

# Developing a Capstone Course within a Health Informatics Program

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## Abstract

This article discusses the ongoing development of a health informatics capstone program in a Midwest university from the hiring of a program coordinator to the development of a capstone course, through initial student results.

University health informatics programs require a strong academic program to be successful but also require a spirited program coordinator to manage resources and organize an effective capstone course. This is particularly true of health informatics master's programs that support health industry career fields, whereby employers can locate and work with a pool of qualified applicants. The analysis of students' logs confirms that students' areas of focus and concern are consistent with course objectives and company work requirements during the work-study portion of the student capstone project. The article further discusses lessons learned and future improvements to be made in the health informatics capstone course.

**Key words:** capstone course, qualitative analysis, healthcare informatics, CATPAC

## Introduction

Are master's degree candidates prepared for the professional world as they approach graduation? This question hinges on student career choices and the expectations of future employers searching the applicant pool for just the right person. Universities are caught between competing requirements as they justifiably teach a range of courses that give students a depth and breadth of knowledge across a broad range of academic areas while developing academic majors that interest students and target career fields in the business/healthcare domain. Students leave the university feeling that academia is not totally in tune with the real world, and potential employers feel that students are unprepared for reality since a university education does not provide all the necessary background and basic core experiences needed to succeed in the professional world. Capstone courses serve to bridge this gap.

A well-developed healthcare informatics capstone course can be an essential bridge between students and the real world.<sup>1</sup> Further, this course can serve as a bidirectional link whereby students bring back real-world knowledge to educate fellow students, faculty, and the academic administrators responsible for developing course materials and providing resources to faculty.<sup>2</sup> Employers can become intimately engaged in the learning process by providing feedback to faculty that improves the program's courses. The key in developing these relationships is hiring a program coordinator with the professional skills needed to fine-tune the program's goals, coordinate faculty activities with the needs of industry partners, and direct students in their final course before graduation. This article discusses the ongoing development of a capstone course in a health informatics program designed to integrate classroom knowledge with practical industry experiences within an academic structure by placing students in a professional situation whereby they perform as real employees but also must reflect upon what they are learning.

This article describes the creation of a health informatics program, selection of the program coordinator, the evolution and development of the health informatics capstone course, and student performance in the course. Conclusions are drawn from the experience, and recommendations for future improvement to overcome miscues and move constructively forward are discussed.

## Creating a Health Informatics Program

Health informatics is a specialized field of study dating from the 1970s that integrates the concepts of clinical informatics (the principal focus of which is on patient care) and general healthcare information systems (IS), which focuses on institutional administration. Targeted business needs range from the storage, retrieval, and interpretation of information in the context of patient care to the implementation and management of complex information systems used in the administration of healthcare. The key players in health informatics include hospitals; physician networks and practice groups; third-party payers and regulatory agencies; and industry suppliers such as pharmaceutical companies, biotechnology companies, and vendors of hospital equipment and medical supplies. Within the context of health informatics, the subfield of clinical informatics focuses on computer applications that address medical data (collection, analysis, and representation of information).<sup>3</sup>

A successful health informatics program should have a community focus, a desire to aggressively revise the curriculum, an existing technology community, an existing healthcare community, and the desire to leverage regional healthcare needs.<sup>4</sup> The distinguishing characteristic for such a program is the focus on the integration and interoperability of technology within the managerial and communication context of the healthcare business environment. Martz et al. (2007) discussed the development of a health informatics graduate program; however, over the intervening years, academic and governmental policy and business needs have led to an expanded interest in the curriculum, making it necessary to create a capstone course that meets different stakeholder needs than could be achieved in a typical work-study program, internship, or co-op.<sup>5</sup> The overall health informatics program at this university still addresses clinical informatics and health IS concerns by focusing on the integration and interoperability of technology within the context of healthcare management. However, the capstone course was envisioned to integrate multiple disciplines such as information technology (IT), project management, workflow analysis, business process redesign, and so forth.

A critical success factor for the program was hiring an aggressive coordinator who could inform employers of the unique contributions of the program. Students with a medical background needed to be placed within a medical IT environment where they could demonstrate their new IT skills. Traditional IT students needed to be in a medical environment where they could practice medical terminology (vocabulary) and apply their IT skills. Employers selected to participate in the program are required to assign students to jobs that complement what they have learned rather than jobs that simply require completing projects that have been on the back burner or just being somebody's assistant for a few months. It is important to emphasize that the hybrid capstone course uniquely targets students with a broad range of IT, business, and professional medical backgrounds that addresses the business needs of the medical community.

The terms *internship* and *capstone course* can be used interchangeably in terms of student learning and experience gained; however, the hybrid approach of our course requires a much closer scrutiny in the selection of the internship location and the assigned student work experience. Students must work in the healthcare industry, work in a business area where they have not worked before, participate in a meaningful activity that broadens their new skill set, and complete regular reports for the program coordinator. Further, we envisioned a joint selection process that places a student based on educational requirements and organizational needs.

Upon completion of the capstone course, we wanted graduates to be ready for hiring within the healthcare industry. Such a graduate would have desirable and proven skills. The closer relationship between students, the program coordinator, and healthcare organizations would allow for more timely updates of the curriculum and a work environment with documented student success on both the program and business sides. This interaction would create a synergistic effect whereby successful students would be hired or promoted and thus encourage other students and healthcare organizations to participate in the program.

## The Capstone Coordinator

### Our Vision

Selecting a capstone coordinator was the first step in creating a sound program. Experience from similar programs suggested that programs without a champion typically stalled or failed to progress. Considerable thought went into the type of individual and the complementary skills needed to grow the type of program we foresaw. In general, we envisioned that students would complement their course work with some kind of work-study program to establish their credibility as they ultimately sought new positions within the healthcare industry.

Beyond this vision, we had little funding, some interest from a small number of employers, a few students interested in the concept, and buy-in from college leadership, who agreed that a capstone course/program was a future direction in which they wanted the college to go.

## Qualifications, Functions, and Job Qualifications

A list of capstone coordinator qualifications was contrived based on what we thought was needed to advance the program. This list was used to screen applicants and guide the interview process. Candidate qualifications, functions, and job requirements included the following:

- Have strong ties to the state and/or community.
- Have a healthcare background.
- Have the ability to advise graduate students.
- Be a member of the college's Master of Health Informatics (MHI) program advisory board.
- Chair student capstone committees.
- Maintain the MHI website.
- Have strong references indicating a wide network of contacts.
- Participate in the writing of healthcare grants.
- Be a leader in the recruitment of students.
- Develop community relationships and expand the diversity of organizations considered for student internships.
- Expand the program into the public health sector.
- Be familiar with federal, regional, state, and local quality improvement programs and healthcare initiatives in general.

## Student Relationships

- Assist students in developing resumes and electronic portfolios.
- Mentor students in personal habits and job productivity skills.
- Mentor students about the healthcare culture and professional conduct.
- Guide students to schedule about 12 hours a week for their capstone experience.
- Encourage students to seek a professional mentor.

## Capstone Courses in IS and Health Programs

A capstone course is offered toward the end of an academic program and integrates student knowledge accumulated during previous courses.<sup>7,8</sup> These courses integrate a variety of learning styles, focus on hands-on experiences, and prepare graduates for the transition to a professional career. Students should work on a variety of projects utilizing different skills but must also complete documentation that assesses their training. Faculty members oversee the course and optimize student learning experiences.<sup>2</sup>

A survey of capstone courses brought to light many different approaches and designs that need to be considered in designing a course.<sup>10</sup> A crucial aspect of any course design is deciding which topics and skills should be the focus of the course.<sup>11</sup> Further, a well-thought-out capstone course should be comprehensive in nature, allowing for a large range of student abilities.<sup>12</sup> Beachboard and Beard discuss a capstone course in information systems at the undergraduate level as being beneficial to students and requiring faculty who are knowledgeable in the area from both the academic and practitioner perspectives.<sup>13</sup> Murray et al. suggest an assessment-based capstone course that includes the mapping of project deliverables and tying them to specific learning outcomes.<sup>14</sup>

Brandon and Pruett discussed the development and implementation of an undergraduate capstone course on IT management from the student perspective.<sup>15</sup> The focus of this course was to create opportunities for undergraduate students to assess business problems; apply IS skills such as systems analysis and design, database management, and other skills; and employ creativity and critical thinking, writing, and presentation skills. The course design included activities such as readings on recent trends in both business and IT development, analysis of business cases, written and verbal reporting, a team project, and a capstone project. The results of this study showed that technically focused students underappreciated or misunderstood the management side of organizations.

Understanding the organizational and management side of a company is important. Master's degree students at the University of South Florida<sup>16</sup> participated in a team-based two-semester capstone course in which students learned to solve problems and integrate learned skills. Similarly, Steiger had students work on a project that integrated different business functions and emphasized a hands-on approach to solve business problems, which offered more learning opportunities than a case-based learning approach.<sup>17</sup> Harper et al. encouraged cooperation between instructors and the use of case studies to help students better understand business functions and problems.<sup>18</sup>

Schwartz and Schwartz suggested an alternative approach to capstone courses that involved coordinated lectures by both faculty and IT professionals, whereby faculty served as facilitators of the seminars.<sup>19</sup> The seminars were an opportunity for students to network with professionals and understand how learned material applied in a professional setting. Students connected with IT professionals and recognized the need to master skills such as critical thinking, technical skills, and business skills in order to establish a successful IT career. Structurally, this course addressed five learning objectives that we considered integrating into our own program:

1. Participate in discussions with members of the business community in a small-group setting,
2. Compare real-world scenarios with prior student learning objectives,
3. Compare written reflections from class discussions with students' own work experiences,
4. Write a term paper in which students critique their own work environment based on what they learned from the capstone course, and
5. Make recommendations for their own work environment based on the knowledge they received during seminars.

Astani suggested an active learning approach to help students understand IS issues from the chief information officer (CIO) perspective.<sup>20</sup> In this capstone course approach, students tied together IS issues with prevailing attitudes suggested by IS professionals. Current IS issues were identified from IS journals and were rated by interviewing local CIOs. The interviews and ratings of IS issues encouraged students to consider the impact of these issues on their business region.

A capstone course founded by the National Institutes of Health/National Institute of Aging focused on health and sociology issues and emphasized hands-on skills while having students work individually or in teams to finish their projects.<sup>21</sup> In this four-credit-hour capstone course, students learned about racial/ethnic disparities in managing diabetes. The key aspect of this approach was having students perform hands-on work with real-world problems.

A pharmacotherapeutics capstone course was designed to integrate knowledge from previous courses with hands-on pharmacy practice.<sup>22</sup> This course included three lecture hours, one hour of recitation, and a one-hour group project per week. Students worked individually and in teams to develop drug formulary kits, learn medication utilization criteria, and understand medical, legal, and marketing jargon. Topics were related to critical care, long-term care, and hospice care; patient management issues in ambulatory care; and pharmaceutical consultation. An important result was that the course needed to include better assessment of student problem-solving skills in order to help students better apply their pharmaceutical knowledge.

Based upon the experiences and lessons learned from other courses, we determined that our capstone course would mandate on-the-job training in a professional setting. Students would be required to maintain a log of their experiences and make a formal report at the end of their capstone experience. The difference between this capstone course and a work-study or internship experience would be the close coordination and mentoring by the program coordinator. Further, great care would be taken to ensure that students were placed in the right situation to match their learning needs and the needs of the organization to which they were assigned. The next section presents the description of the capstone course as developed for our program.

## General Description and Learning Objectives of the Capstone Course

The capstone course in the MHI program is designed to offer students the opportunity to gain real-world experience by working on projects in healthcare delivery organizations. Students are required to work independently on various applied projects to facilitate selection, implementation, and optimal use of information technology in a healthcare delivery setting. Students use their professional and academic knowledge to gain new organizational experiences.<sup>6</sup> Prospective students come from a variety of backgrounds, including nursing, lab work, business analysis, IT security, database administration, and so forth. Students coming from a medical background are given more IT-focused training and those from a business background receive training in medical terminology to allow for cross-pollination of ideas and concepts.

As part of the university accreditation process, active learning occurs throughout the curriculum. Students participate in the active learning component of the capstone course by involving themselves in hands-on projects that demonstrate application of student knowledge and development of skills. Therefore, several course objectives address the active learning component to satisfy accreditation requirements:

- Understand how concepts can be applied in a practical setting.
- Practice facilitation and leadership skills by working directly in a healthcare provider organization or a healthcare business.
- Obtain direct knowledge of the impact of technology on the daily workflow of a healthcare provider organization or healthcare business.

## Capstone Course Management

### Faculty Coordinator

A faculty coordinator was hired to assist and monitor the health informatics program. The faculty coordinator started the new position in the fall semester of 2009. Students in the MHI program were informed that they needed to take two capstone semesters in their final year of the MHI program. Students are not allowed to self-register for the capstone classes, so in fall 2009, students registered with the advisor for both the Master of Business Informatics and the Master of Health Informatics programs.

The capstone experience was designed to be two semesters long. Students registered for Capstone I for the first semester and Capstone II for the second semester. To provide students with an in-depth learning experience, every attempt was made to have students complete both Capstone I and Capstone II at the same host organization.

### Course Requirements and Evaluation

Evaluating students in a capstone course requires a common understanding between faculty (the program coordinator) and the student. The program coordinator, in the faculty role, must clearly state responsibilities and expectations, while students must clearly understand what they can expect from faculty. The program coordinator must facilitate the hands-on experience and contact students on a regular basis to monitor their progress.

Students can expect their grade to be based upon:

1. Active participation throughout the course. Students must actively participate in scheduled meetings, contribute to discussions, and participate in learning groups whether formed by other students or the client facility.
2. Completion of monthly activity logs or status reports in the format provided (see [Appendix 1](#)). Student logs help students stay focused on the course objectives and gather regular information for their final report as the semester progresses.
3. Adherence to the requirements outlined in the course syllabus. Students are required to formally acknowledge that they have read the course syllabus and understand their responsibilities (see [Appendix 2](#)).
4. Completion of a semester activity plan provided and approved by faculty (see [Appendix 3](#)).
5. Completion of a final experience paper covering their capstone experience.

The student is responsible for creating a schedule of planned activities for the semester, along with goals and objectives, in consultation with and for approval by the program coordinator. Each organization accepting a capstone student must assign the student a mentor who directly supports the student's efforts to achieve the stated objectives. Monthly activity logs and the final paper should reflect this plan. Students submit three monthly logs over the course of the semester reflecting their progress in relation to the activity plan for the month covered. As in any work situation, plans may change based on the needs of the student and the client organization. If the plan changes, it is the student's responsibility to submit a modified plan with an explanation of why the changes occurred within the monthly log.

The final requirement for the capstone course is the experience paper. The experience paper demonstrates how the student has applied the concepts learned throughout the MHI program in the healthcare delivery setting. The log of activities will help students develop this paper.

## Student Placement

Each student's placement in a suitable client organization is impacted by a number of student and organizational variables. These variables include the following:

- Student's employment background,
- Extent of student's work experience,
- Student's interests,
- Host organization's current need,
- Host organization's student internship policies, and
- Host organization's administrative policies and procedures.

The capstone experience is different for each student and organization, necessitating that each student be individually placed. The placement system can best be described as matchmaking. The matchmaking process is not perfect but does engage the student, the coordinator, and the host organization in a dialogue that results in a mutual understanding of expectations. The process follows the following steps:

1. Each student's class record is reviewed to determine that the student is eligible for the capstone, that the student has taken the required classes, and that the student has reached the final year of the program.
2. Each student is interviewed to determine his or her thoughts on and interests for the capstone. A resume is obtained from the student. The student's available days and times are noted.
3. The current active list of host organizations is reviewed for possible projects. Contacts at organizations are called to see if there are any new areas of need.
4. When a good match is found, the proposed capstone experience is discussed with the student and the host organization contact.
5. If both the student and the organization contact agree, the student's resume is sent to the host organization contact for review.
6. If the host organization contact is interested in the student, an interview is arranged.
7. If the student and the host organization agree to the match, the student is placed at that organization. The student's schedule is worked out, and the organization's specific on-boarding process is started.

The program coordinator ensures that the intellectual rigor, scope, and integrity of different projects remain consistent across students by aligning student backgrounds and experience with the willingness of a healthcare organization to accept a student. For example, a student with no healthcare or technology background might be placed in a first-tier support role in a healthcare organization. This allows the student to gain broad practical experience in various departments and face day-to-day issues. A student with deep business and healthcare experience could be placed doing special projects for a hospital CIO. A student with hospital department management experience could be placed within a project to plan and organize the go-live for a hospital-wide integrated information system. Each capstone builds on the student's educational experience and work background to expand the student's practical experience related to health informatics.

Students sometimes complete their capstone projects within their current place of employment. In this case, the capstone project must be in a department other than the student's home department, the project must be outside of the student's normal job duties, and the time spent on the capstone must be outside of the student's regular work hours. For example, an intensive care unit (ICU) nurse in a large hospital might work on a system implementation project within the hospital's information technology department. Similarly, someone with a business background might be assigned to a hospital's workflow planning team to work with doctors and nurses as a new medical healthcare record system is being implemented.

## Capstone Syllabus

The capstone syllabus provided to students contains basic guidelines that are consistent with any university syllabus but with some differences. The syllabus is provided electronically. Students are required to sign a form stating that they have read and understand the syllabus (see [Appendix 2](#)). This is done to insure that students understand the rules of conduct for the capstone experience. Additionally, the syllabus covers basic business conduct while at a host facility, including appropriate dress and proper use of cell phones or pagers. Because of the unique nature of the healthcare environment, the syllabus also covers two topics specific to healthcare. The first is a reminder of basic disease transmission precautions. For instance, students are

reminded to wash their hands frequently. Students are also asked not to go to the capstone site if they are ill or a member of their family is ill. These guidelines became especially important because of the concern over H1N1 (flu) transmission. The second healthcare-specific topic covers patient privacy and security. The syllabus reminds students that any host organization business information is not to be disclosed and that patient information is never to be disclosed in any venue or format. In addition, each student receives basic HIPAA (Health Insurance Portability and Accountability Act) privacy and security training during the host facility's on-boarding process.

## Data Collection and Findings

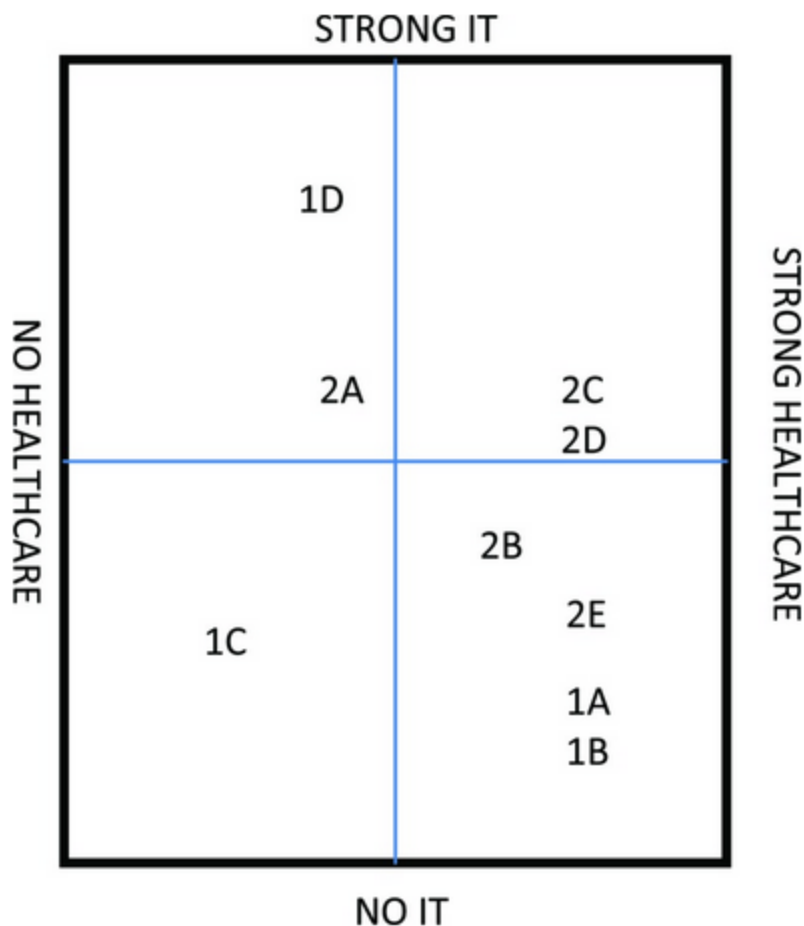
The capstone program was first offered in the spring 2008 semester. The number of students taking the capstone is approximately four students per course, as shown in [Table 1](#). The authors of this study were able to collect data on the student experiences in the last two semesters of the capstone program (fall 2009 and spring 2010). There are no data related to the previous semesters of the capstone program.

**Table 1**  
**Capstone Participation by Semester**

Semester	Number of Capstone I Students	Number of Capstone II Students
Fall 2008	1	0
Spring 2009	4	1
Summer 2009	4	3
Fall 2009	4	5
Spring 2010	4	4

In the fall of 2009, nine students were enrolled in the capstone courses, with four in Capstone I and five in Capstone II. [Figure 1](#) represents the strength of the students' previous IT experience and healthcare experience in the fall 2009 semester. In the figure, Capstone I students are represented as 1A–1D, and Capstone II students are shown as 2A–2E. In this semester, four of the students were placed at large area medical centers, one student was placed at a medium-sized area hospital, and four other students worked with a small ambulatory provider practice on the definition of requirements and initial vendor screening for an electronic health record (EHR) system.

**Figure 1**  
**Student Levels of Healthcare and IT Background in the Fall 2009 Semester**



*Note:* 1A–1D represent Capstone I students, and 2A–2E represent Capstone II students.

In spring 2010, of the eight students enrolled in the capstone courses, two had healthcare experience but no IT experience, one had IT experience but no healthcare experience, and five had neither strong healthcare nor IT experience. One student was placed at a large area medical center, two were placed at midsized area providers, two worked with the Northern Kentucky University College of Health Professions on technology initiatives, and the remaining three worked with a local long-term care facility, the local health department, and a small ambulatory provider.

These groups of students are typical of the students that have enrolled in the program to date. Most of the students have a background in healthcare, a few have backgrounds in technology, and a few have no healthcare or technology background.

Another interesting piece of information is how many students are working on projects with their current employers. As shown in [Table 2](#), in fall 2009, three out of nine students (33 percent) worked on the projects with their current employers, versus one out of eight students (13 percent) taking a capstone course in spring 2010. More of the early students had a healthcare background, making it easier to place them in healthcare IT projects. As the program expanded, students went to more entry-level types of work to gain credibility and experience.

**Table 2**  
**Capstone Students Working for Their Current Employers**

Semester	Capstone I		Capstone II	
	Total	With Employer	Total	With Employer
Fall 2009	4	1	5	2
Spring 2010	4	0	4	1

## Assessment



The variety of capstone projects makes assessment of student progress against the learning objectives challenging. The original learning assessment tool was an experience paper prepared at the end of the capstone course. During the fall 2009 semester, the program coordinator also began collecting monthly project logs from each student so that the student's involvement in the capstone course could be more easily monitored. The monthly log also helped students prepare the experience paper. The suggested log format is found in [Appendix 1](#). In the log and the experience paper, students reflect on applied concepts learned during their MHI courses, what they learned about the host organization culture, how they practiced leadership skills, and what they learned about the impact of technological change within a healthcare organization.

In order to assess what students were doing during their internships, we conducted a text analysis using CATPAC (<http://www.galileoco.com>) to analyze student log files. Inductive content analysis is based in grounded theory and has been used to understand e-mail discussion groups, Listserv discussions, and other archived textual information.<sup>23-26</sup>

CATPAC is a self-organizing artificial neural network computer program used for analyzing text. CATPAC reads and understands text by learning the interrelationships among words and phrases found in the text being analyzed. Text is not pre-coded, nor is it necessary for the analyst to predetermine any categories in advance.<sup>27</sup> CATPAC allows categories to develop from the data by allowing the text being analyzed to develop into meaningful conceptual groupings. The most important output of the CATPAC program is a matrix containing the mean response computed for every pair of concepts. CATPAC then assigns a neuron to each major word in the text and runs a scanning window. Neurons representing each word are paired with other neurons to create word-by-word paired comparisons, resulting in a dendrogram (cluster analysis) that shows the pattern of relationships between key words and further identifies clusters of key symbols (concepts).<sup>28</sup>

All student logs were converted to a single text file for analysis based on the sample size. [Table 3](#) is a descending frequency list of the 25 words most commonly used in the monthly student log files. [Table 3](#) suggests that students were focused on the appropriate objectives. The significant words emerging from the data, such as the most frequently used word, *learned*, all seem to be related to the capstone informatics course. This finding is not entirely surprising, but it is significant that *work*, *hours*, *week*, and *capstone* do emerge as key words, possibly indicating that the students were trying to take advantage of their internship time. Students were well briefed to put in the hours they needed as part of the course requirement, and the journals suggest that this requirement was being addressed in a substantive way. The analysis also might indicate that the students' focus was spot-on, at least when they were writing the journals. This further suggests that the journals have value in keeping students on task and that the frequent repetition of course-related key words reflects the goals and objectives of the course. This analysis provides some small degree of confidence that the students focused appropriately on the objectives of the course.

**Table 3**  
**Descending Word Frequency List**

Word	Frequency	Percentage
<i>learned</i>	47	6.6
<i>information</i>	40	5.6
<i>system</i>	40	5.6
<i>EPIC</i>	37	5.2
<i>site</i>	34	4.8
<i>current</i>	33	4.6
<i>healthcare</i>	33	4.6
<i>project</i>	33	4.6
<i>discussed</i>	32	4.5
<i>capstone</i>	31	4.4
<i>hours</i>	30	4.2
<i>work</i>	29	4.1
<i>week</i>	28	3.9

Word	Frequency	Percentage
<i>technology</i>	26	3.7
<i>patient</i>	23	3.2
<i>process</i>	23	3.2
<i>related</i>	23	3.2
<i>procedures</i>	22	3.1
<i>time</i>	22	3.1
<i>workflow</i>	22	3.1
<i>care</i>	21	2.9
<i>EHR</i>	21	2.9
<i>Juniper</i>	21	2.9
<i>Staff</i>	21	2.9
<i>BCP</i>	20	2.8

[Table 3](#) also shows the words *EPIC*, *Juniper*, *healthcare*, *project*, *technology*, *information*, and *system*. Currently, many healthcare organizations have projects to upgrade or install systems made by EPIC, a major provider of EHR systems for hospitals. *Juniper* refers to a company that builds computer networks and would logically fit with *EPIC* and *project* if healthcare organizations were implementing EHR systems (*healthcare* and *EHR* also appear on the list). *BCP*, or business continuity planning, also appears as a key word, suggesting that business and healthcare go together.

[Figure 2](#) shows the strength of relationships between key words. [Figure 2](#) is more informative than frequency counts because it shows a matrix of relationships between key words. In this figure, the column height has no significance but only reflects the grouping of words in their relative proximity to each other. The word groupings reflect key ideas emerging from the data.

## Figure 2

### Strength of Relationships between Key Words



create a capstone committee to augment the program's advisory board, which is made up of local industry leaders whose organizations are the core sources for placement of capstone students. The capstone committee will be made up of local healthcare organization middle management and will provide input on capstone development and placement.

We also found that students completed their course experience paper in a variety of different formats, making a formal analysis difficult. In the future, we would like to standardize the report format to address issues important for improving the course, better ways of supporting our internship industry partners, and ways of streamlining the course from top to bottom. Our program has been growing, but it is a manpower-intensive activity. If we want to grow, we need to be more efficient and effective in utilizing our scarce resources.

Starting with the spring 2010 semester, the faculty coordinator revised the structure of the capstone class. The changes were intended to facilitate the learning assessment of each student. Students are required to complete three assessment activities. These assessments are as follows:

1. A semester activity plan is submitted within two weeks of the beginning of the capstone.
2. The student submits a monthly log each month (minimum of three) during the semester.
3. At the end of the semester, the student submits an experience paper.

More effort is needed to document the student-mentor relationship. Reducing the administrative burden on a hosting organization is a concern, but perhaps students could document the student-mentor relationship within their activity logs.

## Student Comments and Future Directions

The evolution of our healthcare informatics program is ongoing.<sup>29</sup> As the program grows and matures, our ability to collect and analyze data will improve as well. We have not yet formally surveyed employers about their capstone experiences. Our initial thought process was to get organized in a way that would allow us to manage growth and build a strong reputation with a small number of employers and students at the outset. Anecdotal evidence suggests that employers are happy with our students and desire more capstone students, while the number of students entering the program is increasing. Clearly, more data will be collected in the future to better understand what skills employers need and use and what political and managerial skills students need; we also need to do a better job of providing feedback to the academic side, where the courses are taught.

The student experience papers provide some insight as to where we might start. In a comment typical of many students, the following paraphrases one international student: "It is worthy to state here that my coursework helped me greatly to understand the needs of my assigned organization and how I could help to provide meaningful solutions to the challenges they face. Courses like Database Management, System Analysis and Design, Technical Foundation in Health Informatics, and IT Project Management were the key to my success. Without these courses, I would have been a stranger to the project. However, courses like Data Mining/Data Warehousing and Data Communication would have helped me greatly. I would have also done a little better if I had had some programming experience or knowledge." A more experienced traditional student stated: "My coursework and past experience in the industry was used to leverage knowledge in new areas that I had not previously been exposed to in my twenty-year informatics career." Clearly, we need more specific understanding of which skills and which courses matter the most.

Political skills complement good technical skills. A student with industry experience stated: "Infrastructure was not one of my strengths but through my research, observation and interviewing skills, [I] was able to win over the Director by documenting his 'pain points' and bringing a heightened awareness [of] potential risks that had previously been identified but had 'fallen on deaf ears.'" Not all of the students have this degree of understanding of organizational political processes, so we must consider how to impart this knowledge through training or mentoring.

Additionally, faculty and administration need to understand and appreciate the importance of the capstone coordinator in order to ensure the continued funding of this critical position. A student wrote that "the weekly status updates with the Capstone Project Coordinator help tremendously in problem solving issues/concerns and concepts that needed strengthening and clarification. Thanks [name omitted] for putting up with me each week!"

## Expected Benefits

The establishment of a formal program guided by a dedicated program manager sent the right signals to students, faculty, administrators, other colleges and universities, and the regional business community. It said we were serious, committed, and in the game for the long term. Over time, we expect to grow the program, continue to improve the quality of the capstone course, and increase the quality and number of dedicated students.

Students who know that they will need to complete a two-semester capstone course tend to work harder at their core courses. Further, there is competition for positions with the best capstone organizations. We will not send any student just anywhere; the student basically interviews with faculty and the program administrator to get a good slot. Thus, a good reputation, credibility, work ethic, and other intangibles, in addition to grade point average, have an impact on a student's placement. Even students who complete a capstone experience within their current organization must sell their organization on the capstone.

A well-run program can be copied and emulated in other programs and organizations, not just healthcare. We have attempted to use best practices from other programs and the literature, along with innovation and creativity, to create a successful capstone program with limited resources. We have shared our ideas with others around the campus and the region in an effort to market our program as one that, while not necessarily unique, stands out among the competition.

## Conclusions

A successful healthcare capstone course builds success on a number of levels. Students build confidence in what they have learned. They interview better and increase their likelihood of being hired. The faculty receives feedback from employers and students that allows incremental improvement of course materials on a regular basis. Employers get to see the students in action in a low-risk arrangement. Further, the word gets out to the community and to other students that students are being hired and are doing well. Successful students bring in more successful students. The program grows, and with growth come more resources. Successful firms hire more of the program's graduates, contributing to the alumni network and increasing the likelihood of receiving additional resources in future years. We see the investment in a capstone course as both a short-term win and a winning investment in the future.

## Appendix 1

Student: \_\_\_\_\_

Project: \_\_\_\_\_

Time Period Covered: \_\_\_\_\_

1. What progress did you make on your planned capstone activities for this month? What progress did you make on your learning goals and objectives this month? What value did you add to your client organization? Were there other significant accomplishments this period?
2. Did you encounter any significant barriers? How did you overcome each?
3. What resources did you use (websites, books, articles, magazines, etc.)?
4. Did your course work help you with your accomplishments or to overcome any barriers encountered? What would have made your coursework more helpful?
5. Did you learn anything about the corporate culture at your site?
6. Did you learn anything about providing healthcare or working in the healthcare environment?
7. Did you learn anything about the impact of technology on the workflow of providing healthcare or the business of healthcare?
8. How many hours per week did you work on your capstone project this period?

## Appendix 2

Sample Syllabus Acknowledgment

**Course Number:** xxx

**Course Title:** MHI Capstone I and MHI Capstone II**Spring 20\_\_**

Student Name: \_\_\_\_\_

Host Facility: \_\_\_\_\_

Host Supervisor's Name: \_\_\_\_\_

I have read and understand the MHI Capstone Project class syllabus posted on Blackboard.

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**Appendix 3**

Student: \_\_\_\_\_

Project: \_\_\_\_\_

Semester: \_\_\_\_\_

1. What are your planned capstone activities by month this semester? This should be a brief, concise statement.
2. What are your capstone learning goals and objectives this semester? Your planned capstone activities should support your learning goals and objectives.
3. What value will you be providing to your client organization this semester? Your planned capstone activities should support the value you will provide to your client organization.

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**Notes**

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