're going to go." (Instructor 2)

In discussing ways to use the educational EMR, the instructors mainly focused on ways to work with the data, either pulling it out or pushing it in to the record.

7.8.2 Phase 2 – Student Focus Groups

For the students, comments around use of the EMR were intertwined with suggestions for topics and teaching approaches. In their responses, seven students referred to the data contained within it. Interpretation of data was mentioned above but students also suggested exploring how it is structured within the EMR:

> "Student 2: Would like seeing two datasets populate the same EMR. We could see what a back dataset looks like versus a standardized one. (Student 4 nods yes.)
> Student 3: Yeah."

Other items such as design, information entry and back-end were also mentioned by a few students. For example, three students wanted to see the back-end of the EMR:

> "…if we had access to the back end we could see how the database works on this too." (Student 2)

> "It could be interesting to be able to get more of a back-end perspective on it. Umm because our training is gonna be preparing us more for that…" (Student 6)

In terms of aspects of the educational EMR, students commented on the data contained within it and to a lesser extent, the back-end design.

7.8.3 Phase 1 and 2 Analysis

The students and instructors generally mentioned different aspects of the educational EMR to use during learning and teaching. Half of the instructors thought that the features of the EMR should be explored and that the information contained within the system can be used as part of course work. Some students mentioned these aspects as well but mostly wanted to understand how data is structured within the EMR. The full list of educational EMR parts are listed in Table 15 with descriptions in Table 17.

Table 15 - Aspects of EMR System and Use Mentioned in Phases 1 and 2

Aspect of EMR Use	Instructors (n=6)	Students (n=13)
Architecture		1
Back-end		4
Code		2
Data	2	7
Design		5
Features	3	1
Information Pull	3	3
Information Push	1	5
Interface	1	

Overall, the data aspects of the educational EMR such as entry, retrieval, and structure were of most interest to students and instructors.

7.8.4 Phase 3 – Instructor Focus Groups and Analysis

The focus of this research is the use of an educational EMR which is a comprehensive piece of software that can be use in many ways. Participants were asked about how they could use the tool as part of learning activities and several aspects of it were mentioned. The final list of items is in Table 16 with brief descriptions in Table 17. This grouping was developed with input from both instructor focus groups. At least one instructor felt each item was relevant to undergraduates.

Table 16 - Final List of Items Identified by Participants for Aspects of EMR System and Use

Instruction: Please indicate your level of agreement with each item.			
Grouping	Items	Average Instructor Agreement Score* (n)	Number of instructors indicating relevance to undergraduates
Architecture		4.33 (3)	3
	Back-end	3.83 (6)	4
	Code	3.67 (6)	4
	Data	5.00 (6)	5
	Design	4.50 (6)	5
	Interface	4.50 (6)	5
	Features	5.00 (6)	6
	Information Pull	4.83 (6)	5
	Information Push	4.83 (6)	5

*Scale: 5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree. Green indicates modification to items after the first instructor focus group that were presented to the second group.

Table 17 - Descriptions of Aspects of EMR System and Use

Item	Brief Description*
Architecture	Overall structure of the system encompassing all pieces
Back-end	How the system looks behind the interface
Code	The lines of code for the application
Data	Types of patient information, data captured in the system
Design	How different components are related and put together
Features	Viewing information, prescribing, decision support, case subscription, etc.
Information Pull	Getting information out of the system, exporting
Information Push	Putting information into the system, importing
Interface	Screen, buttons, text boxes, etc. – what the user interacts with

*Descriptions are based on participant responses.

The two items ranked as very important were data and features. Information push and pull were also ranked highly. When it came to working with the data, both students and instructors saw value. Discussion of the data was often tied to the interface. An interesting consideration related to the interface which several students commented on was the complexity of the interface that they saw during the demonstration. This is discussed further under general considerations. One instructor wrote “too technical” on their worksheet next to the interface item. Regardless, some instructors mentioned the possibility of exploring patient data within the EMR. Related to comments about data was exploration of the EMR features offered such as producing summaries and statistics. All instructors ranked this item as very important. Instructors in the first instructor focus group agreed with the importance of exploring all aspects of the EMR for teaching, but felt that they all needed to be tied together. With their input, all items were grouped under the umbrella of ‘architecture’:

> “Instructor 3: A related word would be it’s the architecture.
> Instructor 2: Architecture. Yeah.
> Instructor 3: Tie them all together.
> Researcher: So you’re saying architecture is not part of the back-end. That it’s its own piece?
> Instructor 2: I think so. (Instructor 3 nods yes) I would say it’s so critical that, umm critical, that I think it needs to be separate.
> Researcher: So if you’re looking at the architecture of the system, you’re looking at it outside the system? How the system fits into the architecture? I’m just trying to understand.
> Instructor 3: (motions on the screen around the two boxes) I can see that as sort of architecture circles.
> Researcher: I’m going to do that…
> Instructor 1: Covering all of them.
> Instructor 3: Yeah, sort of a circle or box around that.”

When presented with this new overarching item called “architecture” the second group of instructors agreed. Three students had expressed that they would like to see the back-end of the EMR. However, two instructors commented negatively on their worksheets for this item. One felt it wasn’t relevant and the other felt an awareness is needed but not specific learning activities. They also had the same comments regarding code. Both exploration of code and design were only brought up by students but instructors agreed with the importance of addressing design in their rankings. In general, participants saw ways to use many parts of the EMR but exploring the data and features were deemed to be most important and feasible by instructors.

7.9 General Considerations

Towards the end of each data collection session, students and instructors were given an opportunity to share any additional considerations (including concerns) for integration. Each item mentioned by a student or instructor in phases 1 or 2 was presented to instructors in phase 3 for feedback. This section outlines all considerations that emerged for integration.

7.9.1 Phase 1 – Instructor Interviews

The instructors discussed many items they would need to consider when integrating the educational EMR into their teaching. The most common were development of appropriate cases or tasks, support for the instructor, the learning curve for students, and system aspects. One of the teaching approaches that came up above was the use of case studies and scenarios. In order to do this, four instructors recognized that they would need to ensure cases or tasks given to students were appropriate for the topic and students:

> “I would be striving for umm something that was quite complex, fairly rich set of cases that had lots of different interesting questions to ask…” (Instructor 1)

> “I need the case. I need the appropriate case. (Researcher: Okay.) And the case needs to be sufficiently challenging. Umm I would say it should be a medium, medium complexity case rather than an extremely difficult case.” (Instructor 2)

The need for instructor support was expressed in different ways. Three talked about having technical support for installation, access, and maintenance, while one referred to needing support of the school during the process of integration. Three instructors commented that they would need to learn the system in order to teach with it but four also recognized that there would be a learning curve for students that should be accounted for.

> "So you try to help them navigate through system in a way that would focus just on the pieces that they need to learn rather than having them go through learning EMR itself." (Instructor 3)

Some ideas instructors had from a teaching approaches perspective to help support students in becoming familiar with the system included pre-recorded video demonstrations and having them enter data to get a sense of it.

The fourth most-mentioned area of consideration was the system itself. This included the features and capabilities of the tool and how they could be leveraged for learning. Two instructors specifically discussed having to fit the tool to the topic at hand rather than the reverse:

> "I think depending on the nature of the course I would need to think about how to incorporate the different aspects of the the system into the course material in a way that strengthens the learning." (Instructor 3)

> "Umm I think what you'd really have to consider is what part of that [educational EMR] would be valuable to the point that I'm trying to make in the class." (Instructor 6)

Considering the nature of the course was mentioned by three instructors as well as taking a step-by-step approach to integration so that students aren't overwhelmed with the tool.

7.9.2 Phase 2 – Student Focus Groups

For students, the most prominently mentioned items were having the necessary prerequisites/experience to be able to use the educational EMR and exposure to a variety of systems. For students in their 1st or 2nd year, a consideration that virtually all of them voiced was having sufficient prerequisite knowledge prior to using the EMR. They appeared to find the educational EMR somewhat overwhelming at first sight and thought that newer students such as themselves should have more a foundation in health concepts and technical skills before using it in a hands-on manner:

> "I think using something like that is really valuable uhh probably not in first year because I think a fair bit of knowledge about the healthcare system needs to be utilized to use a system like that…If you expose someone who doesn't understand what's going on with the healthcare aspects they might get overwhelmed and umm not get the most out of the software." (Student 5)

> "…maybe introduction to it but not umm not too much in detail though. I think yeah, as Student 6 said, need more of a mental base before we jump into electronic medical records right away." (Student 7)

> "Umm I think you need sufficient scientific background knowledge as well as interpretation skills and uhh skills in using technology." (Student 8)

> "You can be like, I was just shown this right now in one go, like that's not enough, like even Student 10 said, it was overwhelming." (Student 9)

> "I think like at first it would seem like very overwhelming, like it's a lot of uhh lot of different fields and uhh new terminologies." (Student 10)

> "But when I first just looked at it, the first thing was oh, it would be easier if I just do it with paper 'cause it just looked way too confusing. And just the way it was presented and like the screen was- it just looked overwhelming…" (Student 13)

A few students expressed concerns that being exposed to only one EMR might lead to a limited perspective. They felt that there should perhaps be more than one educational EMR or different types of educational health information systems:

> "Student 2: My only concern would be if umm a tool like this becomes our sort of a, or the people's who would start the program using something like this, their mental de-facto standard of what a EMR should look like…
> Student 4: So maybe a variety.

> Student 2: A variety.
> Student 3: Yeah a variety would be good."

> "You might get fixed into one type of, like one type of umm program. Maybe it's kinda important to keep in mind that like technology's always changing so you have to be able to move with it as well." (Student 7)

> "Umm well I think for educational purposes it's good to have umm a broad view of everything. We shouldn't just focus on one type." (Student 8)

> "I think it'd be good if you can, I mean if you are in the- in the future if there are a few different EMR systems that can be, I mean, can be shown to students (Student 13: Yeah) so students can compare umm those systems as well." (Student 11)

A few students (five) also mentioned that the learning curve for students using a new system should be considered. Three of the 4th year students voiced concerns about integrating it under time pressures within labs, assignments or quizzes. They were also able to reflect on previous lab experiences that involved using systems and suggested that having some supporting documentation would be helpful:

> "Student 4: It was umm difficult to remember all the processes. Like we had some sort of documentation in the lab but it wasn't always fully explanatory.
> Student 3: Yeah. I do, I do think umm like instructions… it does actually help a lot more than trying to figure it out cause then it's just hard."

A major concern for students regarding use of the educational EMR was having enough background knowledge to be able to use it. For some, the tool looked quite complex at first glance.

7.9.3 Phase 1 and 2 Analysis

The major considerations for students and instructors differed somewhat after phases 1 and 2. Students were more concerned with having the necessary pre-requisite knowledge, especially since several commented on system complexity after seeing the demonstration of the educational EMR. They also felt that a variety of systems, other EMRs and other HIS in general should be shown as well. For instructors, learning the system, having appropriate cases/tasks, and system aspects were mentioned by four instructors each. The full list of considerations mentioned by both students and instructors is in Table 18 with descriptions in Table 20.

Table 18 - Considerations for Integration after Phases 1 and 2

Consideration	Instructors (n=6)	Students (n=13)
Access and Remote Use	2	3
Appropriate Cases/Tasks	4	1
Balance and Focus	2	3
Complexity	1	6
Expected Outcomes	1	
Incentives-Motivation for Students		3
Implications for Creativity		3
Installation, Setup, Infrastructure	2	1
Interconnectivity to Other Systems and Sources	2	1
Instructor Learning System	3	
Instructor Support	4	
Instructor Time and Effort	2	
Learning Pedagogy	1	
Maintenance	2	
Nature of Course	3	1
Step by Step	3	5
Student Learning System	4	5
Student Pre-requisites/Experiences	2	8
Student Pressures		3
System Aspects	4	6
Variety of Systems	2	9

From the student perspective, having an adequate amount of background knowledge before using the educational EMR was a big consideration whereas from the instructor perspective, considerations were mainly related to their lesson planning. The learning curve for the system was voiced by both instructors and students as well.

7.9.4 Phase 3 – Instructor Focus Groups and Analysis

All participants were asked about general considerations related to EMR integration i.e. items that instructors would need think about when planning integration. Some of these were voiced as concerns or aspects that would contribute to successful or unsuccessful integration. The final list grouped in categories that all instructors agreed with are presented in Table 19 with brief descriptions in Table 20. At least one instructor identified each item as being relevant to the undergraduate program.

Table 19 - Final List of Considerations for Integration Identified by Participants

Instruction: Please indicate your level of agreement with each item.			
Grouping	Item	Average Instructor Agreement Score* (n)	Number of instructors indicating relevance to undergraduates
Course	Appropriate Cases/Tasks	4.80 (5)	4
	Balance and Focus	4.00 (5)	3
	Expected Outcomes	3.60 (5)	3
	Nature of Course	4.40 (5)	3
	Step by Step	3.20 (5)	3
Instructor	Instructor Learning System	4.20 (5)	3
	Instructor Support	4.20 (5)	3
	Instructor Time and Effort	3.80 (5)	3
Student	Implications for Creativity	3.40 (5)	3
	Incentives-Motivation for Students	3.00 (5)	3
	Student Learning System	3.40 (5)	3
	Student Prerequisites	3.00 (5)	3
	Student Pressures	2.00 (5)	3
System	Interconnectivity to Other Systems	3.60 (5)	3
	System Aspects (e.g. complexity)	2.80 (5)	3
	Variety of Systems	4.00 (5)	3
Technical	Access and Remote Use	4.40 (5)	4
	Installation, Setup, Infrastructure	3.80 (5)	3
	Maintenance	3.40 (5)	3
	Learning Pedagogy	3.33 (3)	2

*Scale: 5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree. Green indicates modification to items after the first instructor focus group that were presented to the second group.

Table 20 - Descriptions of Considerations for Integration Identified by Participants

Item	Brief Description*
Access/Remote Use	Using system from different locations
Appropriate Cases/Tasks	Developing cases/materials to use with EMR
Balance/Focus	Balancing use with course activities/keeping focus on objectives
Expected Outcomes	Expected outcomes for activities using EMR

Implications for Creativity	Implications of showing students an EMR
Incentives/Motivation for Students	Generating interest for students to explore and use
Installation/Set-up/Infrastructure	Preparing EMR for use
Instructor Learning System	Learning curve for instructors to use EMR
Instructor Support	Resources to use EMR for teaching
Instructor Time and Effort	Time and effort required to integrate
Interconnectivity to Systems/Sources	Integration with other systems, linkages to external sources
Learning Pedagogy	Instructor or students' teaching/learning methods
Maintenance	Updating system for use, fixes, etc.
Nature of Course	Topics and objectives of course related to EMR
Step by Step	Integrating EMR for learning gradually
Student Learning System	Learning curve for students to use EMR
Student Prerequisites	What students need to know before using EMR
Student Pressures	e.g. Time pressure for students to use during courses and in labs
System Aspects (e.g. complexity)	Features/capabilities of the EMR
Variety of Systems	Use variety of health information systems

*Descriptions are based on participant responses.

The most highly ranked items in terms of importance for instructors were access and remote use, appropriate cases/tasks, nature of the course, and instructor learning the system. Instructors recognized that they would need to learn the system in order to teach with it and mentioned that a hindrance is the time and effort required to plan integration:

> "I would put the instructor learning system, instructor time and effort and instructor support, not support actually, umm instructor learning… it starts from there. If I don't know it, I cannot teach it. So I would start with that. I need to- I need to be able to have a good understanding, feel, umm (Instructor 3 nods yes) bit of experience (Instructor 1 nods yes) then I can start innovating and say this is how I can use this and this is how, you know, that is that is I start from there." (Instructor 2)

However one instructor commented in their worksheet that instructor support and time and effort were not significant considerations for them as the instructor should already be aware of the EMR.

For students, the most prominently mentioned items were having the necessary prerequisites/experience to be able to use the educational EMR and exposure to a variety of systems. Instructors scored the first item in the disagree to neutral range in terms of importance. However, for the second group of instructors, a significant portion of the discussion revolved around considering prior student experience. This included considering students from other programs and graduate students taking undergraduate HI courses who might have a different level of understanding of EMRs. The 4th year students were able to reflect on previous lab experiences that involved using systems and suggested that having some supporting documentation would be helpful in learning. Some of the instructors also recognized this in the individual interviews. The concern was that the EMR becomes the focus of learning rather than the HI topics which are the learning objectives. As one instructor put it, there needs to be a balance. Several students, as well as one instructor, commented on the complexity of the system after seeing the demonstration in phases 1 and 2. Although system aspects, including complexity, were one of the most discussed items, the instructors scored it relatively low in terms of importance.

Students in all the focus groups also felt that students should be introduced to a variety of systems, both other EMRs and the various clinical systems that link to them in the actual healthcare setting i.e. lab or diagnostic imaging. A few students and an instructor expressed concerns that being exposed to only one EMR might lead to a limited perspective.

In the first instructor focus group, the most-discussed item was ‘step-by-step’ integration which was brought up by some instructors individually as well. During the focus group, one instructor introduced the idea of minimum to maximum integration which then turned into a dialogue on how it could be achieved through a simulation-type activity that gradually became more complex and involved throughout the program. The instructor's general idea was as follows:

> "…it gradually becomes more and more integrated umm as, and depending on the course how you do it. But I would, I would look at your long list and think okay uhh you start with, given how much difficulty it would be to achieve full integration, what can you, how can you start with some simple stuff umm and most interesting and fun first and postponing the really hard part cause if you're committed to maximum integration you don't want opposition from faculty and students and so forth. You wanna start with the fun stuff and umm and then uhh work on it over a long period of time. Umm so those are my thoughts. So I would, I would have a little bit in the beginning and a lot later on." (Instructor 1)

Some discrepancies were also highlighted in the worksheets and comments by instructors regarding the student-related considerations. For example, one instructor scored 'student pressures' and 'student learning system' as strongly disagree for importance, commenting that if the 'step-by-step' consideration is adhered to, they would be irrelevant. Another commented that student pressures should be common to any course or lab. Views towards motivation were somewhat mixed. And while one instructor felt that curiosity in the system would come from working with the EMR (Instructor 2) and another thought motivation was related to outcomes (Instructor 6), some of the 4th year students talked about needing additional incentives.

A new item that came up in the first instructor focus group was 'learning pedagogy' which is one area of the TPCK framework. But instead of viewing it as teaching approaches that were discussed in a previous section, the instructor described it more as an overall philosophy of learning for the instructor that would need to be considered to guide integration. When presented with this item, the second group of instructors ranked it neutral to important.

Overall, all participants identified many items that should be considered when planning integration. "Access and remote use" and the "nature of the course" were found to be important in the rankings. But in terms of discussions during focus groups, having appropriate cases/tasks, learning the system, taking a step-by-step approach and student pre-requisites/experience were seen to be important considerations.

7.10 Summary of Key Themes for Integration

The three phases resulted in some key themes and items from students and instructors with respect to the different categories discussed above. Table 21 provides a concise summary of these, showing which types of participants identified each the most and in what phase of the research. They are discussed further in Chapter 8 to answer the research questions.

Table 21 - Key Items from the Study

Category	Item	Phase 1 Instructors	Phase 2 Students	Phase 3 Instructor Feedback
Prior IT Use	IT to support learning	X		
	Databases		X	
	Little or no hands-on EMR use	X	X	
EMR Descriptions	Content	X	X	
	Electronic or computerized	X	X	
Thoughts on Educational EMR	Provides exposure or introduction		X	
	Provides integration of concepts		X	
	Is realistic/practical		X	
	Contributes to learning and understanding	X		
	Allows kinesthetic use	X	X	
Topics Related to EMRs	Patient and health information and data	X	X	X
	Health care professional roles	X	X	
	EMR (scope)		X	X
	Current trends		X	
	EHR			X
	Usability			X
	Possibly not: Medical fundamentals, clinical		X	X

	methodologies, HIS theory, code, epidemiology			
When to Integrate	Courses Program Introduction in 1st year Hands-on 2nd-3rd year Before Co-op workterm	X X 	 X X X	 X X
Teaching Approaches with Educational EMR	Demonstrations Cases/scenarios Exercises/assignments Play-with and explore Group work Integrated activities Labs Interactive class discussions Instructor presentations	X X X X 	 X X X X 	 X X X X
EMR Parts to Use	Data Information push Information pull Features Design Back-end	X X X X 	X X X X	X X X X
General Considerations	Appropriate cases/tasks Support for instructors Student learning system Pre-requisites/experience Variety of systems Access and remote use Nature of course Instructor learning system	X X X 	 X X 	X X X X

While some items were more prominent among instructors or students, a few overarching themes surrounding integration of an educational EMR into undergraduate HI education emerged during the study:

- There is little or no current hands-on use of EMRs in the classroom but it is desired.
- There are benefits for learning in using an educational EMR from exposure to systems at the start of the program to reinforcing concepts and linkages at the end.

- Experiential methods allowing students to play with and explore the tool and structure cases are appropriate in addition to more traditional methods currently used.
- There should be a focus on the structure, meaning and use of the data contained within the system in addition to scope of the EMR and supporting health care professional needs.
- The complexities of the tool will require instructor and student support for use.

For successful integration of an educational EMR, the thoughts shared by instructors and students in the study should be carefully considered. Below are some examples of ideas for overall integration that were expressed.

7.11 Overall Integration Suggestions

In answering the questions about integration, many students and instructors shared ideas that combined several aspects from the categories discussed above into more general approaches or suggestions for how the tool could be integrated at several levels. For example, in the first instructor focus group, the participants brainstormed a longitudinal integration approach whereby each new student would receive an avatar which is a patient. As they move through the program, the patient becomes ill and their medical history becomes more complex, increasing the amount and types of information tracked in their record. In terms of how the portal could be used throughout the program, one instructor explained the following:

> “They register the course, they get a password for the portal. And then they keep their portal until they graduate. Right? That’s what I mean. And then every time there is a case, analysis, comparison, whatever, they use their password and do what is required in that course, in that

exercise, in that lab, to continue with the same environment.” (Instructor 2)

Another idea that came up in this group was beginning with the student’s personal experience to explore the EMR based on what they already know:

“Instructor 1: Start off with the human experience using and then the whole issue of architecture would come later (Instructor 3 nods yes) where you begin to get a sense of different pieces and system, larger system but uhh initially it would, it would move gradually from your own personal experience.

Instructor 3: Maybe maybe what we’re seeing here is the emergence of sort of a uhh experience, not experiential but experience-based learning (Instructor 1 nods yes). Because I mean I see that as somewhat different from problem-based because it is built on the series of problems and scenarios but you personalize it by making it personal experience-based learning (Instructor 1 nods yes).”

A very popular idea in the first student focus group with 4th year students also involved a longitudinal approach:

“Student 2: Umm, you know, it’d be interesting if there was a tool like this that was longitudinal throughout the program. So in the first year we’re exposed to it and then, you know, if we had access to the back end we could see how the database works on this tool (Student 4 nods yes) and then later on like Student 1 said, we could use it…for usability. So just something that becomes- this tool throughout the program would be interesting.
Student 3: That’s a really good idea.
Student 4: Yeah.
Student 1: That’s a really good idea.
Student 3: They should do that.
Student 4: They should.
Researcher: Okay.
Student 3: Umm yeah, that’s a great idea cause doing that would help so much.
Student 2: Fourth year we build our own or something.”

These ideas tied together some of the individual integration items into an overall strategy.

Chapter 8 - Discussion

The purpose of this work was to explore the context of EMR integration into an undergraduate HI educational program, leading to the development of a framework. What resulted was the identification of some key items for aspects of TPCK but also more general themes about the context of integration for HI education itself. Using the literature review and documentation review to supplement the data collected in the original study produced a wealth of information on this topic in several areas: (1) the multidisciplinary and international perspective on HI presentation, HI from the Canadian perspective, and a specific HI program from a local perspective. This chapter combines all the findings of this research to answer the three original research questions.

Hands-on use of EMRs and similar health information systems within an undergraduate classroom setting was viewed as highly beneficial to learning based on published literature and primary data gathered from instructors and students. Several examples were found in the papers reviewed for the structured literature review. In virtually all papers, at least one positive finding was noted such as student satisfaction and improved performance. As one paper noted “active participation in the experience promotes basic informatics competencies and better prepares students to enter a technologically-rich work environment” (Madden & Hanberg, 2009, e145). Similar sentiments were noted by other authors. Gassert and Sward agreed with a previous article in that “education regarding health information management should be conducted in the context of ‘real-world’ applications and behaviours" (2007, p1392).

Perhaps the strongest evidence for support of ‘real-world’ applications, specifically the educational EMR came from students and instructors themselves during the research study. While there were some concerns to think about, all participants expressed a desire to integrate the EMR into their teaching or learning. Other noted benefits of using the EMR included its ability to provide a foundation or context for topics, integration and reinforcement of concepts, and increased learning/understanding. Comments reported in one of the literature review papers (Dimick, 2008) echoed some of those that came up in the research study. For example, in the paper, feedback from a senior health information management (HIM) student included that they learned more about the EHR through the lab than actually on site and that seeing is understanding when it comes to HIM. In the research study, a 4th year student commented that “in that course in lab where we actually worked with it I got a better understanding doing that than, like, two years of like talking about it (everyone nodding in agreement)” (Student 3). The hands-on aspect of using the system, a form of kinesthetic learning, was seen as powerful, especially by one instructor.

General findings from this work are discussed below, addressing each of the original questions posed at the start of this thesis.

8.1 TPCK Components for EMR Integration

8.1.1 Content

The first question posed at the beginning of this work was: what topics and competencies are currently taught to HI students which are related to EMRs? Through all data collection activities, particularly the documentation review and research study, it became clear that HI is a complex discipline. Topics mentioned by participants were generally consistent with those found in the course outlines review. For example, some students mentioned databases, a topic which appears in first and second year courses.

Participants were generally able to link the EMR to many of the topics currently taught in the program. All instructors were able to see a connection between their course topics and the EMR and actually offered explanations for how without being explicitly asked. Related topics most often mentioned included patient and health information, and data, health information systems, health care professional roles, system design, and current events and trends. From the documentation review, only the HINF course on Electronic Records and Decision Support Systems mentioned the use of an HIS but several others did refer to aspects of them and IT-related topics were the most prominent in the review of HI programs. In the structured literature review, which included most clinical disciplines, there were some overlaps with HI topics in terms of system features, strengths/weaknesses, and security as well as roles and workflows. However most topics generally fell under clinical and health services with documentation of patient care being a popular use of the system. This appeared to be the main difference between clinical disciplines and HI as participants expressed uncertainty about using the EMR for more clinical HI topics, e.g. medical fundamentals, which suggests that topics need to be carefully considered to ensure that students learn what is intended.

What also became evident regarding content was that many overlaps exist. A single topic often appeared in many courses as the courses themselves sometimes addressed many topics. This also became clear in the instructor interviews when instructors were asked to identify whether competencies were addressed in their teaching. Even with only six instructors who taught mutually exclusive courses, many identified the same ones. Interestingly, one that was identified by all, “the health informatics professional assesses the key attributes of data and information (e.g., quality, integrity, accuracy, timeliness, appropriateness) and their limitations within the context of intended use (e.g., clinical and analytical uses)" directly corresponds to one of the most frequently mentioned topics – patient/health information and data, which suggests this is a key topic that can be taught using an educational EMR.

Overlaps were also seen with other disciplines as HI students at UVic and other universities are required to take courses from other departments. For example, some students in their early years of the program often referred to a need for computer science knowledge in relation to EMRs and many students wanted an appreciation of the clinical data. Although HI spans the IT and healthcare fields, the technical and clinical knowledge that HI students need to know is different from that of students who are solely studying one area or another (e.g. computer science or medicine). Looking at Appendices B and E along with the topics identified in the study, students across disciplines and programs address many of the same overarching areas (i.e. the COACH categories) but the specific topics within these differ to some degree. For example, while a nursing student may need to understand the nursing process and clinical significance of documenting patient data in the EMR, a HI student might be required to understand how the data is structured in the back-end database. In fact, participants in the study were unsure about HI students learning medical fundamentals with the EMR. This could be because it is beyond the scope of HI knowledge required but within scope of medical knowledge. However, the overlap does demonstrate that both disciplines (e.g. medicine and HI) are interested in the data contained within an EMR so there may be potential for overlapping approaches to using the educational EMR to develop competencies involving the EMR for medicine and for HI.

8.1.2 Pedagogy

The second question posed at the beginning was: how are EMR-related topics and competencies taught in HI programs and what methods are applicable for use with the educational EMR? In terms of what specific teaching approaches would fit with pedagogy for integration, both current and proposed approaches were included. According to the review of HI programs, a variety of teaching approaches are currently used in HI, from lectures to lab activities. Responses from participants in the research study also verified this. When asked about previous exposure to EMRs, students commented that they had discussed them often in courses but generally had not much hands-on experience with actual systems in class. However, both instructors and students did offer many ideas from general approaches to specific activities that could work well.

Experiential learning methods were overwhelmingly popular, both in the research study and literature review. Case studies, scenarios or simulation were mentioned frequently and were most often used in the papers reviewed. It seems that when it comes to learning about health information systems, students need to experience EMRs. Especially for nursing and medical students, using the system to document care for patients was a common approach. The cases were usually developed by instructors to reflect course learning objectives. In one paper (Stahl, 2000), cases were used as base but modified dynamically by the instructor as the class progressed. For HI, where there is little evidence of prior EMR integration into learning, experiential learning methods were also found to be appropriate. Students and instructors felt hands-on use of an educational EMR was important, even to play-with and explore. Cases and scenarios were also seen as appropriate ways to use the educational EMR.

Case-based learning with an EMR is a viable option for HI education according to the participants interviewed in this study but it does come with additional considerations if it is to be implemented successfully. Dede (2008) notes that even case-based methods are different from discipline to discipline depending on the particular content and skills to be mastered. For example, one pedagogical approach using cases is problem-based learning (PBL), a common approach used for learning in healthcare. According to Reiser and Dempsey (2002), PBL is very popular and communication and information technologies are recognized as valuable tools to support it. One instructor did mention this and it is a possibility but a prior early experience with the implementing the approach in HI was found to be challenging (Green, van Gyn, Moehr, Lau, & Coward, 2004). The authors commented that the needs of health informaticians are different from healthcare providers, which needs to be acknowledged in this type of approach. In this example, PBL was introduced along with supporting IT tools (WebCT). Interestingly, there was a support for the use of IT but concern over the PBL approach (e.g. student concerns about expectations and preparation) which highlights the importance of pedagogy in integration.

More loose experiential methods such as just allowing students to play-with and explore the system were also deemed viable by participants. This has been done in one of the papers reviewed (Gassert & Sward, 2007). According to one instructor in the study, loose experiential methods can help to generate curiosity and interest in students (Instructor 2). At the same time, students in their 1st and 2nd years of study who hadn't seen an EMR before felt a bit overwhelmed and wanted some guidance about EMR use. This is discussed further below.

Many of the ideas that emerged in the research and literature review involved using the system to complement teaching methods such as lecture and discussion. Some 4th year student suggested having health professionals come in to do guest lectures, using the EMR to demonstrate actual use. Using the EMR for illustrative purposes was discussed often by both students and instructors. In some of the papers reviewed, the system was used by instructors to show demonstrations and facilitate discussion in addition to assignments which required students to actually use the system. The student participants who were interviewed, especially those in their 4th year of study, highly valued peer interaction during their education so this piece should be incorporated in teaching activities where possible.

The instructors included in the study were all experienced teachers. According to Harris (2008), instructors may be familiar with designing learning activities but knowing how technology can be used within activities is different and requires new information or ways of thinking. While free exploration, simulation, and demonstrations stood out as the most promising methods for incorporating the EMR system into learning, the results of this work also pointed out the EMR's ability to integrate with a variety of teaching approaches.

8.1.3 Technology

The third question posed at the start of this work was: in what ways can EMR technology be integrated into a HI curriculum? The documentation review revealed many types of applications used to support HI education. In addition to the general IT e.g. Internet, word processing software, there were a few examples of real-world IT. Most common, was the use of database applications such as Microsoft® Access and Oracle®. Students provided similar examples in the focus groups.

In terms of EMRs and similar health information systems, there appeared to be at least one example of use in a HI course from the documentation review but the extent of use was not clear. Some instructors clearly stated that they didn't use EMRs when asked about learning activities and approaches. At the same time, there were four students and two instructors that had heard about the experimental portal being developed at UVic but none were able to describe in-depth use. The portal has, in fact, been used by nursing, medical, and HI students but there is clearly an opportunity to further its level of integration into such educational programs.

The students and instructors in the study were familiar with health information systems and were quite enthusiastic about being able to incorporate hands-on experience with an EMR into classroom learning. An interesting finding was the difference in perspectives between the more "junior" (i.e. 1st or 2nd year) and "senior" (i.e. 4th year) students when it came to EMRs. The junior students seemed to view it as more of an IT application or software. They commented that they needed knowledge of computer science principles to be able to understand it. Many commented on the complexity of the EMR after seeing the demonstration. They expressed feelings of being overwhelmed which led them to believe that they need some background knowledge before using it themselves. One instructor also recognized the issue of system complexity for learning and felt that a simplification of the EMR would be best. The four senior students, however, seemed to view it more from a clinical perspective as a supporting tool for clinical practice. This not only demonstrates the broad nature of the field and applicability of the educational EMR but also the differences between learners at each level of program which need to be considered. A step-by-step approach to integration of an educational EMR may involve beginning with a demonstration or simple exercise using the educational EMR before attempting to implement a large case study in the classroom setting that students work through in a term. This approach would address concerns of students and instructors as they learn the technology because of the presence of a learning curve (discussed in section 7.9).

In some of the papers reviewed in the structured literature review, the EMR (or similar) system could really only be explored from a user perspective. For example, some students were able to access a healthcare facility's EHR system and explore the clinical information contained within it but these systems weren't necessarily designed for educational use. This may work well for the clinical disciplines to train future users, but HI students would likely need to have a different perspective to match the content they need to master. While students and instructors in the study did feel that students need to have an understanding of interface issues i.e. putting information in (push) and getting information out (pull), they would also need to go into the back-end (e.g. the design and programming code). In fact, when the instructors in the first focus group were asked to comment on grouping all EMR parts that were mentioned, they placed them all under the umbrella of "architecture".

In the literature review, there were also some examples of EMR systems designed to support learning. Several schools used an implementation of Cerner's Academic Education Solution version of PowerChart® which was adapted for academic use. The most similar to the portal used in the study was the HIM Virtual Lab described by Dimick

(2008) which allowed students to access a range of applications, including a Cerner PowerChart® adaption called ATHENS. This leads to some considerations that emerged in the literature regarding the technology and it seems the design of the portal used in the study actually mitigates or even eliminates some of the concerns raised in the papers. For example, a major concern with some integration initiatives involving EMR (or similar) systems was access and security, especially where real systems were used. The portal provides a completely fictitious environment with no real patient data and it is already available remotely over the Internet at any time. The architecture also allows for widespread use and scalability with central control by the architect. Students felt it was important to see many EMRs and systems (see section 7.9.2) . A concern expressed by some students was becoming biased after only seeing one particular system. The majority of examples in the literature were limited to one system. In this research study only one educational EMR was demonstrated in the portal but there are others too that could be used as well (e.g. OpenVista®) (Borycki et al., 2009).

However, there were still some other EMR integration items which came up earlier that certainly apply to the portal as described in the results (see section 7.9.4). Individual systems need to be maintained over time and perhaps updated later on to ensure that students work with the latest technology. There also needs to be support available to instructors and students. Most of the papers reviewed usually had some form of an implementation or support team in addition to manuals and reference materials. 4th year students commented on the value of supporting documentation and one instructor mentioned that they would try to guide students so that they aren't just learning the system. This raises another important consideration that also came up in the literature regarding technology use for education: "technology is a tool that can facilitate learning and practice but is not an end in itself" (Curran, 2008, p. 528). In other words, integration needs to ensure that the focus remains on the content to be learned rather than the specific technology.

8.2 Intersections and Beyond

The preceding section highlights a few of the key results of this research in the areas of content, pedagogy, and technology. A fundamental part of TPCK is the pairs of relationships among these areas, many of which have been implicitly described in the discussions above. For example, the components of the EMR to be used in HI education depend on the content HI students need to learn. In this work, relevant ideas from other disciplines were included but since the pedagogical content knowledge required for each discipline differs, so will the ways in which the technology is used. As McCrory states, “TPCK is about a specific topic within a domain using a specific technology” (2008, p. 203). What was perhaps a more significant outcome of this work was the insights into how all the pieces could fit together for integration at a higher level.

Instructors and students in the study seemed to think beyond the single classroom when providing suggestions for integration of the EMR. Especially for topics, instructors didn’t limit themselves to their own areas and students talked about integration of concepts. They all saw how different topics related in general and how that would fit into using the EMR. A few key themes regarding general approaches appeared to emerge, mainly from the literature review and research study.

In most of the papers reviewed in the structured literature review, the introduction of a health information system was treated as a project, sometimes even having a formal project director or manager (e.g. Curran, 2008; Fauchald, 2008). Collaboration among faculty and vendors was often described in planning and implementing a system and this often remained in place to provide ongoing support for instructors (e.g. Melo & Carlton, 2008) and students (e.g. Litt & Loonsk, 1992). A concern for instructors was the amount of time and effort required to learn the system and develop appropriate cases or tasks using it. A collaborative approach, perhaps even just with faculty could perhaps alleviate some of these difficulties.

A second theme that was evident from several participant comments, most notably from the instructors, was that a longitudinal approach to integration would be ideal. This could mean either using a running case throughout a course or even throughout the program. 4th year students and the first group of instructors felt strongly about the latter while one group of students, in their 1st or 2nd year, found that the EMR tied everything together for them. For example, one very popular suggestion that came up in a student focus group of 4th year students involved reflected just that – using it throughout the program for different topics. The level of use would have to be appropriate for students, i.e. exposure in first year with hands-on use starting in second year, but it was certainly seen as feasible. Interestingly, many students, regardless of their level, connected the EMR to mandatory Co-op work-terms but not all instructors in the first focus group did. However, these instructors definitely saw benefits in longitudinal use, and actually began discussing an approach for full scale integration where students could be assigned a patient case in the EMR upon entering the program and then follow it throughout the program as the patient progressed through life, resulting in several encounters with the healthcare system. The evidence from the literature review also supported longitudinal use. Many schools chose to introduce the system gradually but eventually had it incorporated across courses or programs (e.g. Connors et al., 2007; Fauchald, 2008; Lea et al., 2008).

Another theme that perhaps wasn't as explicit from the study, with the exception of a few comments, was the notion of multidisciplinary integration. In the literature review, papers from many different disciplines were included and interestingly, the methods of integration were generally quite similar. A few papers even discussed more than one discipline. As mentioned above for content, the competencies required for each discipline with respect to topics differ so there needs to be a way to adapt or modify the use of the educational EMR for each discipline, depending on the focus. A prime example came from Connors et al. (2007) who described how documentation done in the EHR system by nurse practitioner students was reviewed by information management students who then provided feedback through the EHR on coding and reimbursement issues. Both types of students work with the data within the EMR, except the first pushes it in while the other pulls it out. Students in the research study expressed that they wanted to understand how different health professionals actually use the EMR. Up to this point, the portal has been used with groups of medical, nursing, and HI students individually (Borycki et al., 2009; Joe et al., 2009) but there may be an opportunity for some interdisciplinary use.

Considering these themes and the discussions which arose during the study, it's clear that integrating an educational EMR into HI education can range from a small task or significant undertaking with many complex relationships at play. The content and competencies that HI students need to achieve can certainly be addressed and supported through use of an educational EMR but, depending on the degree of integration desired, it may require a shift in the overall teaching methods currently used and consequently, the technological pedagogical content knowledge required. For example, if the instructor wishes to use the educational EMR to briefly demonstrate the scope of what is included in an EMR to a group of first year students, they may only need to be familiar with the tabs to do a basic walk-through or create a HyperCam™ recording as was suggested in the study. This would be fairly simple. On the other hand, if several instructors wish to use a longitudinal case that students will use throughout the program, this will require students and instructors to learn the system, creation of appropriate cases/tasks for a variety of course topics and ultimately a change in how HI is taught. It is clear that the TPCK required in the first example will be much different than the second.

8.3 A Framework for Integration

In this research a slightly different approach to TPCK has been taken than previous work in the literature (e.g. Neiss, 2005). The investigator explored how technology has been integrated already which includes a range of IT use but the focus for the study was to start with a technology to explore how it fits into the discipline. Harris and Hofer (2009) explain that TPCK shouldn't be 'technocentric', that is, focused around the technology and other authors agree that technology should not be driving pedagogy (Lai, 2008; Jefferies, 2003). However, in this case the goal has not been an attempt to fit the curriculum around the educational EMR, but rather to determine where the educational EMR may fit into the curriculum. In a way, an attempt has been made to reverse-engineer technology integration (i.e. starting with the technology). The objective of this work has not been to try to make it work for all topics and activities in a HI curriculum and in fact, some areas where the EMR perhaps wouldn't fit well have been uncovered. Harris and Hofer's (2009) activity-based approach presents technologies that may be used for specific activity types. This work essentially finds out where the educational EMR could be listed as an option. The investigator agrees that technology is not always the solution for teaching. Students valued discussion and in some cases were satisfied to see examples rather than use one themselves. This is why it is important to integrate the educational EMR appropriately and where/how it will be the most beneficial to student learning. Much of the results of this work revealed the whole of the context of HI education regardless of the EMR (e.g. all HINF topics, IT use, and teaching approaches) in order find out where the EMR fits in rather that how the context will fit it. Understanding these components is required for integration of the educational EMR into HI education.

An important question for this work was how can the TPCK framework be applied to help in integrating educational EMRs into undergraduate health informatics curricula in order to teach topics and core competencies related to EMRs? Using the results gathered from this work, a preliminary framework based on TPCK can indeed be developed for integration of an EMR into HI education. Based on the data gathered from students and instructors in the study, such integration is certainly a desired and viable addition to HI education which can be achieved with careful consideration and planning. What emerged through data collection and analysis were some key components that would need to be incorporated in such an endeavour.

The original TPCK framework is shown in the circle in Figure 11a. The three boxes to the left indicate these three major knowledge areas in the context of educational EMR integration in HI education. Content knowledge consists of HI topics and competencies that relate to EMRs. Figure 11b provides the detail for this box. The seven major COACH categories are shown with all items organized under each. For example, patient and health information and data is an information management topic that students can learn through use of the educational EMR. The next box in Figure 11a for technological knowledge shows that in this context, knowledge of the educational EMR is required. Again, the items that emerged for this knowledge area are shown in the top-right part of Figure 11b. An understanding of the entire architecture is required, and this breaks down into back-end (i.e. design and programming) and interface (i.e. what the user interacts with) aspects. In the study, participants identified the data within the system as being the most important or feasible part to focus on when using the educational EMR but other pieces were mentioned as well. The last box on the left in Figure 11a for the three major knowledge areas is for pedagogical knowledge which is represented by teaching approaches that were deemed to be relevant for use with the educational EMR. The bottom of Figure 11b shows all the potential teaching approaches and activities organized by the main categories of Weston and Cranton's Summary of Instructional Methods (see Figure 2). For example, the use of case studies and scenarios would be an experiential learning method that many students and instructors identified as being appropriate. All items that emerged in the research under each knowledge area have been included here regardless of the scores and comments they received because this is preliminary framework that would need to be further refined and validated.

The relationships between items within each category are key to integration i.e. relationships between HI content/competencies, appropriate teaching approaches, and features of the educational EMR technology. These relationships were evident throughout all three data collection activities. For instance, subjects in the research study often provided examples of potential educational EMR use by describing activities that addressed specific content areas. As well, the papers in the structured literature review often tied uses of systems to topics through descriptions of activities done (e.g. in Curran (2008), students were expected to look up results and clinical data, and document assessments in the EHR).

At the right-hand side of Figure 11a is a box indicating the integration points that were identified. The items reflect the major themes that resulted from the research. The smallest unit is the single activity within a course, followed by use throughout a single course. Next comes the program level which entails exposure before or after Co-op work-terms and the appropriate level of use at specific years of the program. Finally, the largest level of integration going beyond the whole HI program is multiple program, potentially including other disciplines like nursing or medicine.

In addition to the exploration of the three knowledge bases, this work resulted in several additional contextual considerations related to students, instructors, the system, and technical and course requirements which are shown below TPCK in Figure 11a. In effect, these pieces “open-up” the context component that surrounds the original TPCK framework and tell us what would need to be considered for this specific integration challenge. For instance, if use of the educational EMR will involve students completing case studies that require searching for data within the EMR, then the learning curve for students to be able to use the EMR will need to be considered, an appropriate case will need to be developed or located, and the system will need to be set-up with the data already entered, and so on.

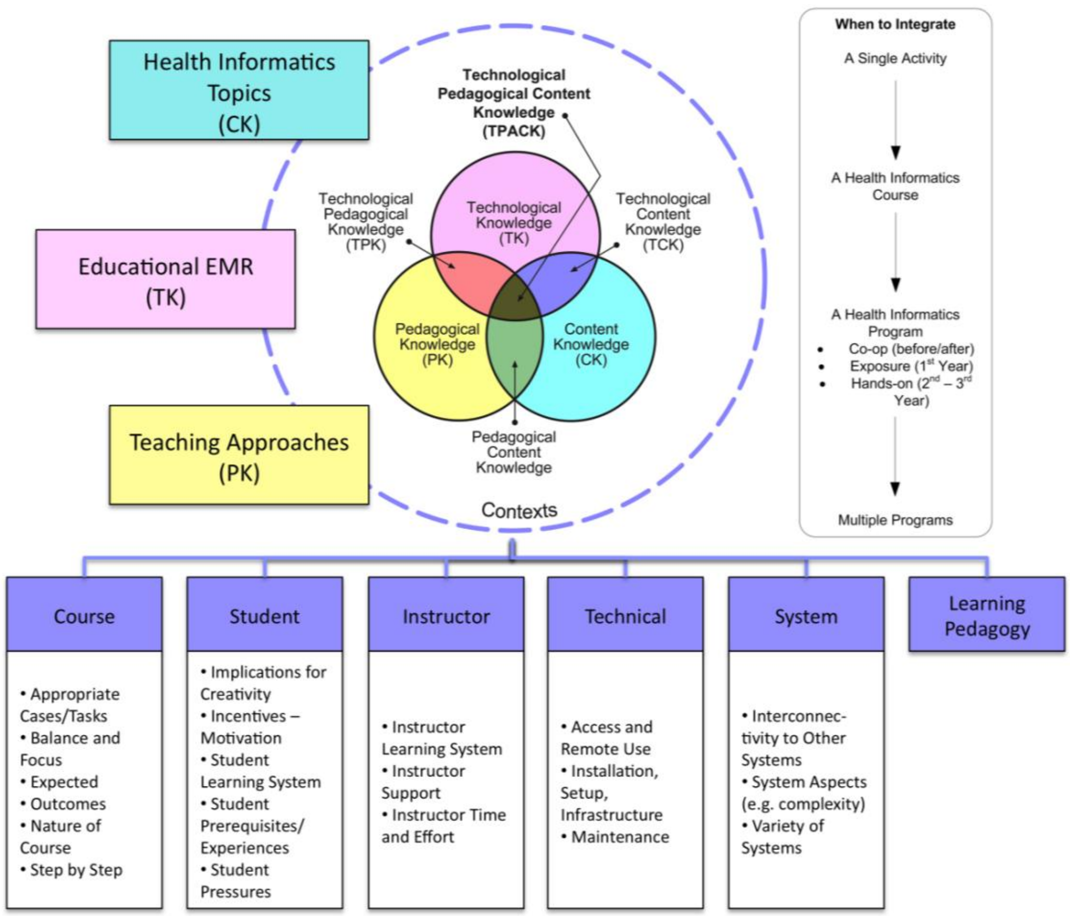

Figure 11a - Proposed Framework for Integration of an Educational EMR into Health Informatics Education

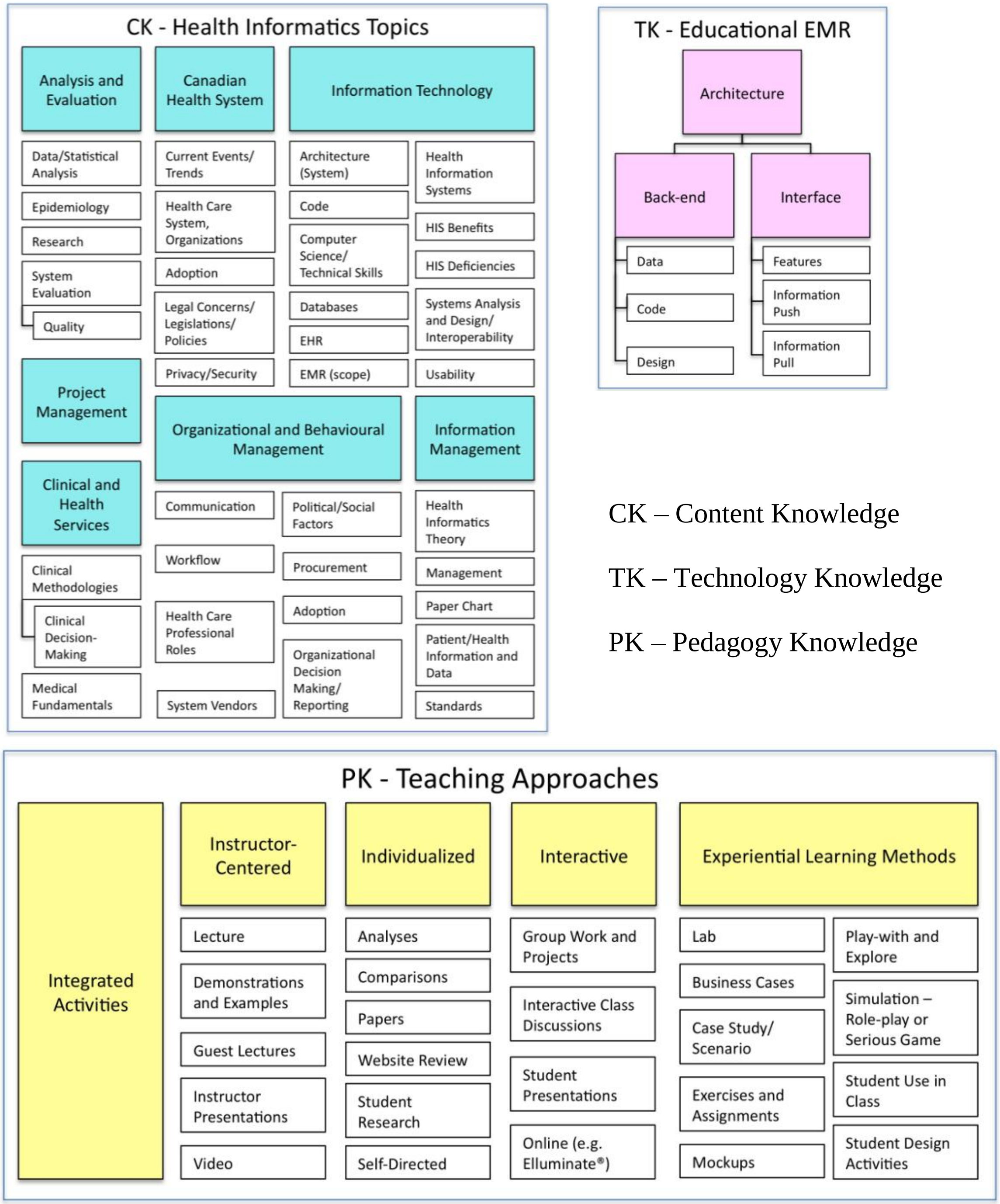

Figure 11b - Detailed Knowledge Areas of the Framework for Integration of an Educational EMR into Health Informatics Education

In terms of applying and using the framework, one approach would be to begin on the top right side of Figure 11a to determine when the educational EMR will be integrated e.g. it be used for a single activity within a course. The instructor would then consider what topic they wish to teach. If they are not clear, they could look at the "Health Informatics Topics" box in Figure 11b to see options. Next, they could refer to the "Educational EMR" and "Teaching Approaches" boxes in Figure 11b for ideas on what aspects of the tool to use and approaches. Finally, they would need to go through each of the contextual consideration areas listed at the bottom of Figure 11a to ensure that they've thought about and accounted for any relevant issues. The framework does not "tell" the instructor how to go about integrating the educational EMR into their lesson, but it provides research-based guidance that would help lead them towards a successful integration effort.

Since this framework was developed based on literature reviews in addition to the research study, it has wide applications locally, nationally, and even internationally. The COACH categories used for the content piece reflect the key competency areas for HI professionals across Canada (COACH, 2009). As well, the integration items can be applied to any "educational EMR" since specific features of one system are not referenced. The students and instructors in the study were briefly shown one example of an EMR system but their thoughts were expressed at a generic level. Essentially, the framework provides a mechanism for any HI program to explore integration of an educational EMR into their own undergraduate curriculum, regardless of location and system involved. The constraints present at the integration site will limit the choices available but the fundamental components will still be present.

8.4 Limitations

It is important to note that the findings discussed above are subject to some limitations in the data collection methods used which are described in this section.

8.4.1 Generalizability

Brill and Galloway (2007) state that "the goals of qualitative inquiry do not include statistically-supported generalization" but they do offer useful insights for advancing the knowledge base. The structured literature review covered a range of disciplines and many examples of integration. Sometimes decisions regarding inclusion had to be made based on judgement of relevance to EMR integration in education. Sometimes the paper was just an abstract but included because it offered something of substance regarding integration. Only the information reported in the papers could be extracted and they varied in level of detail from brief abstracts to full dissertations. Similarly, the documentation review of other HI programs was limited to what was available online. In an effort to be consistent, the investigator examined all program outlines side by side and picked out the core courses as best as possible, even when they came from other departments. Common elements were found even in the brief descriptions, suggesting that the results of the research done at the University of Victoria may be applicable to other programs.

According to Liamputtong and Izzy, "sampling in qualitative research is not concerned with ensuring that the findings can be statistically generalized to the whole population" (2005, p. 44). Particular to focus groups, limitations include 1) a small range of experiences due to the small numbers of participants (Stewart et al., 2007) and 2) the possibility of participants conforming to responses of others (Powell & Single, 2006; Holloway & Wheeler, 2002). In regards to the second issue, while participants did agree with each other on some topics, there were several instances where differing opinions were expressed as noted in the results. The first limitation was seen as the school is relatively small, which made the pool of eligible participants for the research study quite small. Several students who originally expressed interested and even signed the consent form were not able to participate due to conflicts with co-op work-terms, midterm exams, and other commitments. Conducting additional rounds of recruitment with modified strategies helped to secure more students and instructors but took quite some time. Regarding the general principle of saturation for sampling, many authors agree that sometimes researchers have to contend with constraints. As Strauss and Corbin (1998) explain, constraints of time, energy, availability of participants and other conditions will affect data collection. However there are instances under which it is expected to be reached sooner: if it is a small study making modest claims (Charmaz cited in Mason, 2010), if the participants in a sample are similar, and if overarching themes are of primary interest (Guest et al., 2006). These items were seen to some degree in this study. In addition, the small number of participants helped to obtain 'information-rich' cases to study in depth and after second round of data collection, virtually no new items were obtained for consideration. Crouch and McKenzie (2006) suggest that for exploratory studies, it may not only be reasonable to have a small number of respondents but also advantageous. A web-based questionnaire may have elicited a larger sample but wouldn't have resulted in the rich data obtained through face-to-face interviews and focus groups. The sessions included participants from two key groups, thereby allowing many perspectives to be considered and some comparisons to be made. As well, the interview and focus group methods conducted with mostly open-ended questions allowed participants to provide detailed information. Sandelowski (1995) states that while a sample may not be statistically representative, it can be informationally representative in that “the data will be obtained from persons who can stand for other persons with similar characteristics” (p. 181). Many courses/topics were covered over all interviews and focus groups and the instructors had taught courses ranging from 1st to 4th year as well as graduate courses. In the individual interviews instructors mostly focused on their own courses and how they would use the EMR but when all items were presented in the focus groups, there seemed to be shift towards a larger context of use beyond the single classroom and it became more generalized.

The average scores calculated from the instructor worksheets were sometimes based on only three participants’ responses and therefore not very strong. Therefore, they could not be used in any formal statistical analyses. Instead, they were used to only help guide the discussion. It is also important to recognize that the research study was limited to a single HI program at one university.

During the individual interviews, some instructors’ responses were related to experiences in teaching graduate courses. To ensure responses were still applicable, instructors were specifically asked to indicate if items were only relevant to graduate students in the worksheets. There were some things that instructors felt were more appropriate to graduate students but for all items at least one instructor believed they applied to undergrad students. This suggests that the resulting framework could potentially be extendable to the graduate program as well.

8.4.2 Bias

The classification of topics from the documentation, literature and research study into COACH categories was done solely by the investigator, often based on very brief descriptions. Originally, the investigator planned to produce categories solely based on the data collected. However, this proved to be quite difficult in some cases and after the initial attempt was shown during the first instructor focus group, it was suggested that established categorizations be explored. The COACH HIP™ Competency Framework was a clear choice as it encompasses all areas of HI at a national level (COACH, 2009). Classification of topics is subjective as other individuals may classify topics differently or place them in multiple categories according to the actual content taught as was evident during the instructor focus group discussions. This became evident when instructors were asked to identify competencies addressed in their teaching. Several different topics were often associated with the same competency according to their own interpretation. A surprising difficulty was in finding an established classification of teaching approaches that was appropriate for grouping items. A search was conducted with the assistance of a subject librarian. The investigator had to rely on judgement for classification of teaching approaches into the categories based on Weston and Cranton's Summary of Instructional Methods. For example, an assignment may be done individually, in a group, and involve experiential methods depending on the details of the activity. The investigator had to decide based on very little information (e.g. simple mention of a case study) but made an effort to be consistent. Even though cases were found to be most appropriate, they can exist in many forms and be implemented in different ways. Beyond the individual categorizations, the next biggest challenge was in performing comparisons across sources. Tables and matrices were used extensively to help record, organize and identify items for discussion.

The research study may have also been subject to selection bias in terms of the instructors and students who agreed to participate. The recruitment materials made it clear that participants would be asked to provide input on integration so those interested in integration were more likely to respond. Accordingly, all participants expressed a desire to have the EMR integrated into HI education. However, they still expressed some concerns captured under general considerations (see section 7.9).

Although the questions for interviews and focus groups were prepared and tested beforehand, there were some surprises during the sessions. During the individual interviews, instructors were asked to go through each of the COACH competencies and indicate whether the competency was something they addressed in their teaching related to EMRs and how. It seemed instructors may have sometimes interpreted the competencies differently so results were carefully reported based on the majority of responses gathered. The approach of showing instructors lists of items on a projected screen and then having them record scores in the instructor focus groups worked well but could be improved. Even though definitions were provided, instructors sometimes asked for clarification. Some cells in the worksheets were left blank by some instructors so the agreement scores could not be used for any kind of quantitative analysis but did help with the discussion. It is also possible that the instructors hadn’t been exposed to the EMR itself enough to be able to link it to the items so responses were more just their perception of what it would be able to do and how they teach.

While the questions asked to instructors and students were generally similar, for synthesis, it would have helped if they had been more comparable or structured in the same manner. For example, instructors were asked “What are your thoughts on incorporating an EMR like this into your lessons?” and students were asked “What are your general thoughts on using a tool like this in your learning?” These are parallel questions but they could have been replaced with the single question: “What are your thoughts on the use of an EMR like for learning in health informatics?” A few questions would have benefitted from having definitions or examples as some participants had trouble understanding the question. For example, the question asking students about desired types of knowledge, skills and competencies could have been rephrased as “When you complete a course, what would you like to be able to do or what should you know about?”. Simply naming or listing competencies was difficult for both instructors and students and they tended to come up naturally as they talked about experiences and what they would have like to see.

Since coding is a subjective activity, there may have been some investigator bias in coding the research study data as there was only a single coder but the categories and items developed from the codes for worksheets were reviewed by a health informatics expert prior to phase 3 of the study. As part of the constant comparative method, the investigator frequently re-examined portions of transcripts to ensure they were coded to satisfaction. Some of the most challenging portions to code were topics and teaching approaches because participants often jumped back and forth between what had been done in the past and what they felt could possibly be done with the EMR. Upon further inspection, items often fell under more than one coding category. But a thorough process with several coding passes on the same data was used to minimize inconsistencies as much as possible.

Although the majority of this work was descriptive in nature and often involved subjective data, using the literature reviews to supplement findings from the research study helped to strengthen the results, especially where the same findings were discovered across different sources.

8.5 Reflections on Research Methods

In addition to the specific objectives of this work, the entire process produced valuable lessons learned and reflections for the investigator, which are a significant part of the learning process as a master's student. The structured literature review followed a very structured, thorough procedure closely resembling a scoping review which "determines the size and nature of the evidence base for a particular topic area, which can in turn be used to identify gaps in the literature" (Centre for Reviews and Dissemination, 2009, p. 240). Although more time consuming, the benefit of examining the literature in this manner rather than a typical review was that it ensured completeness. All retrieved results were considered and a few groups of papers not in the scope of this thesis could certainly be explored furthered.

According to Holloway and Wheeler (2002), in qualitative research it is necessary to be familiar with the participant's world to understand their experiences but that researchers should question their own assumptions and act like strangers. Throughout this work, it was very helpful for the investigator to be able to internally reflect on her own experiences as a student and having that background definitely allowed her to gain a better understanding of what students were referring to when they discussed coursework.

For example, when they would say “the database course” or simply a course number, she knew exactly what they were referring to which helped tremendously with transcription and interpretation for coding. The investigator also had the perspective of being an instructor in the school, having taught labs and a lecture. Just as the experience of being a former student helped to understand student participant views, being an instructor helped to interpret the instructor views obtained. Despite these benefits of being immersed in the culture of the setting, there could be a potential for researcher bias as complete objectivity is impossible to achieve (Holloway & Wheeler, 2002). However, since the nature of this research was to explore integration of an educational EMR into HI education, it was already assumed that integration was favoured and desired by the investigator. The exploratory work being done here was to determine how to accomplish integration. To mediate the bias, all participants were specifically asked to state their general thoughts about integration first and also to describe both benefits and concerns. These have been reported above. The methods used in this research drew upon a range of established methods for data collection and analysis described in the literature but combined these in unique and sometimes innovative ways to serve the purpose of this work (e.g. instructor focus groups with worksheets and preliminary analysis results projected on a screen, which were modified as the discussion took place).

Chapter 9 - Conclusion

This work resulted in some very interesting revelations when it comes to integrating an educational EMR into HI education and also presented a comprehensive view of the field of HI. It raised many questions and items for discussion, demonstrating that, like all technology integration endeavours, it is a challenge but it can be done with some thoughtful planning. Students and instructors alike were excited about the prospect of incorporating hands-on use of EMRs into course work but were also aware of the difficulties which may arise due to the unique HI context. The structured literature review and documentation review showed that very little has been done so far in this specific context. Therefore, the ideas presented have some important implications to consider.

9.1 Theoretical Implications

Revisiting the different perspectives for learning described at the start, we can now comment on the views in terms of the results. Recall that the three main schools of thought were behaviourism/objectivism, cognitivism, and constructivism. According to the literature on technology integration in general, there has been a shift towards more constructivist approaches in learning (Lai, 2008; Hinostroza et al., 2008; Jefferies, 2003). The majority of papers reviewed seemed to describe a learner-centered approach that leans towards this. As well, in the research study, many of the major items identified seemed to align more with the constructivist and social constructivist view. For example, students strongly favoured an interactive class environment with group work and discussion so that they learned from each other rather than solely through direct instruction. One of the most commonly suggested teaching approaches identified in this work, the use of case studies, also allows students to explore concepts using the EMR with the instructor guiding them through a realistic scenario. Using this method in a longitudinal manner can potentially help students to build their knowledge as they progress through the program. Additionally, allowing students to play-with and explore the system provides some flexibility in learning as opposed to the structure typically associated with objectivist methods. This may be due to the fact that HI learning with EMRs isn't necessarily about training to use a system, but rather about learning concepts surrounding system use which are often not structured pieces of knowledge to be transmitted from instructor to student.

At the same time, aspects of behavourism and cognitivism were also present. For example, in the structured literature review, one paper (Okada et al., 2007) described a system which indicated incorrect student responses and guided them to relevant materials, essentially reinforcing the 'correct' behaviour. As well, lectures are used in virtually all HINF courses but as Hung (2001) points out, it does not necessarily constitute a behaviourist transmission approach if the student constructs the knowledge. The message from the literature on general IT integration is that learning is complex and there is not one single "correct" view so approaches aligning with different perspectives can certainly complement each other within a single context (Dede, 2008; McLeod, 2003; Hung, 2001).

The TPCK framework worked well as a base conceptual framework to ensure that all main conceptual pieces were covered in the exploration of educational EMR integration. Furthermore, the work described in this thesis provides an application of TPCK which adds two key pieces: more explicit descriptions of what content, pedagogy and technology are for this specific integration challenge and contextual considerations that emerged i.e. student, instructor, system, technical, course, and considerations of when to integrate. For example, the TPCK required to integrate for a specific activity would greatly differ from TPCK required to integrate across multiple courses and while this may be implied in the original framework, it has been made more explicit in the diagram as it was a key finding in this work. The complexity of integration will also tend to increase. This fits well with the earlier continuum of loose to high coupling for integration proposed by Kushniruk et al. (2009).

Looking only at the overall framework in Figure 11a, without the specific pieces for HI, it can be seen as an expanded version of TPCK which could be adapted for other IT integration contexts. For instance, suppose a computer science program wishes to introduce a new programming language. They would still need to consider when to integrate it i.e. in one course or several. They would also have to consider the students, instructors, technical requirements, and course requirements. So in this way, the general TPCK framework expansion developed in this work has larger applicability. Then specifically for HI are the detailed items and sections which reflect the HI learning environment that was explored in this thesis.

9.2 Practical Implications

A practical implication of this work for HI competency development is the uncovering of topics that relate to EMRs. To the investigator’s knowledge, this is the first time that anyone has mapped HI course topics specifically to the EMR. As demonstrated by the large list of items in Figure 11b for HI topics, there are new ways to explore how EMRs relate to topics that are currently taught. For example, what do students need to know about political and social factors that influence EMR use or vice versa? This has the potential to expand the depth of topics which make up the HI discipline.

A big challenge throughout this entire thesis was related to terminology. As described in the introduction, there is a distinction between EHRs and EMRs in the Canadian context. However, the definition blurs when international jurisdictions are considered. The system demonstrated in the research study was an EMR and therefore was the focus of this thesis. However, the integration concepts discussed within this thesis can certainly be applied to other types of health information systems. In exploring integration, the definition of the EMR became less relevant but it helped to guide the scope of the type of systems being integrated i.e. it had to perform similar functions to an EMR but could be called an EPR, EMR or EHR. The structured literature review was purposefully broad when it came to the criteria for the system and resulted in many types of systems being included. This allows the resulting preliminary framework to be applicable to wider range of systems.

Based on the data gathered from the literature and research done, the specific tool used as a demonstration in the research study, the UVic EHR Educational Portal (Borycki et al., 2009), appears to be well-positioned for integration into HI education. Some of the considerations and challenges faced by other institutions have been eliminated due to the design e.g. licensing, subscription cost, security, fake patients, remote access. And it can potentially support longitudinal or interdisciplinary use. It has been used with multiple disciplines but individually (Borycki et al., 2009; Joe et al., 2009) so there may be an opportunity for collaboration among multiple programs. Implementing something along these lines would require instructor support for innovative use and case development. As discussed in Chapter 2, there is an abundance of strategies and approaches available for instructional design and curriculum development with technology. The next step would be to explore these in terms of the specific considerations raised in this work to determine the best fit.

At the current stage, the participants identified many high level requirements and ideas but generally weren't able to get into the details of integration such as mapping parts of the EMR to specific teaching activities and topics in HI. If the use of educational EMRs is to become a part of HI education, as this research suggests it should, there will be a need to revisit HI content and competencies in light of educational EMR use. Perhaps it would be helpful to create a matrix that maps items from the three knowledge areas together that would logically work together. It can be envisioned as something that would grow over time based on evidence of use as different HI programs experiment with curricular design that uses the components of the framework. This is where looking to previous literature was the most valuable as it provided practical examples of how such work could be done (see Chapter 3). For example, one paper described how instructor input was gathered to map nursing competencies to the system (Curran, 2008). As well, the literature on general integration may be adaptable such as Guzman and Nussbaum's (2009) domains and teaching competencies for technology integration or Harris and Hofer's (2009) activity types. The Teaching for Understanding (TfU) framework is intended to help guide educators in designing curriculums that stress student understanding (Wiske, 1998). It is in line with the constructivist approach to learning. As part of TfU, learning activities are mapped to the goals with the aim that they will help students to demonstrate understanding. This is mentioned in the Handbook of Technological Pedagogical Content Knowledge for Educators (Koehler & Mishra, 2008). The TPCK components generated in this thesis can be used in conjunction with curriculum design approaches like these.

Learning by design, a collaborative, constructivist approach (Koehler & Mishra, 2005; Koehler, Mishra, & Yahya, 2007) has been applied in other contexts to develop TPCK and could also be employed here. The approach as described by Koehler and Mishra (2005) and Koehler et al. (2007) involves having design teams work together to develop online courses where they needed to consider how to deliver course content and how to use technology to accomplish course goals. In both studies, participants developed a prototype website, syllabus, course structure, readings, student assignments and assessment rubrics. The findings indicated initial confusion and frustration among participants and not a high degree of engagement with the three knowledge bases but by the end, groups were content and had moved away from thinking of technology, pedagogy and content as independent constructs. Angeli and Valanides (2009) used a similar approach termed technology mapping (TM) in which pre-service teachers enrolled in a course on how to teach with ICT. They were given design tasks at two points during the course (5^{th} week and 10^{th} week). Performance was found to be better on the second tasks and the authors also concluded students had improved in developing ICT-TPCK (a term defined in the paper to explicitly refer to ICT integration).

The results of this work were quite optimistic overall but at the root of all this lies instructor and student adoption of the technology. While this work assumes EMR adoption for integration to some extent, it is important to recognize that this may be the first point of discussion required, especially for a longitudinal approach. Instructors have to recognize a need to integrate (Harris, 2008). One literature paper in particular (Curran, 2008) particularly focused on the involvement of faculty during integration to ensure adoption. While some authors (e.g. Hinostroza et al., 2008) agree that use of the IT itself can produce motivation, 4th year students in a focus group commented on the need for motivation or incentives for use, especially when students are expected to explore the system on their own.

Next, we need to realize that the vision for full scale integration across the undergraduate HI program discussed by instructors in the first focus group was very nice but perhaps unrealistic to achieve right away. Examples from the literature showed that systems tended to be introduced gradually e.g. one activity or course at a time, and often as a project (e.g. Curran, 2008; Fauchald, 2008). Instructors need to become familiar with the product to be able to use its features and plan appropriate lessons (e.g. Curran, 2008 and considerations in Section 7.9). Even one instructor interviewed who said they would just need a password to use it, later reflected that they would also need to learn the system first. The demonstration quickly showed some capabilities but more in-depth knowledge of the tool would be required before it could be used. A step-by-step approach to integration would be perhaps be ideal in supporting instructors and students in using the system (see section 7.9.4). This concern is also well documented in the literature surrounding general technology integration (see section 3.2.5.1). According to Guzman and Nussbaum "teacher training must be at the heart of any attempt to formally incorporate technological tools into classroom activity, this training should be the basis for serious reflection that will promote the transformation of teaching practices and make a significant contribution to the adoption of technologies by teachers" (2009, p. 454).

It is possible to start with small activities within courses but if the most benefits are to be achieved with longitudinal integration as this work suggests, some level of coordination and standardization will be required in the educational environment. For example, if the system is going to be integrated across courses in a HI program, the content to be learned also has to be coordinated across the courses. This was the case in one paper, in which the authors commented that content was standardized across courses because of different terminology and interpretations (Lea et al., 2008). In fact, this even came up in the research study when generating the possible list of topics. Initially, "health professional roles" was identified to encompass how health professionals would use the EMR as part of daily work but later on "workflow" was established as a separate topic because participants saw differences between the two. When presented with the full list of topics in the first focus group, instructors also felt that all the items were not at the same level of granularity e.g. computer science is an entire discipline that breaks down into specific topics. At the same time, the overlaps in topics as discovered in the documentation review and research study, may help to facilitate integration throughout the program. Some students saw the EMR as "tying everything together" so with proper coordination, longitudinal integration could be practical but would require discussion, e.g. in curriculum or program design meetings. For instance, in Dimick (2008) an advisory committee determined priorities and strategies for ongoing Virtual Lab development and Fauchald (2008) explained that a project director and technology lead were established. The integration occurred across programs and each of the six health science programs selected a faculty lead as representative and super user. These examples from the literature on previous integrations suggest that someone needs to take responsibility for initiating and leading the integration effort, particularly if it will span more than course (see section 3.2.5.1).

Once integration has been achieved, assessment should not be ignored. Implementing innovative changes to teaching may not receive full acceptance at first (Green et al., 2004) or be successful in the first attempt (McCrory, 2008) but positive outcomes are possible. Seven of the papers reviewed were reporting on studies done to evaluate different aspects of integration from student and instructor satisfaction to impacts on student learning. Gathering this data periodically will be helpful to determine areas for improvement. And as one student noted, technology is always changing. Hinostroza et al. (2008) discuss how this has an impact on student learning in terms of expectations and possibilities as the technological scenario changes.

9.3 Future Research Directions

At the outset of this research, a gap was identified in the use of a real-world technology, the EMR, within HI education to prepare future graduates for the workplace. Recognizing the challenge in integrating technology into education, the question driving this research was whether a framework could be developed to help guide the integration of an educational EMR into undergraduate HI and if so, what HI competencies and topics could be addressed using the EMR, what teaching approaches work would work well with the EMR, and how could the technology itself be leveraged for teaching and learning? During the course of this research, these questions were answered. The resulting preliminary framework, informed by the literature and evidence from an original research study, extends the notion of technological pedagogical content knowledge. It identifies a large number of topics that are related to EMRs, feasible teaching approaches, aspects of the educational EMR which can be used, and larger contextual considerations for integrating an educational EMR into HI education at several levels (i.e. from a single activity to multiple programs). The preliminary framework provides a comprehensive view of integration for this context that will hopefully be a helpful tool to HI programs and educators in guiding their integration endeavours.

This was first step in exploring EMR integration into HI education and the results were very promising. Further research could be devoted to even one piece of integration e.g. learning activities appropriate with the EMR. The structured literature review excluded other types of technology integration but there may something to learn from those as well. An experimental educational EMR is already being used and from what the results showed, students and instructors see many potential benefits. Even some 1st and 2nd year students whose only exposure was the brief demonstration shown during the focus groups were immediately able to see how it tied the content they are learning together. However for maximum integration benefits, careful planning will need to be done involving instructors, ideally addressing components in the preliminary framework. At this stage, the investigator didn’t go into details of items found but it would be interesting to delve deeper into some of them. For example, instructors talked about setting up a longitudinal scenario for students to use throughout a course or program. It is an exciting idea that could certainly be explored further. Perhaps a case study could be done to plan and test such an approach. Integration beyond HI was also discussed in this work so there may also be an opportunity to explore this with other disciplines in healthcare at the same university or other healthcare programs across universities. As the result of this work was a preliminary framework, it would be prudent to obtain feedback on it for refinement from other disciplines and HI students and instructors. For example, it could be studied in the context of curricular design activities for practical applicability across HI programs. There are many possibilities. Given the overwhelming optimism and support of the participants in the study, educational EMRs have a definite role in undergraduate HI education programs. As one instructor commented "…the importance of doing this is definitely its time has come" (Instructor 4).

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Appendix A – General Characteristics of Selected Papers for Structured Literature Review

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Bani-Issa	Teaching Beliefs and Practices and the Use of Electronic Health Records in Nursing Education: A Collective Case Study	2005	Dissertation	Study	Nursing	University of Kansas Medical Center School of Nursing: SEEDS project which established state-of-the-art clinical laboratory setting at a school of nursing where students can practice primary nursing skills in a simulated environment equipped with a computerized EHR	Study to explore teaching beliefs and practices of educators using EHR in the classroom to determine themes and patterns of the beliefs and practices; part of larger study to evaluate the SEEDS project; used a collective case study method to interview and observe seven SEEDS educators.
Barger & Das	An Academic-Service Partnership: Ideas That Work	2004	Article	Descriptive	Nursing	The University of Alabama Capstone College of Nursing and the DCH Regional Medical Center, a teaching and training site for residents and students	Describes 9 initiatives of a collaboration between a university and regional medical center, including one in which the medical center's computerized medical record system is incorporated into a course.

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Brown & Waite	The Role of Simulation and the Electronic Medical Record in Preparing the Next Generation of Nurses	2009	Abstract	Descriptive	Nursing	Saint Francis Medical Center College of Nursing: the NLN Health Information Technology Scholars (HITS) project	Describes a project to integrate simulation into a Baccalaureate nursing program using an EMR. The project goals were: the development of a virtual hospital dedicated to College use for simulation and other learning activities, creation of an EMR training pathway specific to select NLN simulation scenarios, utilization of the EMR and NLN scenarios in the first and last semesters of the nursing curriculum, and evaluation of student self confidence, satisfaction, and simulation design features.
Cholewka & Mohr	Enhancing Nursing Informatics Competencies and Critical Thinking Skills Using Wireless Clinical Simulation Laboratories	2009	Article	Study	Nursing	New York City College of Technology	Describes a project for teaching nursing competencies and development of critical thinking skills through problem-based learning using a Clinical Simulation Laboratory (CSL). Students were given pre and post-scenario tests to measure their knowledge about pneumonia before and after doing a scenario.

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Connors et al.	HIT Plants SEEDS in Healthcare Education	2007	Article	Descriptive	Nursing, medicine, occupational therapy, physical therapy, nutrition, information management	University of Kansas School of Nursing: curriculum overhaul program named SEEDS (Simulated E-hEalth Delivery System). The SEEDS program migrated to the KU School of Medicine and the graduate NP program in 2004.	Describes a program that integrated an EHR into several health professional curriculums, starting with nursing.
Curran	Faculty Development Initiatives for the Integration of Informatics Competencies and Point-of-Care Technologies in Undergraduate Nursing Education	2008	Article	Descriptive	Nursing Informatics	Ohio State University College of Nursing	Describes how faculty development was done to enable integration of point-of-care technologies, including a clinical information system, into an undergraduate nursing curriculum. The goals were to develop an informatics infrastructure, to educate faculty and students in informatics knowledge and skills, and to generate research in informatics. The vision was to create a realistic virtual clinical practice environment for students and use technology to transform the way nursing practice was taught and learned.

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Dimick	Into the Laboratory: HIM Virtual Lab Offers Students EHR Experience	2008	Article	Descriptive	Health Information Management (HIM)	A new Virtual Lab environment containing HIS that provides hands-on use of real-world system for students. One of the first schools to subscribe was University of Illinois at Chicago (UIC).	Describes the AHIMA Virtual Lab which was designed for all schools.
Fauchald	An Academic-Industry Partnership for Advancing Technology in Health Science Education	2008	Article	Descriptive	Multiple: Nursing, physical therapy, occupational therapy, health information management, exercise physiology, and social work	College of St. Scholastica.	Describes a partnership between the College of St. Scholastica and the Cerner Corporation of Kansas City to implement informatics technology into the curricula: Advancing Technology in Health Science Education Now (ATHENS). The goal is to provide health science students practice-oriented exposure to discipline-specific technologies which are oftentimes not available to students in the clinical setting.

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Gassert & Sward	Phase I Implementation of an Academic Medical Record for Integrating Information Management Competencies into a Nursing Curriculum	2007	Article	Study	Nursing	University of Utah undergraduate nursing curriculum.	Describes the first phase of a case report at the University of Utah to incorporate information management competencies throughout the nursing curriculum by using a live-production application that simulates a clinical information system titled UCARE AES. The system was implemented with accelerated baccalaureate students on their first day of clinical classes. Baseline data on students' experience with and knowledge about information systems was collected during orientation and then at the end of the semester.
Kennedy et al.	Using a Modified Electronic Health Record to Develop Nursing Process Skills	2009	Article	Study	Nursing	A school of nursing in a midwestern university medical center using SEEDS (Simulated E-hEalth Delivery System).	A study to describe the experiences and behaviours of beginning nursing students learning the nursing process using a modified electronic health record to develop a care plan for case study patients. A case study design used with a group of 8 beginning nursing students led by a teacher. Procedures included observations of four SEEDS seminar sessions with videotaping, semi-structured open-ended interviews with 5 students

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
							and the teacher, evaluation of care plans generated during the learning activity. Two foundational themes and a concluding theme emerged.
Lea et al.	Undergraduate Learning: Using the Electronic Medical Record Within Medical Undergraduate Education	2008	Article	Descriptive	Medicine	Leeds Medical School.	Describes exploration of potential for using a live clinical information system as a teaching tool to enhance and reinforce learning in a primary care environment, particularly for primary care consultation. The objectives are for students to learn about and learn to use the EMR and to embed this in their course.
Litt & Loonsk	Digital Patient Records and the Medical Desktop: An Integrated Physician Workstation for Medical Informatics Training	1992	Article	Descriptive	Medicine - Medical Informatics	System has been used in a required course in Medical Informatics for second year medical students.	Describes a working model of an integrated physician workstation including a digital patient record and other applications. It has been used by students, physicians, and scientists.
Madden & Hanberg	Integrating Electronic Health Record Systems With Human Patient Simulation	2009	Abstract	Descriptive	Nursing	University of Utah, College of Nursing.	Describes use of integrated human patient simulation with an EHR system for interactive application of IT and patient care management. UCARE (Utah Clinical Academic Record Excellence) is the university's implementation of the EHR.

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Melo & Carlton	A Collaborative Model to Ensure Graduating Nurses Are Ready to Use Electronic Health Records	2008	Article	Descriptive	Nursing	Ball State University (BSU) School of Nursing (SON). Partner is Ball Memorial Hospital (BMH) where students do clinical rotations. The BSU SON Learning Resource Center (LRC) underwent redesign for student exposure to electronic charting systems. The simulation model in the LRC was of a hospital setting, clinic setting and home care setting.	Describes a collaboration between a university and hospital to allow students to have experience with an EHR because all students including first and second year students need access to an EHR before and during their rotation.
Morrow et al.	First-year Medical Students Can Demonstrate EHR-specific Communication Skills: A Control-Group Study	2009	Article	Study	Medicine	University of Texas Southwestern Medical Center at Dallas.	Study aiming to establish the feasibility and practicality of teaching EHR-specific communication skills to early first-year medical students. 17 first-year medical students were randomized to intervention and control groups that participated in a evaluation and feedback session using a standardized patient visit. Both groups received EHR training but intervention received extra EHR-specific communication skills training. The students' general communication skills were evaluated using a checklist designed for the

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
							case.
Muma & Niebuhr	Simulated Patients in an Electronic Patient Record	1997	Abstract	Study	Medicine	University of Texas Medical Branch.	A study to determine if students learn problem-solving skills using an EPR and if students become more favorable toward computer-based information technologies. An intervention group used an EPR and traditional simulations and a comparison group used only traditional simulations. Performance of course objectives was measured by examination scores.

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Naeymi-Rad et al.	Education Review: Applied Medical Informatics-Informatics in Medical Education	1994	Article	Descriptive	Medicine - Medical Informatics	The University of Health Sciences (UHS)/Chicago Medical School (CMS).	Describes how medical informatics has been incorporated into a medical school curriculum, including the use of a medical record entry system and other IT tools (including an EMR in 4th year). The objective has been to emphasize the applied approach.
Nickitas et al.	Increasing Nursing Student Communication Skills Through Electronic Health Record System Documentation	2010	Article	Descriptive	Nursing	A large urban public liberal arts university that includes a publicly supported upper division baccalaureate nursing program. Students learn in lecture halls and are taught skills-based procedures in the college laboratory. Clinical partner is the Veterans Administration (VA) New York Harbor Healthcare System.	Describes an academic-clinical partnership between a university and hospital to allow students to use a real EHRS in a college laboratory.

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Okada et al.	Conceptual Model of Health Information Ethics as a Basis for Computer-based Instructions for Electronic Patient Record Systems	2007	Article	Descriptive	Health Informatics	Department of Health Informatics, Kawasaki University of Medical Welfare. Out of approximately 80 student enrollments each year about half aim to work for hospitals as patient record administrators or healthcare information technologists in charge of health information systems. An EPR Laboratory is used in Health Data Management Practice course for third year students.	Describes a conceptual model (UML) created for the topic of health information ethics that was incorporated into the EPR Laboratory for student learning.
Speedie & Niewoehner	The Minnesota Virtual Clinic: Using a Simulated EMR to Teach Medical Students Basic Science and Clinical Concepts	2003	Proceeding	Descriptive	Medicine	University of Minnesota Medical School.	Describes the Minnesota Virtual Clinic, a web-based technology enhanced learning (TEL) application which can improve delivery of medical education by making educational experiences available at any time and place. The mission is to provide a set of patients that illustrate and supplement the material taught in the courses and clerkships of the undergraduate medical curriculum.

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Stahl	The MuPSi Project--A Learning Environment for Multiprofessional Collaboration	2000	Article	Descriptive	Multiple: social work, nursing	The MuPSi project started with three schools: the School of Health Care and Social Work at Arcada Polytechnic, Helsinki Institute of Nursin, and the College of Midwifery and Nursing. During first two years all other schools within healthcare and social work in Helsinki have joined the project.	Describes the MuPSi project concept where students are provided full access to an EPR with all fictive patient records. The main idea is to use a networked EPR software to enable students studying for different professions within the field of healthcare to act collaboratively as members in a virtual healthcare team.
Stephens & Williams	Teaching Principles of Practice Management and Electronic Medical Record Clinical Documentation to Third-year Medical Students	2010	Article	Study	Medicine	Uniformed Services University (USU)	Study aimed to assess medical student attitudes and self-reported skills regarding practice management, coding and clinical documentation. The goal was to determine student familiarity and comfort with clinical documentation using both handwritten and electronic progress notes using an electronic medical record. Third-year medical students were surveyed before and after training workshop asking about their attitudes towards AHLTA, educational value of workshop, self-reported confidence in ability to document and code a clinical encounter using the EMR.

Authors	Title	Year	Document	Type	Discipline	Setting	Purpose/Methods
Taylor et al.	Integrating Electronic Patient Records Into a Multi-media Clinic-based Simulation Center Using a PC Blade Platform: A Foundation for a New Pedagogy in Dentistry	2007	Proceeding	Descriptive	Dentistry	University of Texas Dental Branch at Houston's Clinical Simulation and Learning Center (CSLC).	Describes a clinic-based simulation center that combines the use of an EPR and picture archive and communications system (PACS)
Weber	Transforming the Student Nurse Experience: A University Integrates e-Health Technology Into the Nursing Curriculum	2004	Article	Descriptive	Nursing	University of Kansas School of Nursing SEEDS program which was developed and funded in partnership with Cerner Corporation.	Describes the Simulated E-hEalth Delivery System (SEEDS) program, the nation's first full integration of a live-production electronic clinical information system into nursing education.

Appendix B -
Topics Mentioned in Selected Papers for Structured Literature Review

Paper	Discipline	Clinical & Health Services	Health System	Project Management	Organizatio-nal & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology	Other
Bani-Issa (2005)	nursing	nursing process (problem, intervention, evaluation of outcomes)					documentat-ion		
Barger & Das (2004)	nursing						documentat-ion		
Brown & Waite (2009)	nursing								
Cholewka & Mohr (2009)	nursing	evidence-based patient care management using advanced IT; physician order documents; laboratory test results; x-ray images correspondin	dynamic changes occurring within the healthcare industry		management and prioritization of client care		documentat-ion	evidence-based patient care management using advanced IT	

Paper	Discipline	Clinical & Health Services	Health System	Project Management	Organizatio-nal & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology	Other
		g to disease entities							
Connors et al. (2007)	nursing; medicine; occupational therapy; physical therapy; nutrition; information management	patient assessments; diagnoses; decision-making; evidence-based guidelines					documentat-ion; structured charting; structured nomenclatu-re	database searching	
Curran (2008)	nursing informatics					structuring data for analysis; evaluation; quality improvem-ent	documentat-ion; structured terminolog-ies		*used a list of informatics competenc-ies
Dimick (2008)	health information management (HIM)	clinical decision support tools (being considered)			revenue cycle management (being considered); financial decision support tools (being considered)		transcription ; coding; master patient index	EHR technology; clinical decision support tools (being considered); revenue cycle management (being considered); financial decision support tools	

Paper	Discipline	Clinical & Health Services	Health System	Project Management	Organizatio-nal & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology	Other
								(being considered)	
Fauchald (2008)	multiple: nursing, physical therapy, occupational therapy, health information management, exercise physiology, and social work	decision making; practice competence; problem-solving; guidelines; evidence-based practice; standards of care and standards of practice; real-life span cases (acute, chronic and mental health conditions); assessments; charting; chart audits; medication information; laboratory values; medical terminology; diagnostic			interdiscip-linary team work; workflow	research	documentat-ion; patient data; reports; graph results		

Paper	Discipline	Clinical & Health Services	Health System	Project Management	Organizatio-nal & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology	Other
		parameters; cultural care references							
Gassert & Sward (2007)	nursing	plan care; discharge planning; standardized language	patient's rights; confidential-ity		practice management		access, enter and retrieve data; document patient care	navigate systems; components of the information system; data security	*other competenc-ies
Kennedy et al. (2007)	nursing	nursing process; low-level decision support					documentat-ion		
Lea et al. (2008)	medicine	medications (prescribing, management, monitoring use and safety); clinical tools; chronic disease management; practical therapeutics; evidence-based practice; consultation and	information governance; confidential-ity		GP role in clinical practice today	data quality	record a full consultation; explore and use clinical coding	strengths and weaknesses of new technology	

Paper	Discipline	Clinical & Health Services	Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology	Other
		communication skills; information to support decision making							
Litt & Loonsk (1993)	medicine - medical informatics	orders and consults; laboratory; radiology					documentation (notes); issues with medical information management		
Madden & Hanberg (2009)	nursing	clinical decision making					documentation		
Melo & Carlton (2008)	nursing	medication administration					charting/ documentation		
Morrow et al. (2009)	medicine	clinical information (chief complaint, history, lab results, medication lists)			EHR-specific communication behaviours		documentation	EHR-specific communication behaviours	
Muma & Niebuhr (1997)	medicine	clinical problem-solving							
Naeymi-Rad et al. (1994)	medicine - medical informatics	comprehensive history of present					collecting and documenting		

Paper	Discipline	Clinical & Health Services	Health System	Project Management	Organizatio-nal & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology	Other
		illness (HPI) (e.g. chief complaints and physician examinati-ons)					clinical data		
Nickitas et al. (2010)	nursing						essential information to support patient care; information management for quality and safety of patient care	information and technology skills for safe patient care; benefits and limitations of communicat-ion technologies and impact on safety and quality; reliable technologies; concepts and processes regarding computer systems and impact on practice; advantages	

Paper	Discipline	Clinical & Health Services	Health System	Project Management	Organizatio-nal & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology	Other
								of electronic tools; importance of nursing contributi-ons to clinical information systems	
Okada et al. (2007)	health informatics	evidence-based medicine	health information ethics		ethics for health information profession-als	statistics	coding	fundament-als of EPR systems: operational aspects, subjects connected with patient information handling, healthcare services and underlying IT; information security	
Speedie & Niewoehner (2003)	medicine	clinical concepts; medical decision making						security and use of EMR for patient care	
Stahl (2000)	multiple: social work, nursing	care planning; problem			multidiscipl-inary communicat		documentat-ion		

Paper	Discipline	Clinical & Health Services	Health System	Project Management	Organizatio-nal & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology	Other
		solving			-ion and collaborat-ion;				
Stephens & Williams (2010)	medicine				practice management		coding (ICD-9, CPT, E/M coding); clinical documentat-ion (SOAP)		
Taylor et al. (2007)	dentistry	issues with real patients: medical histories, infection control, living tissue, ergonomics			issues with real patients: patient management				
Weber (2004)	nursing	nursing process; terminology					documentat-ion		

Appendix C -
Teaching Approaches in Selected Papers for Structured Review

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
Bani-Issa (2005)	instructional approach to documentation; presentation; case study; EHR treated as data entry mechanism (objectivist)	classroom features create an interactive-sharing learning environment by allowing interaction, dialogue and discussion between the students and instructor during the case study; allows instructor to give immediate feedback; learner-centered, internet discussion board, pair up students to share experiences; display lecture notes in different ways; videos; small group work; fun and game approaches; engage students in dialogue; argument and discussion; seminars; peer critique; add interactive questions to EHR information displayed; role model through case example (constructivist)	study questions (objectivist)	problem-based learning strategy; simulation; process data from virtual cases; access data-based references; and conduct internet searches in the context of nursing processes; students access virtual records, document the assessment, problem identification, interventions, and evaluation of outcomes; used EHR during the clinical seminars course and were assigned to the training lab to conduct online documentation using the EHR; students and instructor log onto SEEDS and document care plans on the same patients; case studies (constructivist and objectivist)	tests (objectivist)
Barger & Das (2004)				training module of abstract patients using real-life data; students used in a lab environment before the clinical unit	
Brown & Waite (2009)				simulation scenarios integrated into the first semester of the junior nursing courses and the	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
				second semester senior courses; after completing simulation students were asked to complete two evaluation instruments	
Cholewka & Mohr (2009)				problem-based learning; simulation; lab activities were combined with course tutorials; data collected by students in their clinical sections and entered at the college through networked computer connected to a database server; students and faculty able to update patient simulator records by documenting nursing care that they provide within each care scenario with either a PDA or notebook computer at the bedside in the lab; individual patient simulator scenarios were developed for clinical courses and based on skills and knowledge included in the NCLEX exam content	
Connors et al. (2007)	computer training room allows instructors to project the EHR onto a screen so students see what is being discussed and follow on their own computers	students use the EHR while the instructor projects their work on a screen and gives immediate feedback; students interact with same case study so they see what their peers are documenting; nurse practitioner student documentation is reviewed by information management (HIM) students in the School of Allied Health who provide		created a simulated healthcare delivery system that followed the basic flow of the curriculum and simulates point-of-care use; beginning students have problem-based critical-thinking seminars to analyze patient case studies to determine assessment data, appropriate nursing diagnoses, goals and nursing interventions and then enter into the EHR; as students progress	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
		feedback via the EHR on coding and reimbursement issues		through the curriculum care plans are completed within the EHR; at the School of Medicine instructors push out case materials to medical students in classrooms and seminars to mimic a case presentation viewed through an EHR	
Curran (2008)				used EHR in class or for homework assignments; sophomore level: students participated in focused simulation exercises using the EHR that embedded informatics content and competencies, students expected to look up results and clinical data and document assessments; junior level: case-based high-fidelity simulations, assignment to review a clinical case in the EHR and look up best practices for the diagnosis, in lab they received a bedside report with access to the EHR and asked to provide care; senior level: constructed data displays for analysis, aggregated data, quality improvement exercise with benchmarking and scorecards, complex patient scenarios in simulation	
Dimick (2008)		used system in class group meetings	used system outside of class; Virtual Lab offers library of lessons and exercises	school assignments are crafted off the system, instructing students in real-world uses of health IT; at UIC junior HIM	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
				classes use the encoding application to get the basics on coding and look the innards of an electronic record with the EHR application; juniors will use the MPI application to learn how to detect and prevent duplicate patient records	
Fauchald (2008)		provide opportunities for interdisciplinary collaboration; debriefing to review case; frequently a selected case is used across multiple student levels; interdisciplinary practices are discussed by reviewing notes- students learn to navigate EHR and the consulting process and services as basis for classroom discussion	students complete planning on a specific case and provide direct care	simulations; use system at point of care which may be nursing simulation lab, traditional classroom setting or actual occupational therapy clinic; work with live EHR in view-only mode or input data by documenting in forms or templates; system and cases paired with simulation in the skills lab; faculty can manipulate the case to include unexpected outcomes to stimulate critical thinking	
Gassert & Sward (2007)			case studies for student use during the semester were created: students located information needed for assignments from case studies, they charted the information requested on themselves as patients; to learn data security and confidentiality they are warned that faculty could track where they have been in the system	users encouraged to chart anything for play patients to become familiar with system; case studies; first semester: use to document individual patient assessments; second semester: use to locate data, synthesize information from multiple sources, make clinical decisions based on data; third semester: use for pediatrics and maternity nursing-assess scenarios on patient simulators (manikins) and obtain patient history from	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
			and if they look at fellow students' charting	system for pediatrics, review a case study, prepare care plans, enter nursing orders, and practice reading fetal monitoring strips, use a form to practice communication with nurse and physician providers	
Kennedy et al. (2007)		all exchanges were collaborative; student-teacher interactions were usually initiated by the student with a question; teacher as facilitator with student-centered learning	during four 90-minute classes each student and the teacher had individual computer access that provided hands-on navigation through the EHR; a care plan for the patient and family was developed by each student	small groups of beginning nurses given written case studies for the purpose of entering patient data in the EHR	
Lea et al. (2008)		students actively encouraged to review each other's entries and explore implications for record keeping, audit, and continuity of care; discussion		support learning with supervised, hands-on exposure to the EMR (using dummy patients) prior to clinical placements; entering clinical data; student selected components feature clinical audits that require access to medical records and analysis- hands-on experience will provide understanding of issues	
Litt & Loonsk (1993)			each student is assigned a patient case	students must review all the clinical information and apply the medical information tools on the desktop to the case; assignment is completed by producing a SOAP progress note including diagnosis and treatment; case-based learning	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
				provides a familiar clinical environment for more medically knowledgeable users; case based approach helps students improve their clinical and diagnostic skills	
Madden & Hanberg (2009)				students use simulated patient scenarios to learn how to retrieve data and apply it directly within a simulated patient care environment; as the human patient simulation scenario progresses students make clinical decisions based on relevant patient data; students document simulated interventions and outcomes	
Melo & Carlton (2008)	students are introduced to the software, POC devices, and the E-MAR through a School of Nursing instructor-led computer-based patient care scenario			patient care scenario	
Morrow et al. (2009)		in a mini-lecture faculty discussed areas affecting EHR communication; students practiced role-plays with peers and computers;	engaged students in guided discovery where students spontaneously generated the EHR-specific communication skills they observed	documented chief complaint and history of present illness; looked up lab results; checked medication lists; students participated in 45 minutes of role plays and practical exercises using the Epic test patient; role-played two ambulatory encounters demonstrating good and poor EHR-specific communication skills; students instructed to take and document electronically a history from a	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
				patient	
Muma & Niebuhr (1997)	presented an EPR in a course in clinical problem-solving			EPR was a new medium for presenting simulated patients	
Naeymi-Rad et al. (1994)		analysis of the database of cases entered using the IMR-E and discussions	first year: introductory elective course to teach basic computer literacy (use Excel, Lotus 123, Word-Perfect, MS Word) with simple programming exercises (use DBASE, Hypercard, or Oracle® SQL)	2nd-3rd year: Introduction to Clinical Medicine course is first hand-on clinical medicine where students use the IMR-E, in the Applied Biostatistics and Epidemiology course students use the computer for calculations, do a clerkship at remote sites through informatics tools, students given Mac PowerBooks to enter and manage their patient's data using IMR-E; 4th year: students introduced to state-of-the-art decision support software in the informatics workup that consists of many IT tools (EMR, MEDLINE, IMR-E, MEDAS, QMR, Dxplain, Iliad, PKC, Drug Advisor), stress searching electronic knowledge sources at the bedside, also use document managing tools to organize results of workup into reports (use MS Word, IMR-E), WordPerfect)	
Nickitas et al. (2010)	had to change to only faculty accessing system and then guiding the students			identified skills: use for safe processes of care, navigate and locate information, observe use, respond to decision support and alerts, monitor outcomes, use patient information for patient	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
				care	
Okada et al. (2007)	EPR Laboratory designed to supplement conventional lectures on health information systems as part of the undergraduate curriculum		laboratory meant for self-learning; test, fail, review cycle; learning materials are arranged in sections with an objective, descriptive texts, and exercises; example section starts with a fictitious story that an elderly lady comes to visit a hospital, descriptions continue as she moves through the visit; screens used: data entry, creation and registration of templates for data entry, semi-automatic coding of diagnoses (ICD-10), computation of hospital statistics; at a certain point there is a test and students can't move to the next screen until they pass; three levels of questions: fundamental (answer can easily be found in learning materials), advanced (answer can be obtained from multiple materials), and applied (answer cannot be found directly from materials, often taken from real-	scenario	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
			life problems that could be very complex); for applied questions the student answers in a textbox which is sent to the instructor to score		
Speedie & Niewoehner (2003)	cases are linked to specific lectures, discussion and class exercises	cases are linked to specific lectures, discussion and class exercises; provides for student interaction through responses to questions and participation in online discussion groups	cases are linked to specific lectures, discussion and class exercises	system enrolls a group of simulated patients representing a variety of conditions and cultural backgrounds and follows them over time; students "attend" the clinic weekly to review the latest developments for the patients - ongoing virtual care of a group of patients; student "visits" the clinic by going to the clinic web page, signing in, and viewing a simulation of a typical clinic electronic patient record system; as the year progresses new information is revealed each week so that students not only develop understanding of patient's medical conditions but also the time course of disease development and resolution	
Stahl (2000)		students should share their case with other students in the field of health care: project aim is to set together teams of students studying for different allied professions at different schools to form teams like they will be part of upon graduation and teachers also work		teachers took role of simulators by constructing cases and then inventing and documenting events, findings, and observations that the students have to respond to; didactical cycle where students and teachers interact offline using the EPR: teacher (team)	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
		together in teams; think-aloud in front of each other over an electronic discussion group passively attended by teachers; teacher available when needed in person, phone, e-mail or discussion group		describes case textually, students start planning care using software, students proceed basing their plan upon the new facts, teachers follow up from within the program by recording findings that change; process of patient case should extend over two to four weeks providing the necessary dynamic in slow motion; students make initial assessment based on a short description and little data and then log on to make an initial plan for the patient using the EPR and then log off, the teacher then logs on and acts as a peer health care worker on next shift and during shift they use the EPR software to record observations findings and needs "expressed" by the patient giving feedback to student but also interfering on development of the situation; student and teacher continue logging on in turns as if working shifts	
Stephens & Williams (2010)	students were shown the video of a standardized case presentation; at the end of workshop students were shown a second standardized video	each element was discussed relative to the principles of practice management within the MHS		workshop focused on clinical application of EMR/AHLTA as a practice management tool; students were shown the video of a standardized case presentation and asked to document the encounter using an AHLTA training simulator on a personal laptop; used the EMR	

Paper	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
				in the practice management portion of the workshop to use the EMR to create a standard clinical progress note; used a primary care template in the simulation software for introduction to principles of coding, using a standardized patient each term was defined and the clinical application of each term reviewed; at the end of workshop students were shown a second standardized video and again asked to document the encounter using the AHLTA training simulator	
Taylor et al. (2007)	lectures			students use fully-functional operatory	
Weber (2004)	faculty incorporate the electronic record into lectures as well; illustrate stories	everyone sits at a computer and while they work each can see a wall projection of everyone else's screen	instructor can monitor and comment on individual progress, call attention to oversights, question reasoning, highlight exemplary work	student nurses gather in a laboratory in small seminar groups (1 instructor, 8 students) to apply the nursing process to the construction of an individual care plan for a simulated patient; case studies are rich compilations of input from all the disciplines	

Appendix D -
EMR and Related IT Use in Selected Papers for Structured Literature Review

Paper	IT Type	IT Description
Bani-Issa (2005)	EHR	• Online, Windows-based • Designed to be used by all members of a healthcare team who might be involved in providing patient care • Has components added by educators to design nursing care plans for selected virtual case studies • Students can use a reference text browser that directs to useful Web site documents • Computer skills laboratory has 12 computers with instructors at front with computer connected to an LCD projector, each computer has access to SEEDS software and information charted is projected onto the screen and can be viewed at individual terminals
Barger & Das (2004)	Computerized medical record system	• Real system • Medical centre set up a remote site at the college which allowed faculty and students access • Abstract patients' documentation
Brown & Waite (2009)	EMR	• Selected four exemplars from purchased scenarios and modified to create a corresponding electronic medical record • EMRs constituted the College's virtual hospital and became key in integrating informatics and simulation throughout the curricula
Cholewka & Mohr (2009)	Patient simulators; PDAs; online PRS	• Clinical Simulation Laboratory with a wireless data network high-tech patient simulators, wireless PDAs, and an online PRS • Patient simulator scenario parameters match the data fields in the PRS
Connors et al. (2007)	EHR	• Embedded a clinical information system (EHR) from Cerner Corporation (PowerChart®) in the basic curriculum • Installed and adapted PowerChart® into a new teaching platform AES designed to follow education workflow • Installed Cerner's full data repository, clinician order entry, documentation and clinical decision support tools to run a live-production environment • Have a computer training room with computers and the learning laboratory (where

Paper	IT Type	IT Description
		physical exam and clinical skills are practiced) has simulated point-of-care settings with EHR available to document • Students have anytime access to the EHR for homework assignments through the Internet
Curran (2008)	EHR; PDAs	• EHR • Point-of-care hand-held PDAs
Dimick (2008)	EHR; health IT software	• Virtual Lab contains a collection of EHR and health IT software accessible over the Internet • Currently offers six applications: QuadraMed MPI Suite - SmartID and SmartMerge, QuadraMed Quantim encoding application, ATHENS EHR (adapted for academic use from Cerner's PowerChart®), Dictaphone Voice Technologies, McKesson Horizon Patient Folder, HealthPort EDMS • Not installed locally - accessed over Internet
Fauchald (2008)	EHR	• The College's 6 health science programs use the ATHENS system which is based on Cerner's EHR Millennium Solution Suite that make up the remote-hosted AES • ATHENS Help Place is embedded into the EHR provides evidence-based practice information, clinical best practices guidelines, research, standards of care, standards of practice • Accessible 24/7 via secured Internet connection from any computer on campus and at home
Gassert & Sward (2007)	EMR	• Utah Clinical Academic Record Excellence (UCARE) is the name of the Cerner AES system installed for use in first semester undergraduate courses • Hosted remotely • Application that simulates a clinical information system using Cerner's PowerChart® • Has an academic overlay that provides students with prompts and evidence-based practice information as they learn to document assessments and simulated patient events • Three schools share a domain server and databases hosted at Cerner headquarters but each has a unique username and established structure
Kennedy et al. (2007)	EHR	• A modified EHR • Visual prompts provided by the technology
Lea et al. (2008)	EMR	• Use TPP SystmOne - one of the main systems students will meet on their clinical placements
Litt &	Digital patient record; "Visual Chart";	• Digital patient record is divided into four "browsers" for notes, orders and consults, lab

Paper	IT Type	IT Description
Loonsk (1993)	"Medical Desktop"	tests, and radiological studies • Browsers written in Microsoft® Visual Basic and have two parts: selection of what to view and display of clinical information • Programs are represented as separate clickable applications • Digital patient record works with other software • Developed a "Visual Chart" for case presentation and patient information presentation that integrates different types of medical information • "Medical Desktop" assembles many medical reference tools and makes them accessible through the same Windows interface used in the digital patient record
Madden & Hanberg (2009)	EHR	• Cerner AES fully functional EHR system with an academic overlay implemented with a consortium of schools • High-fidelity EHR simulator
Melo & Carlton (2008)	EHR; E-MAR; mobile wireless computing POC devices	• Hospital uses an electronic medication administration record (E-MAR) that includes a software solution from McKesson called Horizon AdminRX • Implemented a wireless infrastructure for the simulated care areas in the Learning Resource Centre • Installed PCs with the hospital's EHR software and connected to the hospital's live systems using an existing fiber-optic connection • Also have examples of POC wireless devices
Morrow et al. (2009)	EHR	• Use Epic EHR system with test patients
Muma & Niebuhr (1997)	EPR	• EPR with simulated patients
Naeymi-Rad et al. (1994)	EMR; Off-the-shelf software: Microsoft® Excel, Lotus 123, WordPerfect, Microsoft® Word, Dbase, Hypercard, Oracle® SQL; decision support programs: MEDAS, QMR, Dxplain, Iliad, PKC, Drug Advisor	• Intelligent Medical Record-Entry system (IMR-E) developed at the Chicago Medical School to computerize the collection and generation of a medical encounter case report • Provides a reminder vehicle to ensure students don't forget to ask important questions • Students use a Mac PowerBook during rotations and IMR-E enables the student to store patient data gathered on the local server at the hospital in a time series data representation- able to manage multi-encounter patient records on the one network • Has a file server (Max AUX), database management software (Oracle® 7), communication protocol (AppleShare), client systems (PCs and Macs) • Hospital site is connected to the server at the medical school so staff can provide documents to students at sites and monitor students' clinical experience at the site

Paper	IT Type	IT Description
		• IMR-E is uses passwords to protect patient confidentiality • Also use many other HIS and IT tools including an EMR
Nickitas et al. (2010)	EHRS, CPRS, BCMA system	• Veterans' Administration electronic health record system (EHRS) has two elements: the CPR system (CPRS) and the Bar Code Medication Administration (BCMA) system • Purchased 10 laptops and a BCMA scanner • Wired the college laboratory to have Internet access to the VA EHRS • Faculty used a VPN client to log-in
Okada et al. (2007)	EPR	• EPR Laboratory is a computer-based learning system • When students fail a test the system shows which questions weren't answered correctly and guides them to relevant materials as specified in the programming • Developed using Cache 5.0.11 (InterSystems) • Set up in a computer room with one web server and 140 client PCs • Used only for educational purposes and not a full-fledged EPR system • Two levels of access mode: record administrator and doctor
Speedie & Niewoehner (2003)	EMR	• The Minnesota Virtual Clinic is a web-based educational tool using a simulated EMR to expose students to critical basic science and clinical concepts in the context of patient care • Underlying tools facilitate educational links for any item of information from simple popup windows for definitions to illustrative student exercises • System details the patient's demographic information, past medical history, family history, social history, and progress notes, problem lists, lab tests, medications, and radiologic images • Software provides mechanisms for educational links for any patient item
Stahl (2000)	EPR	• Commercial EPR software - the MD-Miranda is used for the patient database • Server is available to the workstations within the LAN but also to remote workstations over the TCP/IP protocol • Have a project website to spread information and introduce potential users to the project • Planning a forum and chat
Stephens & Williams (2010)	EMR	• The Armed Forces Health Longitudinal Technology Application (AHLTA) allows for integrated documentation of clinical care and has an embedded coding feature for recording clinical workload on and individual or an institutional level • AHLTA training simulator is on laptop

Paper	IT Type	IT Description
Taylor et al. (2007)	EPR; PACS; Microsoft® PowerPoint; Internet	• EPR used • Clinical space has a central teaching station that includes a fully-functional operatory; overhead, intra-oral and document cameras, DVD and VCR players, and computer video output for displaying MS PowerPoint or internet resources • All lectures are digitally recorded and archived and accessible to students at any time • Each of the 43 operatories has a mannequin/torso with dentoform, a mulimedia monitor controlled from the teaching station is mounted on each dental chair • each operatory also has a networked computer: blade PC system thin-client and RDP access to a CPU and allows up to 4 thin client RDP connections
Weber (2004)	EMR	• An adaptation of Cerner's PowerChart® clinical information system

Appendix E -
Topics Addressed in UVic Undergraduate Health Information Science Courses

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
HINF 130 - Introduction to Health Information Technology (Fall 2009)	bioinformatics	long-term impact of IT on society		communications theory; organization theory	research	health information management; information theory	spreadsheets; databases; medical graphs; multi-media medical information systems; acute care physiological signal processing; diagnostic expert system; design; community health information systems; health information networks; systems theory; security issues; computer-based patient records; patient-care systems; imaging systems; information retrieval systems; e-health applications; clinical decision support tools; usability

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
HINF 130 Lab (Fall 2009)						data modeling	health informatics decision support models; Telnet, FTP, operating systems, spreadsheets, databases
HINF 140 - The Governance and Structure of Health Care Systems (Spring 2010)	health; illness; chronic and communicable diseases; environmental and occupational health; community health	healthcare governance at the local, provincial, national and international levels; Canadian health care system with comparison to US and Great Britain; international health care policy development, administration, and management; national health insurance; healthcare reform; issues; healthcare system: structure, history, funding, professionals		healthcare professionals; healthcare institutions			

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
HINF 200 - Principles of Health Database Design (Fall 2009)						conceptual database design; database use, trends, management issues	development of database applications for health data; implementation and physical database design to support health information systems; current technologies
HINF 200 Lab (Fall 2009)							database design: DBMS, Microsoft® Access, SQL, VBA
HINF 201 - Database Management and Development for Health Care Systems (Spring 2010)					reporting	database background; data modeling	SQL; database management system (e.g. Oracle®); architecture of database management system; design, implementation, maintenance, and administration of database; database applications; programming; data entry and storage

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
HINF 230 - Organizational Behaviour and Change Management (Fall 2009)				management of individual, group, and intergroup behaviour in health care organizations; decision making and problem solving; work groups; leadership; power and influence; labour relations; process engineering; risk management; communication; change management			
HINF 265 - Health Care Delivery Organization (Spring 2010)		command and control in healthcare versus other industries; governance and integrated delivery system models; components of health care system; inter-relationships and inter-dependencies;		health organization management and finance; organization theory; power and culture; division of labour; types of organizations; types of staff			

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
		trends and issues					
HINF 265 Lab (Spring 2010)	MIS guidelines; case mix costing; CIHI grouper methodologies			financial accounting; management accounting; budgets; inventory control; cost accounting	financial analysis; reporting management		management and financial information systems
HINF 280 - Biomedical Fundamentals (Spring 2010)	principles of biochemistry, cell biology, organ physiology, pathology; integrated functions of physiological systems: nervous, endocrine, muscular, cardiovascular, respiratory;			coordinate and communicate health information; organizational structure			information system

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
	bioinformatics; disease; anatomical and medical terminology; medical decision-making						
HINF 310 - Electronic Records and Decision Support Systems (Summer 2009)					critical analysis of automation of clinical data acquisition, processing, and storage	health plans	electronic health records; departmental systems (e.g. lab, pharmacy, intensive care); PACS; computerized physician order entry (CPOE); clinical data repositories; personal health records; data warehouses; components/features of electronic records

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
HINF 310 Lab (Summer 2009)						MEDLINE; coding and healthcare classifications: ICD-9, ICD-10, CCI; nomenclatures; taxonomies: SNOMED-CT; UMLS; LOINC; medical forms; datasets	decision-support systems; EHRs; EMRs; MEDCIN software; medical communications
HINF 320 - Project Management (Fall 2009)			project management and the project life cycle in healthcare; project processes; project charter; network diagramming; scope management; stakeholder identification; cost management; risk; change management; scheduling	project management tasks in health care organizations			project management tools and techniques
HINF 320 Lab (Fall 2009)			health informatics system project				Microsoft® Project

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
HINF 330 - Legal Issues in Health Informatics (Summer 2009)		confidentiality; privacy; legal liability of software systems; contractual issues; legal terminology; reasoning; basic principles of law which apply to and govern health systems in Canada; policies; legal issues for health information					
HINF 335 - Health Information Standards (Fall 2008)				socio-organizational implications of health information standards		data, messaging and terminology standards: meta-data schemas, HL7v2.X, HL7v3, HL7-CDA, CCR, CCD, DICOM, ICD10, LOINC, SNOMED CT, archetypes and nursing terminologies; historical evolution and lifecycle; modeling	

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
						techniques for health databases	
HINF 345 - Networks, Interoperability and Systems Security (Summer 2009)							data communications technology; networks; distributed processing; impact of emerging communications technology on health information systems; telehealth; home healthcare monitoring; pervasive computing; communication models and protocols; communication techniques; communication system design; interoperability;

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
							security
HINF 345 Lab (Summer 2009)							data communications and computer networking
HINF 350 - Human Aspects of Healthcare Information Systems (Fall 2009)	use of technology to support clinical decision making and decrease errors; cognitive processes; decision making and reasoning; patient safety; evidence-based medicine			human cognition; socio-technical approaches; system adoption	workflow analysis; evaluation	information retrieval; human aspects of health informatics	human-computer interaction; usability engineering; human aspects in design

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
HINF 351 - Information Technology Procurement (Summer 2009)	clinical point of view for selecting IT to support patient care	Regional Health Authority (RHA) procurement of IT; EHR journeys		selection of IT; RFPs; system vendors	evaluation methodology for system selection		
HINF 371 - Clinical Methodologies (Summer 2009)	clinical decision making in diagnosis, treatment, planning and prognosis; alternate models for decision making using subjective and objective data and information; case based reasoning; clinical practice guidelines			decision-making for developing IT solutions			
HINF 381 - Epidemiology, Population Health and Public Health (Fall 2009)	surveillance systems of infectious diseases, population health, health promotion, disease prevention issues	health policy planning			epidemiology: concepts, principles, methods, history, measures of morbidity and mortality; measurements of disease occurrence, study designs		

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
HINF 381 Lab (Fall 2009)					epidemiology; data analysis; statistics	data management and presentation	
HINF 410 - Information Management and Technology (Spring 2010)		IM&T principles for public and private sector; IT application to Canadian health care organizations		issues for CIOs to provide right information to right people at right time and at right price; supporting roles of IT in organizations; strategic and operational needs; issues for information system departments; CIO and CEO responsibilities		IM&T principles and methods	
HINF 420 - Societal and Ethical Implications of Technology (Spring 2010)		systemic, societal and ethical implications of computer-based IT; individual, regional and global perspectives: privacy, access to information, autonomy, education, health		issues related to IT professionals			security

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
HINF 450 - Health Information System Design (Spring 2010)			design, implementation, maintenance and replacement of complex information systems	role of systems design in healthcare environments; workflow; reasons for success/failure			computerized patient records systems to decision-support systems; technical principles; modern systems analysis and design; systems development lifecycle models; object-oriented methods, human-computer interaction; usability engineering
HINF 450 Lab (Spring 2010)					problem-solving skills for system analysis and design for health informatics	diagramming standards	system design techniques; object-oriented techniques; UML; prototype creation
HINF 461 - System Evaluation and Quality Improvement (Spring 2010)					formative and summative evaluation, quantitative and qualitative methods, developing performance metrics, total quality management (TQM), core principles of clinical quality		

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
					improvement (CQI). balanced scorecards and dashboards; workflow analysis		
HINF 470 - Trends in Health Informatics (Spring 2010)	evidence-based medicine	consumer empowerment and consumer health informatics; changing the relationship between consumers and providers; ergonomics; patient empowerment and safety; globalization of healthcare; pervasive computing; national, regional and		diversity training and cultural competence		efficacy of medical information available from websites; data mining and knowledge discovery; standards	eHealth applications; geospatial technologies; security

Course	Clinical & Health Services	Canadian Health System	Project Management	Organizational & Behavioural Management	Analysis & Evaluation	Information Management	Information Technology
		provincial initiatives; governance; contribution of private sector; privacy; confidentiality					

Appendix F -
Teaching Approaches Used in UVic Undergraduate Health Information Science Courses

Course	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
HINF 130 - Introduction to Health Information Technology (Fall 2009)	lecture	interactive class environment; class discussions	pre-class readings; chapter summaries		tests
HINF 130 Lab (Fall 2009)	lecture		pre-class readings; individual assignments	lab; hands-on exercises	quizzes
HINF 140 - The Governance and Structure of Health Care Systems (Spring 2010)	lecture		pre-class readings		quizzes; tests; final exam
HINF 200 - Principles of Health Database Design (Fall 2009)	seminar	interactive class environment; group project	assignments; individual practice and study	hands-on learning exercises	quizzes; group project; assignments; midterm exam; final exam; lab
HINF 200 Lab (Fall 2009)	lecture; demonstration		pre-class readings; assignments	hands-on exercises	exercises/assignmen ts
HINF 201 - Database Management and Development for Health Care Systems (Spring 2010)		group project		lab; hands-on (explore database architecture, construct database, maintain and administer database; develop prototype database	group project; attendance and quizzes; midterm exam; final exam

Course	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
				application); exercises	
HINF 230 - Organizational Behaviour and Change Management (Fall 2009)	lecture	group discussion; group presentation	individual assignment	case studies	midterm exam; individual assignment; group presentation; final exam
HINF 265 - Health Care Delivery Organization (Spring 2010)	lecture	class discussions; group assignment (presentation and paper)	pre-class readings	case studies; in-class exercises	midterm exam; final exam; assignment (presentation and paper); lab
HINF 265 Lab (Spring 2010)		assignment/project		lab	tests; assignment/project
HINF 280 - Biomedical Fundamentals (Spring 2010)	instructor presentation	group project (website review, business case); student presentation; student driven review of course material		project (prototype creation); case study	quizzes; project work; final exam
HINF 310 - Electronic Records and Decision Support Systems (Summer 2009)	seminar; guest lectures	interactive class environment; group project	assignments; individual practice and study	exercises	quizzes; group project; assignments; midterm exam; final exam; lab

Course	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
HINF 310 Lab (Summer 2009)	lecture; examples; instructor presentations	class discussions	assignments	hands-on exercises	assignments; tests
HINF 320 - Project Management (Fall 2009)	lecture	individual presentation; interactive class participation; instructor, self, and peer feedback	individual assignment		individual presentation; individual assignments; midterm exam; final exam; lab (group project and presentation)
HINF 320 Lab (Fall 2009)		group discussions; individual presentations; group project and presentation		hands-on lab exercises; project or running case (project notebook, project website, progress reports); project team roles	tests; group project
HINF 330 - Legal Issues in Health Informatics (Summer 2009)	guest lecture	interactive lecture; class discussion	pre-class readings	case studies	midterm exam; final exam
HINF 335 - Health Information Standards (Fall 2008)	lecture	group discussions; student team presentations	short essays; term paper	weekly class activities; hands-on exercises	assignments; team presentation; term paper
HINF 345 - Networks, Interoperability and Systems Security (Summer 2009)	lecture		pre-class readings; assignments	case studies	case study; midterm exam; final exam; lab
HINF 345 Lab (Summer 2009)	instructions	group work		group hands-on exercises and case study	assignments; quizzes

Course	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
HINF 350 - Human Aspects of Healthcare Information Systems (Fall 2009)	lecture; guest lectures	interactive class environment; group project (presentation)	pre-class readings; individual assignments	case studies; group project (web portal analysis)	individual assignments; group project; final exam essay
HINF 351 - Information Technology Procurement (Summer 2009)	lecture; guest lectures	teams; interactive class environment	pre-class readings	simulation/role-play (health care organization IT procurement); exercises	team assignments; final exam
HINF 371 - Clinical Methodologies (Summer 2009)	presentation of material; guest presentation	group paper; discussion	term paper	activity	group papers; term paper
HINF 381 - Epidemiology, Population Health and Public Health (Fall 2009)	lecture	class discussions		exercises; case studies	quiz; tests
HINF 381 Lab (Fall 2009)	lecture		pre-class readings	hands-on exercises (data analysis)	quizzes/assignments
HINF 410 - Information Management and Technology (Spring 2010)	lecture	interactive class environment; class discussions	pre-class readings	case studies; in-class exercises	midterm exam; final exam; assignments
HINF 420 - Societal and Ethical Implications of Technology (Spring 2010)		intensive discussions; small group sessions	pre-class readings; term paper		quizzes; discussion facilitation; tests; term paper
HINF 450 - Health Information System Design (Spring 2010)	lecture; guest lectures	interactive class environment; project	pre-class readings		lab; project; midterm exam; final exam

Course	Instructor Centered	Interactive	Individualized	Experiential Learning Methods	Assessment
HINF 450 Lab (Spring 2010)	demonstration	team project	self-paced tutorials; individual assignments	problem sets; team project (build prototype)	assignments; project
HINF 461 - System Evaluation and Quality Improvement (Spring 2010)	lecture; guest lectures	interactive class environment; project	pre-class readings		project; midterm exam; final exam
HINF 470 - Trends in Health Informatics (Spring 2010)	lecture; guest presentations	group project and presentations	term paper; topical research and analysis		term paper; group project and presentation; topical research and analysis; participation

Sources: Course outlines available from: http://hinf.uvic.ca/courses/index.php (Note: outlines are changed when new terms begin.)

Appendix G - IT Use in UVic Undergraduate Health Information Science Courses

Course	General IT	IT to Support Learning	Real-world IT
HINF 130 - Introduction to Health Information Technology (Fall 2009)			
HINF 130 Lab (Fall 2009)	Internet		telnet; FTP; UNIX; Microsoft® Excel; Microsoft® Access
HINF 140 - The Governance and Structure of Health Care Systems (Spring 2010)	Internet		
HINF 200 - Principles of Health Database Design (Fall 2009)	Internet		
HINF 200 Lab (Fall 2009)	Internet		SQL; Microsoft® Access; VBA
HINF 201 - Database Management and Development for Health Care Systems (Spring 2010)	Internet		Oracle® 10G; SQL
HINF 230 - Organizational Behaviour and Change Management (Fall 2009)			
HINF 265 - Health Care Delivery Organization (Spring 2010)	Microsoft® PowerPoint and Microsoft® Word presentations; Internet		
HINF 265 Lab (Spring 2010)			
HINF 280 - Biomedical Fundamentals (Spring 2010)	Internet (website review); computers (note taking and information source)	Moodle	application (evaluation)
HINF 310 - Electronic Records and Decision Support Systems			
HINF 310 Lab (Summer 2009)	Internet		EHR software "MEDCIN"; MEDLINE
HINF 320 - Project Management (Fall			

Course	General IT	IT to Support Learning	Real-world IT
2009)			
HINF 320 Lab (Fall 2009)	Internet (create website)		Microsoft® Project
HINF 330 - Legal Issues in Health Informatics (Summer 2009)			
HINF 335 - Health Information Standards (Fall 2008)	e-mail; Internet		CliniClue software; 7Edit software; HL7 V3 tools; XML editing tool
HINF 345 - Networks, Interoperability and Systems Security (Summer 2009)			
HINF 345 Lab (Summer 2009)			Microsoft® Excel; VBA
HINF 350 - Human Aspects of Healthcare Information Systems (Fall 2009)		Blackboard; videos	Online tools
HINF 351 - Information Technology Procurement (Summer 2009)			
HINF 371 - Clinical Methodologies (Summer 2009)	computers (note taking and information source)		
HINF 381 - Epidemiology, Population Health and Public Health (Fall 2009)			
HINF 381 Lab (Fall 2009)			Microsoft® Excel; SAS; Epi Info™; Epi Map
HINF 410 - Information Management and Technology (Spring 2010)	Microsoft® PowerPoint and Microsoft® Word presentations; Internet		
HINF 420 - Societal and Ethical Implications of Technology (Spring 2010)			
HINF 450 - Health Information System Design (Spring 2010)	computer-based aids		
HINF 450 Lab (Spring 2010)	Microsoft® Visio		

Course	General IT	IT to Support Learning	Real-world IT
HINF 461 - System Evaluation and Quality Improvement (Spring 2010)			
HINF 470 - Trends in Health Informatics (Spring 2010)	Microsoft® PowerPoint		

Appendix H –
Instructor Interview Script

Subject: ____________

This research pertains to the integration of instructional technology for health informatics education. There are two parts of this interview and I don't anticipate it will take more than an hour of your time.

I will be audio recording this interview for later analysis to ensure I don't miss anything. Your responses will be kept anonymous in my final thesis.

The first few questions are about your teaching experiences.

1. Please indicate your position with the School of Health Information Science
   a. Regular Faculty
   b. Adjunct Faculty
   c. Lab Instructor
   d. Other: _____________________

2. Approximately how long have you been a health informatics professional/educator?
   a. < 1 year
   b. 1 – 5 years
   c. 6 – 10 years
   d. 11+ years

3. Approximately how long have you been teaching courses in health informatics?
   a. < 1 year
   b. 1 – 5 years
   c. 6 – 10 years
   d. 11+ years

4. How would you describe an electronic medical record (EMR)?

Thank you. The term EMR is often used interchangeably with electronic health record (EHR), electronic patient record (EPR), computer-based patient record (CPR), and many others. For this research, I am focusing on the Canadian context and am using the following definition: electronic medical records (EMRs) refer to electronic records maintained within a clinic or private practitioner's office.

5. What courses have you taught that included content related to electronic medical records (e.g. HINF 450 – Systems Analysis and Design)?

6. What kinds of learning activities/approaches have you used in the courses with EMR content? For example, how is a typical class session structured?
   a. Have your students had any hands-on learning with any instructional technology tools?
   b. Have your students had any hands-on learning with electronic record systems (e.g. EMRs, EHRs, etc.)?
   c. If yes, how and what have been your experiences with these activities?
   d. If no, why not?

7. Competencies are the skills and knowledge that students should obtain through their studies. What competencies (health, information, and management sciences) do you think students should have regarding EMRs in the courses you teach? Feel free to refer to your course outlines.

8. COACH, Canada's Health Informatics Association, has developed a set of core competencies for health informatics that are divided into three areas – health sciences, information sciences, and management sciences. Within each of these areas there are specific competencies as listed here <<Show list of COACH competencies, available from http://www.coachorg.com/career_development/professionalism/core_competencies.htm>>. Do any of these stand out as being directly related to EMRs in your teaching? As we go through them, please stop if you think one is and tell me how the competency relates to EMRs in a course you teach. That is, how do you refer to EMRs when addressing the competency?

9. Would you consider having students use specific EMR instructional technology in your teaching of EMR concepts?
    a. If yes, why?
    b. If no, why not? What are your concerns?

Recently a portal was developed, allowing students to use real EMRs that have been modified for educational use. Here is a brief overview of one EMR. <<Show the selected EMR>>

10. What are your thoughts on incorporating an EMR like this into your lessons?

11. <<if positive>> What are some way in which you might incorporate it? i.e. How might you use it?

12. <<if positive>> What would you need to consider when planning a lesson using the EMR?

13. <<if negative>> What factors influence your decision to use a tool like this?

Thank you very much for your time today. Do you have any additional comments or questions?

Appendix I – Phase 1 and 2 Analysis Procedure

The following analysis occurred after instructor interviews and student focus groups.

Step 1: Each interview and focus group session was fully transcribed. Line numbers were added to the transcript.

Step 2: A Microsoft Excel® spreadsheet was created for items to be listed in the first column and a new column for each data source (i.e. transcripts).

Step 3: In the first coding pass, all new items were identified and line numbers were inserted into the spreadsheet. As portions were coded, they were highlighted in green in the transcript to ensure completeness.

Sample excerpt from a student focus group transcript:

297 even just to umm kind of click around it and see the different values that are there. Umm and
298 see the different data that it can capture and how it would be used by a physician. Just kind of
299 exploring it.

300 S4: Yeah.

301 R: Okay. Next.

302 S2: Yeah, I share a lot of thoughts with <<S1>>. I think it would be interesting to just play
303 around with it. But also interesting if uhh with using this we also could, were exposed to what
304 they're doing with paper chart so we can sort of compare, compare the two. Umm, you know,
305 it'd be interesting if there was a tool like this that was longitudinal throughout the program. So
306 in the first year we're exposed to it and then, you know, if we had access to the back end we
307 could see how the database works on this tool <<S4 nods yes>> and then later on like <<S1>>

Portion of the spreadsheet with section corresponding to above transcript enlarged:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
179										SFG1								SFG2					
180				I1	Quotes	I2	Quotes	I3	Quotes	S1	Quotes	S2	Quotes	S3	Quotes	S4	Quotes	S5	Quotes	S6	Quotes	S7	Quotes
181	**Integration**																						
182	**Thoughts on using EMRs in teaching/learning**																						
183		Yes				x	238-240; 312-314	x	335; 425-426; 475-476	x	286	x	574-575	x	117-118	x	117-118	x	141; 190-191; 197-198; 287-	x	209-211	x	165-166; 185; 248
184			Desire to incorporate	x	49-51; 56-59; 435-437																		
185			Need	x	56-57; 90-92									x	581-582			x	259-262				
186		No																					
187																							
188	**When to integrate**																						
189		Program						x	405-409; 415-419; 470-472	x	300-304; 461-463; 490-492	x	296-301	x	300-308; 317	x	300-306						
190			1st year							x	457-463	x	297-299; 468			x	27-30					x	164-167; 170; 228-
191			2nd-3rd year									x	468-469			x	352	x	141-147; 214-222; 259-262	x	209-211	x	229-232
192			4th year									x	309; 499										
193		Courses				x	38-39			x	490; 661-669	x	661-670	x	490-491; 661-669	x	318; 551-552; 661-669						
194			specfic course							x	542-545			x	525-527; 533-534;	x	542-546						
195		Before Co-op														x	634-637	x	266-269	x	209-213	x	173-174; 231-232
196		After Co-op												x	618-621								
197	**Suggested Teaching Approaches**																						
198		Exercises/Assignments						x	436-442; 460-468	x	287-288; 321-322					x	417						
199			Analysis	x	535-539; 541-543																		
200			Comparisons									x	295-296										
201			Case Study			x	318-319; 327-331; 350-352					x	54-55	x	54-56; 426-429	x	54-56; 352-354; 366-370; 424-425; 602-603					x	234-238
202			Student Use In-class	x	552-562																		
203		Group Work/Projects						x	436-442	x	564-566			x	42; 564-568	x	41-42						
204		Integrated Activities		x	541-543									x	422-425; 481-486	x	422-425; 479-485; 600-605						
205		Interactive Class/ Discussion								x	214-215; 217-218; 564-566			x	564-568	x	41-42; 214-215						
206		Lab						x	66-67					x	37; 426-427; 525-527; 583-587; 590-	x	426-427; 585-589						
207		Lecture																					
208			Demonstrations/ Examples	x	514-519; 582-591					x	341-343					x	27-30; 551-552; 602					x	228-229
209			Guest Lectures							x	120-123; 134-137; 659-660			x	120-123; 134-136	x	120-128; 134-136						
210		Presentations														x	424-425						
211			Role-play							x	378-383					x	378-384						
212			Videos	x	582-291																		
213		Readings/Reviews																					
214			Student Research			x	328-337			x	157-163	x	157-160										
215		Self-directed																					
216			Play-with/Explore	x	553-562			x	433-434; 459-461	x	289-291; 341-343	x	294-295	x	342-346	x	117-120; 290-292; 352-354			x	178-181		
217	**Topics related to EMRs**																						
218		Health Informatics																					
219			Current Events/Trends							x	211-218; 675; 685-686	x	50-51; 295-296; 685-686	x	217-218; 681-688	x	51; 211-215; 678-689	x	259	x	249-255		
220			Theory							x	217-220			x	581-582	x	600-602						
221		Health Information Systems								x	574-580	x	574-579	x	547-580	x	574-580; 585-589						
222			EMR (scope)							x	164-165; 661-669	x	164-165; 661-669	x	164-166; 661-669	x	27-31; 164-165; 506; 661-669			x	20		
			Benefits							x	157-165	x	157-165	x	157-166	x	30-31; 164-			x	253-254		

Self-directed												
	Play-with/Explore	x	553-562			x	433-434; 459-461	x	289-291; 341-343	x	294-295	x

Step 4: Items in the first column were grouped logically based on the codes.

Appendix J - Student Focus Group Script

Group Number: ____________

Welcome to today's focus group.

In today's session I'd like to get your input on the types of learning activities you've completed in your HINF courses and get your ideas on using a new EMR tool for learning. I hope it will be fun and informative.

Before we get into the focus group, I'd just like to mention a few things. The purpose of holding this focus group session is to generate discussion and gather ideas. I don't anticipate there will be any problems but I'd just like to remind everyone to be respectful of each other and acknowledge that differing opinions may be shared. To protect confidentiality as much as possible, all information shared today should not be discussed outside this session. Everyone here has signed the letter of consent. Are there any questions?

Second, I will be audio and video recording the session for later analysis and recording the screen to help identify which parts of the EMR the comments were associated with. Your responses will be made anonymous in my final thesis.

This is a small group and I'd like everyone to take part. Let's begin by quickly going around the room and introducing ourselves. Please say a quick hello and what your favourite course in the program is or was.

Great, thanks. Let's begin! (I will now begin recording.)

1. How would you describe an electronic medical record (EMR) to someone who has never heard of one in one or two sentences?

Thank you. The term EMR is often used interchangeably with electronic health record (EHR), electronic patient record (EPR), computer-based patient record (CPR), and many others. For this research, I am focusing on the Canadian context and am using the following definition: electronic medical records (EMRs) refer to electronic records maintained within a clinic or private practitioner's office.

2. What kind of knowledge and skills do you think you need to learn about regarding EMRs?

3. What kinds of activities have you done in classes when learning about EMRs or health information systems in general?

4. Is there any knowledge or skill related to EMRs that you would like to learn more about in class in the areas of health, information or management sciences?

Here's a new tool that was developed recently. It includes several systems including EMRs that can be used by students like to you in your learning. Let's take a walk through it together to see some of the features. At any time during the demonstration, if you have any questions or comments please feel free to interrupt me.

5. What are you general thoughts on using a tool like this in your learning?

6. How could it be used for your education?

7. Do you see any potential benefits for learning or have any concerns?

8. Do you have any ideas for when and where it would be most appropriate to use?
    a. At what point in the program would it be best to introduce the tool?
    b. What sorts of activities would it fit well with or not so well with?

9. Does anyone have any additional questions or comments they’d like to share?

This concludes the focus group. Thank you very much for your participation and feedback. I hope you enjoyed it.

Appendix K –
Instructor Focus Group Script

Welcome to today's focus group. As you know, I have been researching the integration of EMRs into health informatics course work. As a result of my previous work, several themes have emerged surrounding integration. In today's session I will present these and ask you some open-ended questions to generate discussion and feedback. I hope it will be fun and informative.

Before we get into the focus group, I'd just like to mention a few things. The purpose of holding this focus group session is to generate discussion and gather ideas. I don't anticipate there will be any problems but I'd just like to remind everyone to be respectful of each other and acknowledge that differing opinions may be shared. To protect confidentiality as much as possible, all information shared today should not be discussed outside this session. Everyone here signed a letter of consent prior to the individual interviews that still applies here today. Are there any questions?

Second, I will be audio and video recording the session for later analysis and recording the screen to help identify which parts of the EMR the comments were associated with. Your responses will be made anonymous in my final thesis.

This is a small group and I'd like everyone to take part. Let's begin by quickly going around the room and introducing ourselves. Please say a quick hello and what aspect or topic of health informatics you're most interested in.

Great, thanks. The way this session will work is that I will present the information I've found from individual interviews with instructors and focus groups with students and we will discuss it as a group. I've also given each of you a worksheet. After the group discussion, I'd like you to individually record your answers to questions and hand them in to me at the end. (I will now begin recording.)

<<Put up slides of themes in categories>>

1. The following are lists of items generated from earlier interviews and research that may need to be considered when integrating the EMR into course work. These are complete lists of everything that was mentioned grouped into some larger categories for your feedback.
   A.
   B.
   C.
   D.
   E.

Let's go through them one at time.

Do you agree the item is important for integrating EMRs into health informatics education? Should the item be considered first or before others?

Now please fill in your worksheets.

5=strongly agree, 4=agree, 3=neutral, 2=disagree, 1=strongly disagree. The extra line beside each item is to enter a brief comment about your reasoning if you wish to elaborate.

Also, please indicate if each item is applicable for the undergraduate program or graduate program or both by placing a check mark in the column(s).

2. Finally, I'd like to get your feedback on how these items fit together logically. Do some items have something in common or overlap at all?

For each category, the items which resulted from my research have been grouped together. We'll go through each category one at a time on the screen and I'd like your feedback on what you think of where items belong.

Again on your worksheet feel free to note any logical groupings you see and any explanations.

3. Is there anything else you'd like to add that would help you in using the EMR tool in your teaching?

This concludes the focus group. Thank you very much for your participation and feedback.

Appendix L – Phase 3 Analysis Procedure

The following analysis occurred after instructor focus groups.

Step 1: The focus group session was fully transcribed. Line numbers were added to the transcript.

Example excerpt from the instructor mini-focus group transcript:

I3: A related word would be it's the architecture.

I2: Architecture, yeah.

I3: Tie them all together.

R: So you're saying architecture is not part of the back-end. That's its own piece?

I2: I think so. <<I3 nods yes>> I would say it's so critical that umm critical that I think it needs to be separate.

R: So if you're looking at the architecture of the system, you're looking at it outside the system? How the system fits into the architecture? I'm just trying to understand.

I3: <<motions on the screen around the two boxes>> I can see that as sort of architecture circles.

R: I'm going to do that…

I1: Covering all of them.

I3: Yeah, sort of a circle or box around that. <<draws box around both groupings>>

R: So that would be architecture you said. <<adds box on border labeled 'architecture'>>

I3: Which then you <<to I2>> will need integration as part of that architecture design.

Step 2: The Microsoft Excel® spreadsheet created after Phase 2 was re-opened and new columns added for each new data source (i.e. worksheets and transcripts).

Step 3: The new data sources were coded using the existing code set. The set of codes were refined or added as needed. The number of participants mentioning an items were tallied to identify the most mentioned items for discussion.

Portion of the spreadsheet with section showing code refinement:

96			Student Designed	
97			Integrated Activities	
98	EMR Parts - Technology			
99		Architecture (+)		
00			Back-end	
01				Code
02				Data
03				Design
04			Interface	
05				Features
06				Information Pull
07				Information Push
08	Integration			
09		Considerations		
10			Course	
11				Appropriate Cases/Tasks
12				Balance and Focus

Step 4: The resulting spreadsheet contained references to all data sources where items were coded. To facilitate comparisons planned in Table 2, the exact quotes for each reference (instructors and students) were extracted from the transcripts into one Microsoft Word® document for each major grouping.

		computer side. S7: Umm I'm interested in more the management side, bridging the gap between the health and management more so than the actual computer, to do with like computer database.			
Paper Chart	S13: Umm well for basically since in HINF 130 we just compared it to the paper records. And just the similarities and differences and which one is better and how is it better. Just yeah, the basics.	S2: with it. But also interesting if uhh with using this we also could, were exposed to what they're doing with paper chart so we can sort of compare, compare the two. Umm, you know, it'd be S13: Oh. I think before the first Co-op so it umm, like in our first HINF 130 is good enough where you just get an introduction, basically a description of what is an EMR. And it's good how like they, they get a relation between the patient records but maybe in 2nd year you should S13: But when I first just looked at it, the first thing was oh, it would be easier if I just do it with paper 'cause it just looked way too confusing. And just the way it was presented and like the screen was- it just looked overwhelming and not very. I don't know it wasn't very colourful, I didn't...	4.40	y	I4: Need to understand business process before automating it I5: is this relevant? I6: Very important to understand where one comes from
Patient and Health Information and Data	S9: and we were looking at that one system Oscar and like just umm seeing how the data is put in. I I1: Some of them certainly did and uhh umm I feel that a reasonable goal should be for that course to be connected with analyzing and umm a demonstration of electronic medical	S1: medical record and then from the information sciences perspective umm learning what information umm, patient information is specifically put into an electronic medical record and how it's used. And I don't know where, what category this would fit into but like have a more,	4.83	y	

Step 5: The investigator reviewed all quotes pertaining to each item within each grouping in order to summarize the results.

Appendix M - Instructor Responses for COACH Competencies Addressed in Teaching and Related to EMRs

The list of competencies is available in *Health Informatics Professional Core Competencies Version 2.0* (COACH, 2009). List reprinted with permission.

Key:
The columns I1 to I6 represent each instructor participant.
Y = Yes, it is related.
N = No, it is not related.
S = It is somewhat related.

		Does the competency stand out as being directly related to EMRs in your teaching?					
	The Health Informatics (HI) Professional:	I1	I2	I3	I4	I5	I6
A1. Information Management							
1.1	Contributes to and advocates for the management of information as a key strategic resource.	N	Y	Y	Y	Y	N
1.2	Applies information management principles and best practices (e.g. Canadian Health Information Management Association practices).	N	N	N	N	Y	Y
1.3	Assesses the key attributes of data and information (e.g., quality, integrity, accuracy, timeliness, appropriateness) and their limitations within the context of intended use (e.g., clinical and analytical uses).	Y	S	S	Y	Y	Y
1.4	Determines appropriate data sources and gaps in data sources in relation to identified business needs.	S	S	Y	Y	Y	Y
1.5	Demonstrates an understanding of the data interrelationships and dependencies among the various health information systems (e.g., decision support systems, electronic health records, order entry, etc.).	Y	N	S	Y	Y	Y
1.6	Demonstrates an understanding of the implications of: i. current legislation ii. medical, professional, ethical, and legal obligations iii. guidelines relating to privacy, confidentiality and security of health information.	N	N	N	N	Y	Y
1.7	Applies accepted policies, principles and guidelines for the collection, use, disclosure, access to, protection and	N	N	N	N	Y	Y

	destruction of health information (e.g., COACH Guidelines for the Protection of Health Information).						
1.8	Demonstrates knowledge of relevant health information standards and their appropriate use (e.g., classifications, vocabularies, nomenclature, etc.).	S	Y	Y	Y	Y	N
A2. Information Technology							
2.1	Understands key information technology concepts and components (e.g., networks, storage devices, operating systems, information retrieval, data warehousing, application, firewalls, etc.) and their interrelationships.	N	N	Y	N	N	N
2.2	Identifies all relevant stakeholders and their roles throughout the system development life cycle.	S	S	Y	Y	N	Y
2.3	Applies appropriate methods of identifying information, business and technical requirements to meet the full range of stakeholder's information needs.	N	Y	Y	Y	N	Y
2.4	Participates in the selection and utilization of appropriate information technology tools to locate, store, retrieve, analyze and present data and information.	S	N	N	Y	N	Y
2.5	Applies knowledge of different standards and enterprise models to facilitate the interoperability and assimilation of data and information from multiple sources.	N	N	S	Y	N	N
2.6	Applies understanding of knowledge, data, information and workflow models to information technology solutions.	N	S	S	N	Y	Y
2.7	Demonstrates knowledge of the system development life cycle by applying appropriate methods to develop, test, deploy, evaluate and decommission information technology.	N	N	Y	N	N	Y
2.8	Demonstrates knowledge of best practices and solutions required to manage the security of data, systems, devices and networks. i. Identifies and manages risks. ii. Ensures the implementation of appropriate security policies and procedures. iii. Identifies solutions that assure data privacy, patient and user confidentiality, security, integrity and recovery.	N	N	N	N	N	Y
2.9	Identifies and addresses the safety risks associated with information and the implementation, use and maintenance of information systems.	N	N	N	N	Y	Y
2.10	Applies best practices in the operation and maintenance of information systems and technology (e.g., service level agreements, disaster recovery, business	N	N	N	N	N	N

	continuity and incident management).						
B3. Clinical/Health Services							
3.1	Applies knowledge of basic clinical and biomedical concepts, clinical care processes, technologies and workflow methods for purposes of analysis, design, development and implementation of health information systems and applications.	N	Y	N	Y	N	Y
3.2	Understands basic clinical terminology and commonly used abbreviations and acronyms.	S	Y	Y	Y	Y	Y
3.3	Recognizes commonly used formats, structures and methods for recording and communicating clinical data and how these are incorporated into system and application use.	S	Y	Y	Y	Y	N
3.4	Promotes the effective use and benefits of clinical systems (e.g., electronic health records, clinical decision support and diagnostic information systems).	N	Y	N	Y	Y	Y
3.5	Facilitates the adoption and use of health information systems in clinical settings.	N	S	Y	Y	Y	Y
3.6	Facilitates appropriate consumer use of health information and related technologies.	N	Y	N	Y	Y	N
B4. Canadian Health System							
4.1	Demonstrates knowledge of health and health systems in Canada and appropriately applies this information to work products and services, including: i. key characteristics of the Canadian health system (e.g., governance, funding, structures, agencies, related organizations, strategic directions and issues, etc.), ii. key factors influencing health status (e.g., environment, genetics, socioeconomic), and iii. key factors affecting healthcare (e.g., demographics, supply and distribution of health professionals, new technologies, incentives).	S	N	Y	N	Y	Y
4.2	Understands how HI contributes to the organization's strategic direction.	S	N	Y	Y	Y	Y
4.3	Promotes the appropriate use and benefits of HI.	Y	S	Y	Y	Y	N
4.4	Articulates the key characteristics of different types of healthcare organizations (e.g., hospitals, clinics, ambulatory centres and community health agencies, regional health authorities).	N	N	Y	Y	Y	Y
4.5	Demonstrates knowledge of how people, resources and information flow through the health system.	N	N	Y	Y	Y	Y

4.6	Understands and applies knowledge of the roles and relationships of health providers and managers along with the organizational and regulatory structure in which they work.	N	N	Y	Y	Y	Y
4.7	Understands and addresses the challenges related to the adoption and use of information systems in the health sector.	Y	N	Y	Y	Y	Y
4.8	Understands the need to balance the privacy of personal health information with improved care delivery and health system management.	N	N	N	N	Y	Y
C5. Organizational and Behavioural Management							
5.1	Understands and applies the basic theories, concepts and practices of management including: i. Organizational behaviour and culture (e.g., change management, team dynamics, collaboration), ii. Human resources (e.g., terms of employment, staffing requirements, performance management and training and development), iii. Financial and budget management (e.g., business case development, ROI, costing), iv. Governance, accountability, risk analysis and management, v. Business and clinical transformation and quality improvement, vi. Procurement, contracts, agreements and vendor relationships, and vii. Customer relationships.	S	N	S	N	Y	Y
5.2	Contributes to organizational plans and strategies to ensure that information and information systems enable and are aligned with business goals.	N	N	S	Y	N	N
5.3	Promotes an information culture by encouraging and facilitating appropriate uses of information and knowledge.	Y	N	N	N	Y	Y
5.4	Facilitates individual, team and organizational learning and development through the use of appropriate technologies, communication and organizational skills.	S	N	N	N	Y	N
5.5	Understands, applies and promotes the application of relevant legal and regulatory standards and policies.	N	N	N	N	Y	N
5.6	Uses audience-appropriate communication and language to present information and convey concepts.	S	N	N	N	Y	Y
C6. Project Management							
6.1	Understands project management principles and practices and applies them appropriately (e.g., project charter, scope, life cycle, budgets, resourcing, timelines,	N	N	N	N	N	Y

	milestones, monitoring, status reports).						
6.2	Works collaboratively and contributes to project planning, implementation, monitoring and evaluation.	N	N	N	N	N	Y
6.3	Anticipates issues and opportunities and mitigates risks associated with projects.	N	N	N	N	N	Y
C7. Analysis and Evaluation							
7.1	Identifies and frames information questions in collaboration with stakeholders to meet their needs.	Y	Y	Y	Y	N	Y
7.2	Identifies relevant sources of data and information in order to: i. assess the quality of evidence, and ii. inform appropriate conclusions.	Y	Y	Y	Y	N	N
7.3	Demonstrates a basic understanding of appropriate analytical and evaluation techniques and concepts (e.g., qualitative and quantitative methods, basic statistical and epidemiological techniques, indicators and evaluation measures) and awareness of recent innovations.	Y	Y	Y	N	Y	N
7.4	Contributes to quality analysis by organizing and transforming data into reliable and meaningful information for diverse audiences.	Y	Y	N	Y	N	N
7.5	Presents data and communicates information in a way that is effective for users.	Y	Y	N	N	N	Y