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Issue on Teaching and Training Future Health Informaticians: Partnering with Students to Develop a Capstone for a Graduate Health Informatics Program

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Conflict of Interest: All of the authors have an affiliation with the MSc eHealth program. NW, CL, VM, NB (faculty members), and ML (internship coordinator) are employees of McMaster University and receive salary through program revenues. RJ, TB, EW, SZ, and JF are alumni of the program.

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Abstract:

Objective: To assess the desirability, feasibility, and sustainability of integrating a project-based capstone course with the course-based curriculum of an interdisciplinary MSc health informatics program guided with a student-partnered steering committee and student-centered approach.

Methods: We conducted an online cross-sectional survey (n=87) and three semi-structured focus groups (n=18) of health informatics students and alumni. Survey data was analyzed descriptively. Focus groups were audio-recorded and transcribed verbatim and then analyzed using a general inductive and classic analysis approach.

Results: Most students were supportive of including a capstone project but desired an option to work independently or within a group. Students perceived several benefits to capstone courses while concerned over perceived challenges to capstone implementation, evaluation, and managing group processes. Themes identified were: 1) professional development, identity, and career advancement; 2) emulating the real world and learning beyond the classroom, 3) embracing new, full circle learning, 4) anticipated course structure, delivery, and preparation, 5) balancing student choice, interests, and priorities, and 6) concerns over group dynamics, limitations, and support.

Conclusions: This study demonstrates the value of having students as partners at each stage in the process from methods conception to course curriculum design. With the steering committee and the curriculum developer, we codeveloped a student-centered course that integrates foundational digital health-related project knowledge acquisition with an inquiry-based project which can be completed independently or in small groups. This study demonstrates the potential benefits and challenges that health informatics educators may consider when (re)-designing capstone courses.

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Special Issue on Teaching and Training Future Health Informaticians:

Partnering with Students to Develop a Capstone for a Graduate Health Informatics Program

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Abstract

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Results: Most students were supportive of including a capstone project but desired an option to work independently or within a group. Students perceived several benefits to capstone courses while concerned over perceived challenges to capstone implementation, evaluation, and managing group processes. Themes identified were: 1) professional development, identity, and career advancement; 2) emulating the real world and learning beyond the classroom, 3) embracing new, full circle learning, 4) anticipated course structure, delivery, and preparation, 5)

balancing student choice, interests, and priorities, and 6) concerns over group dynamics, limitations, and support. **Conclusions:** This study demonstrates the value of having students as partners at each stage in the process from methods conception to course curriculum design. With the steering committee and the curriculum developer, we codeveloped a student-centered course that integrates foundational digital health-related project knowledge acquisition with an inquiry-based project which can be completed independently or in small groups. This study demonstrates the potential benefits and challenges that health informatics educators may consider when (re)-designing capstone courses.

Keywords: interdisciplinary education; digital health; health informatics; experiential learning; problem-based learning; students as partners

1. Introduction

Interdisciplinary education combines two or more disciplines to explore and better understand a common theme or central focus, with each person contributing from their perspective^{1,2}. In Canada, the Health Informatics Professional Competencies is a supported curriculum framework that involves the four domains of health science, information and computer science, business management science, and data science^{3,4,5}.

Multidisciplinary fields like health informatics set the tone for interdisciplinary project-based or problem-based learning approaches as teachers and learners are likely to be trained in a variety of disciplines⁶. Interdisciplinary teaching methods in health programs often include small group teaching, case studies, experiential learning, problem-based learning, and traditional presentation lectures⁷. A systematic review identified eight domains of core competencies across the various subdisciplines of health informatics: data (e.g., statistics, analysis, modelling), information management, project management, leadership (e.g., change management), research

and evaluation skills, healthcare, human factors (e.g., patients, stakeholders, communication), and systems development (e.g., health technology development, programming, and implementation)⁸. Learning these core competencies and skills by didactic teaching is not always the most effective route. Student-centered learning may be a better approach where instructional strategies, assessments, and course content are centered on, with, or within students (i.e., self-ownership of learning)⁹. Conceptual frameworks for student-centered learning design are constructivist in nature and involve behavioral, social, and motivational aspects of learning and knowledge generation not solely defined or directed by the teachers¹⁰. Some functions of student-centered learning environments are to incorporate learning that is rooted in relevant context and/or personal experiences, supporting self-regulatory and self-ownership of learning, and more meaningful activities tied to cognitive processes¹¹. In student-centered learning, students have more choice in how they are assessed and are more active in their own learning¹². Their experiences act as a basis for curricular development or improvements and can result in feeling more responsible for their learning and perceiving the content to be more relevant¹³.

For instructors to engage in student-centered curriculum development and/or negotiation, students should be given the opportunity to participate in decision-making processes, make changes to their learning through interpersonal cooperation with others, and develop a greater capacity to work with others from diverse backgrounds¹⁴. Student-centered curriculum negotiation can include sharing prior knowledge, selecting questions and topics for class assignments, and planning how to answer those questions¹⁴. A major curriculum change towards greater student-centered learning should consider the student voice in program (re)design.

The McMaster University Master of Science in eHealth is an academic graduate program launched in 2008 collaboratively by three existing disciplines and faculties– the DeGroot School of Business, the Faculty of Health Sciences, and the Faculty of Engineering. The program enrolls roughly 40 students per cohort, with full-time thesis and full- and part-time course-based options that include four core courses (one per faculty + statistics) and electives from across the faculties. Full-time students complete an 8-month industry or research internship. All course-based students also complete a scholarly paper as their final milestone, often a literature review driven by the students' interest and supported by faculty and industry readers with related expertise. The program prepares students for professional work in health informatics; most of the students go on to pursue industry careers and the thesis-stream is an option for those who wish to pursue research-based careers or further post-graduate studies.

Through a regular institutional and provincial quality assurance process, recommendations to strengthen the program included consideration of a design-focused capstone project as an alternative, complement, or replacement for the scholarly paper as a culminating milestone. Such a curriculum change could enhance interdisciplinarity by further supporting experiential learning, developing relevant competencies, and enhancing cross-faculty collaboration, while leveraging and continuing to build relationships with, and support the needs of, community partners/employers.

Capstone projects often center around a complex real-life problem posed by an organization, interest group, industry sponsor, stakeholder, or a student's workplace, and provide learners with a forum to practice skills they anticipate utilizing in employment¹⁵. Capstone projects include student-informed, interdisciplinary collaborative inquiries in methodology, solutions, presentation, and division of tasks with an interdisciplinary-trained "moderator" (i.e.,

course instructor) to assist the learners^{15,16}. A capstone project amalgamates information and knowledge from an entire course or program and encourages students to think about their future careers or educational trajectories and engage in self-discovery as they anticipate transitioning to (future) professionals in their field rather than students in academia^{17,18}. . An informal environmental scan of local and international interdisciplinary capstone course syllabi highlighted a range of curricula elements, including course deliverables, module content, resource requirements, and course lengths^{18,19,20,21,22}.

1.1 Objective

The objective of this quality improvement study was to assess the desirability (positive perceptions and feelings towards the change) feasibility (if the program and faculties have the resources to implement/support the change), and sustainability (determine the likelihood that the change can be successfully maintained for future cohorts by analyzing pros/cons) of a new interdisciplinary design-focused capstone project course that would be integrated into a 20-month MSc course-based health informatics program in partnership with students and using student-centered curriculum development.

2. Methods

This mixed-methods quality improvement study, comprised of a survey and focus groups that engaged current and former students, was managed by the program's Faculty of Health Sciences faculty coordinator (CL) and included the core faculty members from across the disciplines/faculties. Using a student-partnered approach, it involved students through all phases of the research and curriculum development process.

The project was led by a steering committee of four program instructors/faculty members, the program internship coordinator, one alumni of the full-time program, one alumni

of the part-time program, and a (then) current full-time student to guide methodology, decision-making, and course design. Two current students and one alumna were hired as research assistants and the curriculum developer who supported course development was an alumna. The student research assistants supported the environmental scans, initial design of the survey, recruitment emails, survey and focus group data collection, analysis, manuscript writing, knowledge dissemination at conferences. We received a waiver for full ethics review from the Hamilton Integrated Research Ethics Board as this was deemed a quality improvement study. We did not require written informed consent from participants; for the focus groups, they were made aware of and allowed the recording and informed that they could leave or chose not to respond to any of the question prompts. All files were securely housed behind our University firewall with only the project team having access.

2.1 Study design and data collection

Student survey

We used a cross-sectional survey to assess the feasibility and desirability of a capstone course for current students and alumni. The survey questions were co-developed and reviewed for clarity by the steering committee and student research assistants to ensure it was understandable for our target audience. The survey was exploratory and not externally validated. There were no other inclusion or exclusion criteria. The convenience sample of respondents were contacted through email via program distribution lists and the University's alumni office, and via social media postings in a program-specific group. The invitations included a description of the study purpose and goals and a link to the survey. The survey introduction included a description of the program and the current curriculum milestones, a definition/description of a capstone project, and how it could be integrated into the program. The questions were exploratory and

broadly asked students about their experience or expectations writing the scholarly paper (the current final program milestone) and perceptions about a potential capstone project (see Appendix 1). Response options were level of agreement with statements (5-point or 6-point Likert scale, from strongly agree, agree, neutral/neither agree nor disagree, disagree, strongly disagree, and unsure/not applicable) regarding the scholarly paper, group work, logistical considerations for the capstone, and exposure to interdisciplinary educational components. The survey of 18 questions was administered through Microsoft Forms between January and February 2023. The results were anonymous and analyzed in Excel. Respondents who provided their email addresses subsequent to completing the survey were included in a random draw for two \$50 CAD gift cards.

Student focus groups

We employed a convenience sample of self-selected respondents who provided their email at the end of the survey to be contacted by a research team member. These students were emailed to participate in one of three focus groups aiming to further understand survey responses and why a health informatics capstone project may be desirable. No other criteria other than being a past/current student was required to be included in the focus group. Due to scheduling challenges, the three focus groups were attended by 9, 5, and 4 students, respectively. Eleven semi-structured questions were co-developed with the student research assistants and the project steering committee. Like the survey, the focus groups began with a description of the study goals and a definition/description of a typical capstone project. The focus group guide allowed for probing, follow-up, or rewording of questions based on learnings from the previous sessions (see Appendix 2). Participants were asked about their satisfaction with the scholarly paper milestone, interest in a capstone, key desired skills for their careers, optimal timing of a capstone project,

benefits and challenges, strategies to accommodate part- and full-time students, and potential projects. The focus groups were facilitated between February and March 2023 by the lead investigator or a student steering committee member, both of whom have experience in qualitative research; the research assistants took notes during the sessions. The use of multiple investigators helped reduce (not eliminate) observer bias. We did not collect demographic characteristics of participants. Each participant received a \$40 CAD honorarium in recognition of their time. The three 1-hour sessions were held online through Zoom, audio-recorded and transcribed verbatim automatically, then anonymized and double-checked for accuracy by a research assistant.

Student-partnered evaluations

Engaging students as partners was key to the project. To evaluate their experience, each student engaged with the conduct of the work as part of the research team was invited to provide feedback using an adapted version of the validated Public and Patient Engagement Evaluation Tool²³ as there are no tools available to evaluate student partnership engagement. We wanted to receive feedback on how the student partnership went and how the experience could be improved for the students involved (namely three on the project steering committee, two research assistants, and the curriculum developer).

Curriculum co-development

Following analysis of the survey and focus groups, the steering committee determined that a capstone course was desired and feasible, and decided to move forward with co-developing the curriculum with the full steering committee and a curriculum developer (program alumna and PhD). This was guided by principles of co-design for student-centered learning environments where students have opportunities to: 1) access, produce, and organize course

knowledge, 2) interact with peers and instructors, 3) receive and reflect on formative assessments, and 4) self-manage their learning after receiving feedback²⁴. The curriculum development phases included problem analysis, ideation and developing the course syllabus with students on the steering committee; future phases will include implementation, and evaluation, to align with other student-instructor partnerships^{25,26,27,28}. The co-creation approach was supported by bi-weekly meetings and iterative course planning in which we gathered information on the content and implementation of interdisciplinary capstone courses through reviewing syllabi on program websites and informally interviewing local instructors. This was done to better understand the range of course deliverables, modules, resources, and durations, operationalization, challenges, and effective strategies for managing a capstone program, which informed our course development.

2.2 Analysis

The survey data were analyzed by frequency and percentage of responses using descriptive statistics; the open-ended responses were summarized into similar themes per question based on a qualitative description content analysis approach, sticking close to the data²⁹. A transcript-based analysis of the three focus groups was conducted via Microsoft Word using thematic analysis independently by two research assistants with prior university-based research work experience and one of them had formal education in qualitative data analysis at the PhD course level and previous qualitative research publications. The thematic analysis was based on a general inductive and classic analysis approach^{30,31}. We chose this analytical approach because the nature of the questions asked meant that the coding and organization of themes would be data-derived and based on the interview guide questions. After reading through each transcript, they were chronologically analyzed line by line. Sentences, words, or phrases relevant

to the question(s) asked were coded into categories. The categories were further revised, consolidated, and grouped into themes based on similarity and patterns in the data^{30,31}. The codes and themes from both analyses were discussed with and reviewed by the primary investigator for consensus, coherence, and consolidation; we did not identify any disagreements with the data. Quotes were selected and presented that conveyed the themes we identified within and across focus groups.

3. Results

We received 87 survey responses; 55 (64%) from current students (18 part-time) and 32 (37%) alumni (5 part-time); due to the recruitment strategies employed, it is impossible to determine the response rate. Many students agreed (50.6%) or strongly agreed (25.3%) that they received sufficient interdisciplinary course experience. Most had not completed capstone projects but agreed or strongly agreed that a capstone would be valuable to their education (89.7%) and resume (83.9%). Forty-five students (52%) preferred a capstone while 17 (20%) preferred the scholarly paper. Students' perceptions about the benefits and challenges of a potential capstone project and the current scholarly paper program requirement are shown in Figure 1 and Figure 2; percentages are available in Appendix 3. They agreed a group-based capstone project supports interdisciplinary application of knowledge, group work and collaboration, and career-enhancing skills. Despite highlighting challenges in the scholarly paper process, most students agreed the paper provided an opportunity for individual work and exploring a topic of personal interest in depth, while strengthening critical appraisal and writing skills. The consistent themes that came up from the open-ended responses to curriculum preferences and anticipated benefits/challenges included developing new skills, disapproval of group work, group time constraints, need for formal accountability in group work, student choice of scholarly paper or capstone based on

post-graduation plans, exposure to real world experiences and job opportunities aligned with preferences, and setting standards for the capstone beforehand (Table 1). Current students were unsure of how a capstone may work in this context and unsure of the overall impact of either program milestone.

Eighteen past and current students participated in the focus groups. Interconnected themes identified across the focus groups aligned with sentiments in the surveys: 1) professional development, identity, and career advancement; 2) emulating the real world and learning beyond the classroom, 3) embracing new, full circle learning, 4) balancing student choice, interests, and priorities, 5) anticipated course structure, delivery, and preparation, and 6) group dynamics, limitations, and support (see Table 2).

Students were excited for the possibility of a capstone and envisioned an interdisciplinary approach that reflected real-world learnings and that would better connect them to potential employers and alumni. The students reflected on their own professional interests and future roles and how that would affect their educational choices and agreed that a capstone would reinforce their preparedness for collaborative/interdisciplinary health informatics work, which raised the need for choice among culminating projects. For example, several participants valued the scholarly paper because they could explore a topic of interest independently and practice writing/research skills useful for future research-oriented careers or further education, though some downfalls included unclear preparatory information and communication issues between readers. Career trajectories could be created, strengthened, and modified based on the success of the capstone and enhance preparation for employment in the workforce in addition to strengthening soft skills that are useful beyond the classroom.

Students foresaw customizable, collaborative, and structured learning possibilities within an integrated culminating project. They considered logistical constraints and success factors for curriculum delivery, deliverables, timing, integration, and course structure, relating back to the themes of managing diverse student interests, real-world learning, and experience beyond the classroom. We found that students want the program, faculty, and alumni to be more involved with learning, assessment, and accountability within a formally structured course, though the students recognized that this would involve more administrative, financial, and resource complexity. Mixed opinions about the nature of group work, technical limitations of existing software solutions, limited time provided by industry partners, and varied program supports could affect the success of a capstone. Challenges in group coordination, negative group dynamics, time management, availability of industry-sponsored projects, and overwhelming project complexity were noted by participants.

The capstone project course is intended to be completed over the final two semesters of the program. Student voice is reflected in the groups size limits (1 to 4 students) to allow for choosing independent exploration and to mitigate the logistical and personal challenges with working in larger groups. The content for foundational knowledge was informed by suggestions based on knowledge gaps student partners identified during their internships and post-graduation. The syllabus is provided in Appendix 4. Students and alumni who were integrated into this project, via the steering committee, or as research assistants and the curriculum developer, reported strong involvement with the project (see Figure 3). They also felt that their insights would be useful to future cohorts and graduates to make the course content practical and interdisciplinary.

4. Discussion

This quality improvement study sought to understand the desirability, sustainability, and feasibility of a curricular change (the introduction of a capstone project course) in a health informatics graduate degree program using a student-partnered approach. We found that a capstone project course is desirable for students and would enable a truly interdisciplinary approach with students working together with a greater range of community partners to design innovative human-centered solutions.

Capstones and interdisciplinary learning

Interdisciplinary learning approaches have positive social effects on students' understanding of their professional roles and that of their peers, as well as team-working skills such as communication, problem-solving, and team conflict resolution, though actual comprehension of informatics theories/content could be improved^{17,32}. This study demonstrates that students perceive these skills to be important to their professional development and believe that a capstone would facilitate these skills. More flexible thinking, higher-order cognition, critical thinking, and creativity can be achieved with interdisciplinary studies as the focus is on deeper learning and multi-sided arguments because the students acquire and integrate knowledge from different disciplines and, over time, become aware of the principles and strengths or limitations of each discipline². There have been successful capstone projects embedded in other health informatics^{33,34}, public health³⁵, and global health graduate degree programs³⁶, citing personal and professional benefits for students and employers. This study also adds to the literature to support the utilization of capstone projects in health informatics programs.

For an interdisciplinary program to be successful, faculty should have expertise and interest in interdisciplinary curriculum, and pedagogy focused on gradual and iterative collaboration, integration, and reflection, rather than memorization³⁷. The challenges to

implement interdisciplinary curriculum are lack of time and financial resources to plan and facilitate a course, course/program prerequisites preventing students from full participation, and unsupportive academic institutional systems that favor strong disciplinary boundaries for faculty^{7,38}. Interdisciplinary informatics programs address challenges in siloed health informatics work, such as a lack of synergy among software developers, health service researchers, and health practitioners, which may impact the usability, appropriateness, and integration of digital health technologies³⁹. The capstone course will include faculty members from across the represented disciplines as mentors to student groups, allowing for integration of the various perspectives in one course. Gaps between health informatics core competencies and industry needs/desires also exist due to the breadth of health informatics fields; for example, employers expect more technical skills in data analysis and database management than students may possess⁴⁰. According to our findings, a successful capstone could address data analysis, project management, and leadership skills, which aligns with recommended health informatics knowledge/skills areas⁴¹. This problem-based learning provides an avenue for professional enculturation and improves self-efficacy when students are asked to reflect on their process⁴². This is beneficial for health informatics education programs that are geared toward industry careers post-graduation and well-connected with community employers through on-campus career and professional development offices.

Student-partnered curriculum development and evaluation

We co-developed a two-semester three-credit capstone course syllabus based on our findings and the principles of student-centered curriculum development that included an integration of modules across the disciplines, micro-learning opportunities that mirror real-world experience in the sector, and preparation for post-graduation. We considered the student-centered

learning principles with innovative approaches such as reflection exercises and multimedia options to promote creativity and flexibility to meet the individual needs of full- and part-time students. Other considerations included timing of course modules and progression, various communication modes, leveraging virtual and in-person spaces, regular check-ins, and flexibility with project topic choices. Structured instructional strategies such as monthly check-ins with mentors, progress reports, and reflective writing assignments will maintain momentum and progress towards degree completion yet allow students to work independently or collaboratively with peers to conduct their background research, analysis, prototype solutions, and present findings.

There is great value in student involvement with curriculum design, resulting in better learning outcomes such as higher grades, better attendance rates, personal satisfaction with higher education, transformation of the traditional power relations between teacher and learner, and shared respect, trust, tolerance, and responsibility among the learning community^{43,44}. After integration of the capstone into our curriculum, we plan to evaluate its effects on student learning and partner experience through quantitative assessments detailing numbers of partners engaged, projects, and students. We will also incorporate annual mixed/qualitative assessments (e.g., results of start-stop-continue exercises within sessions, a student experience survey, a partner experience survey and/or exit interviews, and analysis of students' reflection assignments) to allow for content modification. We plan ongoing evaluations of student and instructor experiences each year, and to conduct focus groups after three years so we can gather longitudinal data on long-term impacts and sustainability of the curriculum changes.

4.1 Strengths and limitations

Our study contributes to a limited body of research on health informatics capstone courses and their potential to address core competencies required of health informatics students. The study also adds to the interdisciplinary health informatics education literature and shows the value of exposure to student-centered learning activities for students preparing for careers in health informatics. A major strength of this study is the active involvement of students and alumni in the decision-making process, ensuring their perspectives and needs were central to curriculum development. Including student partners, surveys, and focus groups was a conscientious effort to study a potential program change that empowered students to share their experiences, concerns, and desires in support of a more holistic and personalized student experience. The student partners reported strong engagement with the project. We note that the program change and course curriculum have been approved in Winter 2024 by the curriculum committees of the three collaborating faculties and will be offered for the 2024 incoming cohort of students.

We may have missed alumni who were unreachable through email or social media. Due to the convenience sampling used we missed the opinions of those who did not want to participate; they naturally may differ from those who chose to participate, so there is a risk of sampling bias. The survey was not externally validated so there may be limitations with survey validity, reliability, acquiescence/social desirability bias. We did not use semantic differential scales so there may be a confirmation bias in the questions. Though we did our best to provide a non-judgmental and inviting platform for open expression in the focus groups, the academic setting and group dynamics may have impacted the answers provided or risked social desirability bias in the presence of students' course instructors/academic advisors. We acknowledge the lack of generalizability of our findings and representativeness of our study sample which were limited to one program in one university and with only 18 focus group participants. We did not collect

demographic information from respondents and focus group participants beyond the year of school they were in and their part-time or full-time student status, so we were not able to systematically analyze other sociodemographic factors that may have influenced their perspectives, potentially leading to oversimplification of their responses and feelings. We acknowledge there is a minor risk in removing the scholarly paper milestone, though students who wish to pursue an independent research study will still have the choice to select or switch into the full-time thesis stream. Future plans include evaluating the experience of students, faculty, industry partners, and employers and understand how the change and its effects align with the overall mission (interdisciplinarity, collaboration, cultivating professionals to advance technology and health care) and values of the program (e.g., student-directed learning, diverse perspectives, collaborative team work, and experiential learning).

5. Conclusion

With the shift toward more student-centered learning activities, we collaborated with students and alumni to explore the feasibility and desirability of a health informatics capstone course that combines foundational knowledge acquisition in digital health with hands-on, inquiry-based projects. Health informatics programs should continuously prepare students to enter the changing workforce by reviewing and revising program curriculum to better meet the practical, applied, and research learning needs of students.

Clinical Relevance Statement

Health informatics programs can better serve the learning styles and needs of students by engaging in students-as-partners/student-centered learning approaches for curriculum development. The addition of a capstone or enhancement of other culminating milestones in graduate programs enhances soft and technical skills of future health informaticians making them

better prepared for careers in health informatics. Capstone courses must be carefully planned to ensure relevance to students and meet the current needs of the health informatics industry and the population served.

Multiple Choice Questions

Question 1: How does a capstone course for a health informatics program enhance student learning?

- a) Students do not need to understand technical aspects of health informatics
- b) Integrates foundational health informatics knowledge acquisition and application
- c) Eliminates the need for program instructors to monitor the course
- d) Students teach themselves without input from their capstone mentors

The correct answer is B). A capstone course can enhance student learning by combining and integrating knowledge learned in the classroom with more learning by applying this knowledge in a real-world or plausible problem-based or project-based scenario. Often capstone projects will include a community partner or industry project sponsor from an organization with a need for a solution to a defined problem.

Question 2: What are the benefits to student-centered learning?

- a) Students are less motivated to learn the material
- b) Students participate less in the classroom
- c) Students do not feel responsible for how or what they learn
- d) The content is more relevant and relatable to students

The correct answer is D). Student-centered learning is intended to involve students in curriculum choices, development, and pedagogical strategies with some flexibility in the content

they want to learn and how they can most effectively and enjoyably learn the content. This results in students who are more motivated to learn, more engaged with the content, and therefore participate more actively in the classroom.

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Conflict of Interest: All of the authors have an affiliation with the MSc eHealth program. **NW, CL, VM, NB** (faculty members), and **ML** (internship coordinator) are employees of **McMaster** University and receive salary through program revenues. **RJ, TB, EW, SZ,** and **JF** are alumni of the program.

Human Subjects Protections: This study received clearance from the Hamilton Integrated Research Ethics Board.

List of Appendices

Appendix 1: Student Survey Question Guide

Appendix 2: Student Focus Group Question Guide

Appendix 3: Results from the student survey about capstone and scholarly paper perceptions

Appendix 4: Capstone Course Outline

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Figure Captions

Figure 1: Students' perceptions about the benefits and challenges a capstone course would create (n=87).

Figure 2: Students' perceptions about the benefits and challenges of the scholarly paper program requirement (n=87).

Figure 3: Student engagement feedback questionnaire (n=4).

Table 1: Student open-ended responses to learning activity preferences and benefits and challenges of a capstone compared to a scholarly paper

Question	Themes
Do you think a group-based Capstone Project has greater benefits than potential challenges? For the question above, please explain your reasoning.	Unsure
	Timing
	Varied student timeframes for completion
	Challenging to pick a topic
	Gather all learnings
	Real world group experience
	Appreciate different perspectives
	Utilizing skills from course group work
	Expand knowledge in other competencies
	More creativity
	More in-depth analysis
	More interesting
	More networking
	Learn from peers
	Fewer group participation issues at Masters level
	Reflects real-life challenges and environments
	Collaboration
	Group work expands skill set
Varied backgrounds support learning about specific organizations and technological solutions	
Would you prefer to do a scholarly paper individually or a capstone project in a group? Please explain your reasoning behind the above answer.	Unsure of impact of scholarly paper
	Unsure what a capstone would look like
	Prefer group work
	Learning more in capstone
	Varied priorities e.g., research vs industry
	Burnout from too much group work
	Need for the option
	Worried about unequal workload in capstone
	Connected to external organizations in capstone
	Become knowledge expert during the scholarly paper process
	Need for better workflow processes for scholarly paper
	paper
Is there anything else you would	Positive benefits of capstone
	Unique student needs and experiences need to be

like to add?	considered
	Provide students an option to work independently
	either way
	Reach out to alumni more often
	Scholarly paper and knowing how to read and appraise research is valuable

Table 2: Desirability, feasibility, benefits, and challenges of a capstone course identified by focus group participants

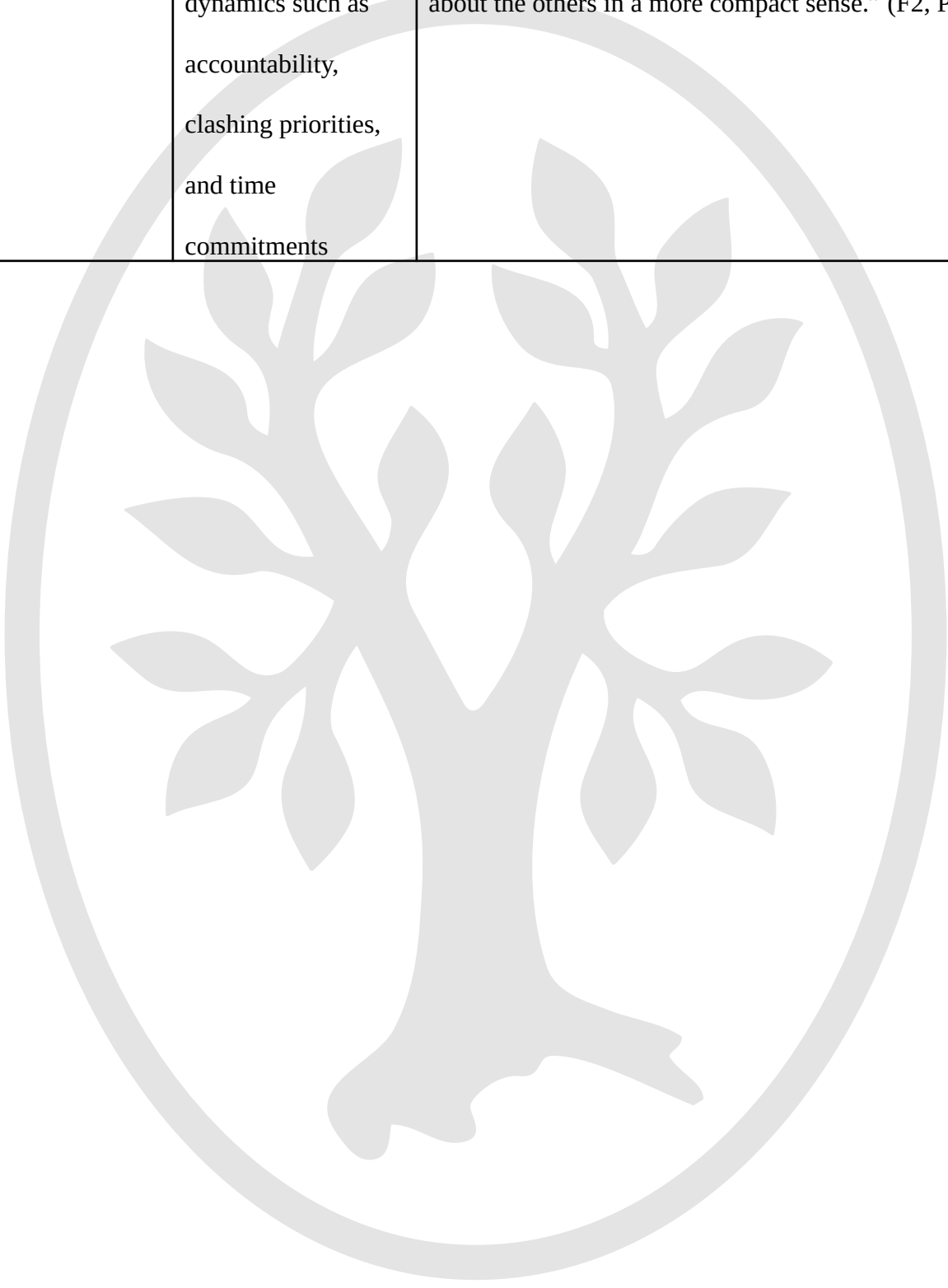
Theme	Description	Selected Quotes
Professional development, identity, and career advancement	Interest and orientation towards academic activities that involve industry partners, prepare for workforce, advance professional identity, and assist with job-seeking and resume building	<p>“One of the benefits for the capstone would be greater connections when it comes to internships. Having other organizations see the benefit of having eHealth students work on some projects, but I think it also depends on where the projects are coming from” (F1, P5)</p> <p>“You could have an alumni representative for each role... that could help us to network with potential alumni, which I know a lot of people don't get the chance to do” (F2, P3)</p>
Emulating the real world and learning beyond the classroom	Appreciation for learning that reflects real-world contexts and current problems pertinent to the industry and	<p>“This is actually pushing you into an industry-led situation... You're going to expose a lot more of the soft skills that employers are looking for, such as your creativity and your ability to apply the knowledge...actual work integrated learning which again is more realistic to the workplace and beyond</p>

	skills that are useful in daily life and employment outside of academia	that, it's the connections and the networking that you'll make through it" (F3, P3) "The learnings can go well beyond what's in the classroom as well. But I also think the engagement that it solicits is also like a really big bonus to doing the capstone and like putting you in charge of your own project... As I'm doing my scholarly paper, I'm not as engaged. Like it's just mostly me, myself and I and no other third parties. I'm not working with anyone." (F2, P3)
Embracing new, full circle learning	Reflections on benefits of the capstone for positive and lasting learning experiences, envisioning greater interdisciplinarity, new compensatory or complementary skill development, and appreciation for a deep dive of a topic of interest	"It encompasses all the things that we've learned through our course in the program, such as like, doing a literature review, doing the research, and then presenting your findings. I think that is sort of like what the program thrives on, which is that interdisciplinary approach of it... With their different ideas coming with their different professional and academic backgrounds, I feel they could fill the gaps and serve the purpose of the interdisciplinary mode of this program" (F3, P3) "I will be able to kind of encompass all of my learnings together and it kind of acts also like a like a reflection project... you're using all of those skills in this way, whether it's for a paper or project...which

		definitely makes you more conscious of what you learned, how you learned it, where to apply it” (F2, P6)
Balancing student choice, interests, and priorities	Awareness of differences in students interests and priorities within the program and their anticipation of future roles. Desire to consider curriculum that offers students milestone choices that align with their professional and career preferences and schedules outside of school (e.g., work and family)	<p>“I don't know how practical it would be in terms of staff and guidance... everyone has different priorities, right? If some people are looking for professional advancement, capstone is really, really great. If you're looking at maybe doing things on your own time, maybe looking more at academic research, then scholarly paper” (F1, P4)</p> <p>“There needs to be different options and different pathways available to see what that individual student is lacking. Are they lacking academic preparedness? Are they lacking industry experience? Are they lacking project experience, right?... Leave the different opportunities open for pathways for students to pick and choose what they feel that they are lacking, what they are missing” (F3, P2)</p>
Anticipated course structure,	Discussions on potential logistics for the course	"Having a variety of deliverables to work on in a real-world context would be really useful for us to practice and see how our skills could be applied in

<p>delivery, and preparation</p>	<p>structure, pros, and cons of various delivery modes (e.g., blended, online, in-person), how to prepare students for working on a capstone (e.g., pre-capstone workshops and modules), and how to choose topics/groups</p>	<p>the real world” (F2, P4)</p> <p>“It has to be realistic because if it's not, then it's just another thing that you had to do...It's not adding any benefit to your studies and what you have accomplished in this program... How is it different and why is it so different, right? What's the purpose behind it. What am I going to gain?” (F3, P2)</p>
<p>Group dynamics, limitations, and support</p>	<p>Reflections on challenges that may arise due to external limitations of industry partners technological limitations of software chosen, limited support/communication from the</p>	<p>“Formation of groups, number of students, the same interest, and also depends on the availability and the matching of industry partners. These are all unknowns that I think might that be a challenge” (F1, P6)</p> <p>“I'm coming from an engineering background, so I would appreciate if I had someone with insights from Health Science background, or someone with insights from a management background to be on the team and that would, I think, play the whole project well, so everybody would have their own kind of</p>

	program, and group dynamics such as accountability, clashing priorities, and time commitments	niche where they could contribute to, but also caring about the others in a more compact sense.” (F2, P6)
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Student Survey Question Guide

We are assessing the desirability, feasibility, and sustainability of a capstone project in the MSc eHealth program. We are in the preliminary stages and this survey asks past and current students about their scholarly paper experience/expectations and perceptions about a capstone project and group work. Depending on the data collected and analyzed, this capstone project would replace the scholarly paper requirement for incoming students in 2024. NOTE: The content and format of delivery of the capstone has not been determined as its development will come after we gauge interest.

Reminder: Key eHealth MSc program learning goals are foundational knowledge across the 3 disciplines, integrating this knowledge, critical thinking, professional and research skills, and working collaboratively in interdisciplinary teams. These are met through courses which emphasize group projects, internship, and the seminar series.

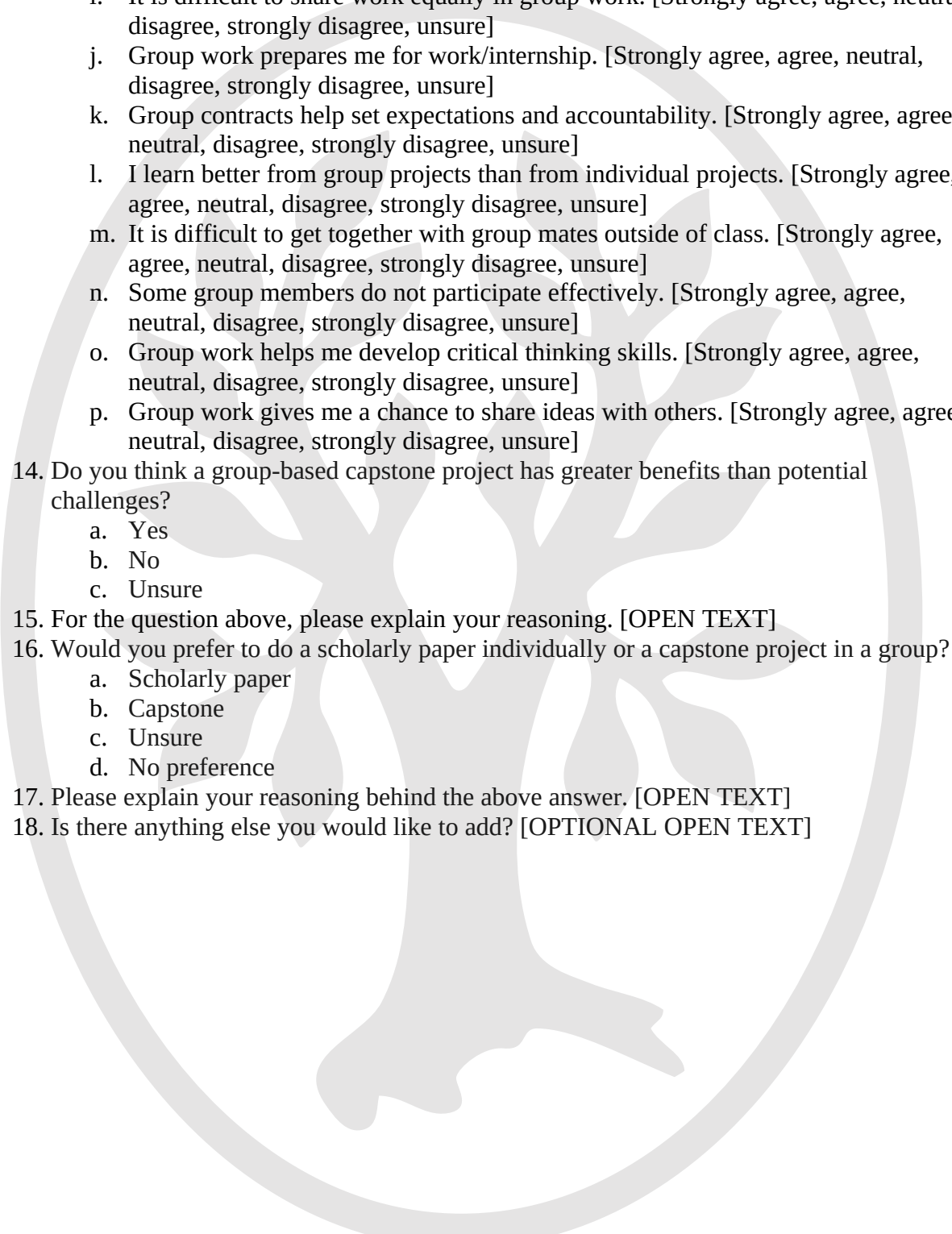
Thank you in advance for providing your valuable input.

1. Are you a current student or alumni?
 - a. Current student
 - b. Alumni
2. If current and course-based, what stage are you currently at?
 - a. Part time student
 - b. Full time year 1 student
 - c. Full time year 2 student
 - d. Not applicable
3. If alumni, which stream were you in at registration into the program?
 - a. Part time
 - b. Full time
4. Interdisciplinary study involves the combination of 2 or more academic disciplines into one to introduce new perspectives. From an eHealth MSc degree perspective, interdisciplinary refers to the combination of Health Sciences, Business and Engineering.
 - a. Based on your experience in the eHealth courses, do you feel that you are getting/had sufficient interdisciplinary experience (business, healthcare, information tech)? [Strongly agree, agree, neutral, disagree, strongly disagree, N/A]
 - b. For full-time students who have completed an internship: Based on your eHealth internship experience, do you feel that you are getting/had sufficient interdisciplinary experience (business, healthcare, information tech)? [only for full-time students] [Strongly agree, agree, neutral, disagree, strongly disagree, N/A]
5. A typical capstone project is a culmination of knowledge and skills derived from the information, concepts, and methodologies they learned from their curriculum. In the eHealth program, it will emphasize interdisciplinarity and integrative problem-based learning by challenging students to apply their personal, academic, and professional experience to demonstrate a mastery of the field. A capstone project will partner student groups with real-world companies/organizations to address existing issues. Students will document their learning and project progress relative to external industry/professional

requirements/standards. A capstone project is largely independent, with guidance but minimal instruction from academic supervisors to allow students to approach their problem(s) in unique and creative ways. Instead of binary outcomes, students are assessed through written documents (e.g., progress reports, literature reviews, research analyses, proposals, meeting logs), diagrams, oral and poster presentations. At the end of the capstone project, student teams present their solutions and at a symposium attended by academic supervisors and company clients who assess the results.

- a. A capstone would be valuable to my interdisciplinary education. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - b. Completing a capstone project would be a good addition to my resume. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
6. Have you completed a capstone project in other programs?
- a. Yes
 - b. No
7. If you have previously completed a capstone project, what was the focus of your project?
[OPEN TEXT]
8. A capstone project would help me to:
- a. Identify, formulate, and solve complex healthcare problems by applying principles of business, health, and information technology. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - b. Apply design principles to produce solutions that meet specified needs. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - c. Communicate effectively with a range of audiences. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - d. Function effectively on a team. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - e. Experiment, analyze and interpret data, and use judgment to draw conclusions. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - f. Acquire and apply new knowledge. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
9. A capstone project would:
- a. Not offer new learning/be redundant to previous learning in the program. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - b. Take more time/effort than a scholarly paper. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - c. Be more beneficial than a scholarly paper. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
10. The scholarly paper is currently a mandatory component of the MSc eHealth program for all course-based students. The topic is driven by the student's interest and supported by faculty and industry readers with related expertise. The ~20-page paper shows a student's individual ability to apply their knowledge and skills to address an important issue in healthcare using information technology in a concise, critical, and coherent manner. During the internship, students begin the scholarly paper process with guidance from their academic advisor. This may be replaced by a capstone project.
- a. The lack of firm deadlines made/makes the scholarly paper experience challenging. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]

- b. Working independently made/makes the scholarly paper experience challenging.
 - c. Finding a suitable scholarly paper topic was/is challenging. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - d. Finding readers for the scholarly paper was/is challenging. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - e. Finding the internal motivation to complete scholarly paper is challenging. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - f. The scholarly paper helps me to consolidate my interdisciplinary learning. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - g. The scholarly paper enhances my critical appraisal skills. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - h. The scholarly paper strengthens my report writing skills. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - i. The scholarly paper allowed/allows me to explore a topic of interest in depth. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - j. The scholarly paper allowed/allows me to connect with new faculty members. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - k. The scholarly paper provided/provides me with the opportunity to support my internship/a community partner. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - l. I appreciate that the scholarly paper is an independent project, done alone. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
11. What stage are you on in the scholarly paper?
- a. Completed
 - b. Writing
 - c. Preparing my proposal
 - d. Thinking about a topic
 - e. I have not considered the paper at this stage
12. Please share any thoughts/suggestions about the scholarly paper (the task, process, or assessment). [OPEN TEXT]
13. Group Work: Based on your experience in the eHealth program:
- a. The challenges faced in group work outweigh the benefits. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - b. Group work allows students to take on different roles. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - c. Peer evaluation helps ensure students contribute to the group. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - d. There was adequate opportunity to address challenges in group work through remediation/negotiation. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - e. Group work makes me unnecessarily busy. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - f. Group work motivates me to learn. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
 - g. Group work develops my independent learning habits. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]

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- h. The benefits of group work outweigh the challenges. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
- i. It is difficult to share work equally in group work. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
- j. Group work prepares me for work/internship. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
- k. Group contracts help set expectations and accountability. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
- l. I learn better from group projects than from individual projects. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
- m. It is difficult to get together with group mates outside of class. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
- n. Some group members do not participate effectively. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
- o. Group work helps me develop critical thinking skills. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
- p. Group work gives me a chance to share ideas with others. [Strongly agree, agree, neutral, disagree, strongly disagree, unsure]
14. Do you think a group-based capstone project has greater benefits than potential challenges?
- Yes
 - No
 - Unsure
15. For the question above, please explain your reasoning. [OPEN TEXT]
16. Would you prefer to do a scholarly paper individually or a capstone project in a group?
- Scholarly paper
 - Capstone
 - Unsure
 - No preference
17. Please explain your reasoning behind the above answer. [OPEN TEXT]
18. Is there anything else you would like to add? [OPTIONAL OPEN TEXT]

Student Focus Group Question Guide

Part 1: Team introductions, expectations

Part 2 Study background and context: As you know from the survey that you completed, the eHealth program is assessing the desirability, feasibility, and sustainability of a potential change in the program requirements to include a capstone project instead of a scholarly paper.

Understanding the student perspective will greatly influence our assessment of ‘desirability’. A capstone project is a culmination of a student’s educational career. It emphasizes interdisciplinary, integrative problem-based learning; challenge students to apply their personal, academic, and professional experience; and demonstrate a mastery of the field. A capstone project is generally largely independent, with guidance provided but minimal instruction or supervision to allow students to approach their problem(s) in unique and creative methods. Alternative to binary pass/fail marking schemes, capstone students are typically assessed through a variety of incremental deliverables, including progress reports, literature reviews, research analyses, proposals, meeting logs, diagrams, oral presentations, and poster presentations. Though we do not know what an eHealth capstone would yet include, we are exploring: Group-based, industry/community/clinical partnerships to bring projects, and learning modules (e.g., design thinking, business plan development)

1. What is your name, and what years you were in the program? Indicate if you are/were a part-time student.
2. What are your initial thoughts about such a proposed change?
3. What benefits would a capstone project bring you? The program?
4. What are your concerns? Do you foresee any challenges, or have you encountered some in other similar courses/activities?
5. How would you want to see it integrated into the program?
 - a. Probing on timing, length, delivery (in-person vs virtual)
 - b. Student-identified problems/solutions
6. What do you think should be the outcome of a capstone course? (e.g., deliverables or skills used)
7. When integrating a capstone into the program, we need to consider timing. What would the optimal timing be? Length of the course?
8. Is there anything you would like to share about the scholarly paper?
9. Would capstone vs. paper impact your decision to pursue the eHealth program?
10. What is your general impression of group work in the program?
11. Logistic Capstone Questions (need a better sense of potential options)
 - The capstone project should be offered over 2 semesters (fall/winter)
 - The capstone should be in our final winter semester
 - Most of the capstone work should be done virtually
 - Capstone education modules should be virtual
 - Capstone modules should be asynchronous
 - Capstone modules should be in person
 - Capstone projects should be student-initiated
 - Capstone projects should respond to community/industry partner needs
 - Course and group meeting times should be scheduled in firm timeslots

Appendix 3: Results from the student survey about capstone and scholarly paper perceptions

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Unsure
Identify, formulate, and solve complex healthcare problems by applying principles of business, health, and information technology	39.1%	51.7%	5.7%	0.0%	0.0%	3.4%
Apply design principles to produce solutions that meet specified needs	43.7%	48.3%	4.6%	0.0%	0.0%	3.4%
Communicate effectively with a range of audiences	35.6%	46.0%	11.5%	3.4%	0.0%	3.4%
Function effectively on a team	36.8%	37.9%	18.4%	3.4%	2.3%	1.1%
Experiment, analyze and interpret data, and use judgment to draw conclusions	42.5%	46.0%	3.4%	2.3%	0.0%	5.7%
Acquire and apply new knowledge	44.8%	48.3%	4.6%	0.0%	0.0%	2.3%
Not offer new learning/be redundant to previous learning in the program	5.7%	8.0%	8.0%	43.7%	29.9%	4.6%
Take more time/effort than a scholarly paper	13.8%	24.1%	34.5%	10.3%	9.2%	8.0%
Be more beneficial than a scholarly paper	36.8%	33.3%	16.1%	3.4%	4.6%	5.7%

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Unsure
The lack of firm deadlines made/makes the scholarly paper experience challenging	21.8%	25.3%	24.1%	17.2%	4.6%	6.9%
Working independently made/makes the scholarly paper experience challenging	25.3%	24.1%	19.5%	19.5%	3.4%	8.0%
Finding a suitable scholarly paper topic was/is challenging	25.3%	29.9%	19.5%	13.8%	4.6%	6.9%

Finding readers for the scholarly paper was/is challenging	19.5%	26.4 %	19.5%	11.5%	2.3%	20.7%
Finding the internal motivation to complete scholarly paper is challenging	27.6%	32.2 %	14.9%	8.0%	4.6%	12.6%
The scholarly paper helps me to consolidate my interdisciplinary learning	8.0%	35.6 %	28.7%	6.9%	6.9%	13.8%
The scholarly paper enhances my critical appraisal skills	16.1%	49.4 %	17.2%	3.4%	3.4%	10.3%
The scholarly paper strengthens my report writing skills	29.9%	43.7 %	12.6%	1.1%	1.1%	11.5%
The scholarly paper allowed/allows me to explore a topic of interest in depth	23.0%	59.8 %	6.9%	1.1%	1.1%	8.0%
The scholarly paper allowed/allows me to connect with new faculty members	4.6%	35.6 %	31.0%	10.3%	2.3%	16.1%
The scholarly paper provided/provides me with the opportunity to support my internship/a community partner	8.0%	19.5 %	25.3%	19.5%	9.2%	18.4%
I appreciate that the scholarly paper is an independent project, done alone	17.2%	24.1 %	35.6%	12.6%	6.9%	3.4%

Appendix 4. Capstone Course Outline

MSc eHealth

COURSE OBJECTIVE

The MSc eHealth capstone course provides students with the opportunity to integrate the knowledge gained during the eHealth program core courses and apply that knowledge to a real-world project outside the traditional classroom environment. In doing so, this course supports an experiential learning process. Through this process, students demonstrate acquisition of the required skills employers expect from MSc eHealth graduates.

COURSE ELEMENTS

Credit Value: 3	Leadership: Yes	IT skills: Yes	Global view: Yes
Avenue: Yes	Ethics: Yes	Numeracy: Yes	Written skills: Yes
Participation: Yes	Innovation: Yes	Group work: Yes	Oral skills: Yes
Evidence-based: Yes	Experiential: Yes	Final Exam: No	Guest speaker(s): No
REB approval If req'd			

COURSE DESCRIPTION

The eHealth capstone course is designed with a comprehensive goal of providing a culminating exercise for course-based students. This goal will be achieved by having students apply the integrated knowledge accumulated through the core courses of the program to a tangible healthcare challenge and propose possible solutions. To reflect the challenges of digitizing healthcare, the course will by necessity include a broad range of projects for students. Regardless of the type of project, students are expected to a) develop a proposal which will include a project plan, b) research and ideate possible solutions, and c) present their final projects to stakeholders.

A capstone project may be proposed by students or sourced from community partners. Examples of a capstone project may include: a project aligned with the students'/partners' workplace or experience, the continuation of a project from a previous course, a product design project, or a research project. The defining feature of a capstone project is field-based, experiential learning. A capstone project is managed by the student(s), not the instructor(s)/consultants. The instructors/consultants are available in a supportive capacity for

guidance. A capstone project can be completed individually or as a group (maximum 4 students).

This capstone course is offered over two semesters. In the Fall semester, students will complete 12 weeks of preparatory asynchronous online self-learning via a curated mini-course of LinkedIn learning modules and readings culminating in a Project Pitch session (in person). The Winter semester consists of the capstone project itself with a kick-off hybrid session, regular mandatory online check-ins with course consultants (eHealth faculty coordinators) and other stakeholders every two weeks, and individual or group-led project work. Apart from the project pitch and kick-off sessions, all work and interaction for this course will take place virtually (some synchronous and some asynchronous).

LEARNING OUTCOMES

Upon completion of this course, students will be able to demonstrate the following key skills:

- L1 - Integrate learnings from across the eHealth program core courses, as well as the capstone course Fall semester modules, in the creation of a proposal
- L2 - Demonstrate the ability to work collaboratively to effectively manage the ambiguity involved with a complex project
- L3 - Apply and enhance effective communication skills with team members (if applicable), stakeholders and instructors
- L4 - Design deliverables with the potential to be integrated into health/healthcare settings
- L5 - Reflect on performance, experiences and learnings throughout the capstone project
- L6 - Evaluate the outputs of the project regarding contributions to knowledge or practice, and/or viability/sustainability in a real-world context, as well as critical appraisal and considerations of implementation

REQUIRED COURSE MATERIALS AND READINGS

FALL SEMESTER SELF-LEARNING MODULE ASSIGNMENTS

For most weeks, an exam accompanies the LinkedIn course. Students will provide the results of the exams and certificate of completion. Details in the Appendix.

EVALUATION

Learning for the capstone course results primarily from the planning and execution of your capstone project. Evaluation focuses on completion of preparation modules, project-related

presentations and documents. Students will also be providing peer-critique of classmates' presentations to enhance skills in appraisal and communication of feedback. Should the capstone be undertaken as a project with more than one member, each member will receive the same grade for all capstone components.

Components and Weights

Individual Assignments

Week	Due Date	Assignment	Learning Outcomes	% of Final Grade
Fall				
F1-2	Optional	Personal goal setting for the course		0%
F1-4	End Wk 4	Complete self-learning modules 1, 2, 3, and 4	All	5%
F5-7	End Wk 7	Complete self-learning modules 5, 6, and 7	L2, L3, L5	5%
F8-10	End Wk 10	Complete self-learning modules 8, 9, and 10	All	5%
F11-13	End Wk 13	Complete self-learning modules 11, 12 and 13	All	5%
Winter				
W6	Wk 6	Peer critique of mid-term presentations	L3	5%
W13	Wk 12	Individual reflection essay on capstone experience and learning	L5, L6	20%
W13	Wk 13	Peer critique of final presentations	L3	5%
Total allocation for individual assignments				50%

Capstone Assignments

Due Date	Assignment	Learning Outcomes	% of Final Grade
Winter			
W1	Defined project summary		0%
Graded w12	Bi-weekly progress meetings with faculty consultants (virtual), pre-scheduled for	All except L6	10%

	the semester (weeks 2,4,7,9, optional 11)		
W3	Proposal	L1, L2, L3, L4, L6	5%
W6	Mid-term presentations (15 min +5 for Q&A)	L2, L3, L4, L6	5%
W12	Final presentations (15 min +5 for Q&A)	L2, L3, L4, L6	10%
W14	Final report	All except L5	20%
Total allocation for capstone assignments			50%

Grade Conversion

At the end of the course your overall percentage grade will be converted to your letter grade in accordance with the following conversion scheme:

LETTER GRADE	PERCENT	POINTS
A+	90-100	12
A	85-89	11
A-	80-84	10
B+	77-79	9
B	73-76	8
B-	70-72	7
F	00-69	0

Course Deliverables

Individual Deliverables

Self-learning modules (20%)

Graded individually. The goals of the modules are to provide you with foundational skills such as design thinking, leadership, communication, change management, team building and team collaboration. Proposal writing modules are included; these modules complement the proposal writing template provided to you on A2L. Together, these modules prepare you for a successful capstone experience.

Peer critique of mid-term presentations/final presentations (5% each, 10% total)

Graded individually. This is an opportunity to provide feedback by engaging critical, analytical and design thinking skills when assessing capstone projects of peers with regards to the rationale for problem selection, feasibility of proposed solution(s), and clarity in communicating both aspects of their capstone project. Rubric provided.

Reflection essay (20%)

Graded individually. Although you will submit a reflective essay in week 13, we encouraged you to take the time to reflect on their learnings and experiences throughout the Fall and

Winter terms. There will be a submission folder for you to draft (ungraded) individual personal goals you set for yourself early in the course. When writing your reflective essay, you can review how and if you achieved them. Consider also if your capstone work could be applied in settings other than the one originally chosen for the capstone project. Template and rubric provided.

Capstone Activities and Assignments

Capstone pitch and team forming event (0%)

Projects will be pitched by students and on behalf of community partners late in the Fall. Capstone project ideas and defined projects will be reviewed by the course instructor, who will provide feedback on the suitability and feasibility of the project. The suitability criteria are an assessment of project complexity, feasibility of project scope within the given timelines, vetting of chosen project sponsor, and team composition.

The capstone may be completed as an individual or by a group with a limit of 4 members. Groups will form based on interest in the pitched projects, much like a hackathon event, and the instructors will not be involved in forming or managing groups. If working in a group, the entire group is expected to agree on the defined project, and to participate in the pitch presentation. Not graded.

Regular progress meetings with consultants/faculty coordinators (10%)

The 3 faculty coordinators will each act as consultants for 1/3 of the groups and meet on weeks 2, 4, 7, 9 and optionally 11. These meetings are mandatory. Students will document the meeting discussion, create action items, and report on progress. A Project Team Log template is provided on A2L.

Week 2 discussion

- Feedback on project summary, team contract
- Progress on proposal, roadblocks, obstacles, how they were overcome
 - Demonstrate managing ambiguity, collaborative team work
- Communication with external partners
- Informal group reflection

Week 4 discussion

- Progress on project; troubleshoot arising issues
- Informal group reflection

Week 7 discussion

- Feedback received during week 6 mid-term presentations
- Progress on project; troubleshoot arising issues
- Informal group reflection

Week 9 discussion

- Progress to complete presentation by week 12; troubleshoot arising issues.
- Informal group reflection

Week 11 discussion (optional)

- Practice presentation; progress on final report;
- Informal group reflection

Defined project brief (0%)

At the beginning of the winter term, you/your team must have a defined project. This is not a proposal but rather a short paragraph (3-5 sentences) describing the capstone project you would like to undertake. Not graded.

Kick-off session

This one-hour hybrid session will be in week 1 of the winter term to set the expectations and learning objectives for the capstone project component of the course. Not graded.

The following assignments are graded. If a group is working on these assignments, all members of the group receive the same grade.

Proposal (5%)

The capstone project is done in an experiential learning context that will challenge you to address "wicked" problems within realistic contexts. Undertaking a capstone project means to understand multifaceted problems within the frame of your own mental models rather than that provided by your professors, textbooks, and other reading materials. At the end of the capstone project, you will have derived new, useful knowledge combined with experience, context, interpretation, and personal reflection.

The proposal will expand on the initial project summary and incorporate feedback and suggestions from consultant meeting 1. Groups may also meet with project partners/sponsors in developing their proposal (if applicable).

The proposal must include a team charter (aka group contract) if the capstone is undertaken as a group. The proposal is your opportunity to formulate the problem, why it is important, and the plan to address the solution. Template and rubric provided.

The capstone instructors and students will ensure that:

- the proposal centres on the challenge of digital health and integrates the knowledge accumulated through the eHealth program core courses
- the solution(s) contribute to knowledge, practice, viability, and sustainability in a real-world context

- the proposal includes a critical appraisal of solution(s) , as well as implementation considerations
- the proposal is feasible.

During the week 4 consultant meetings with the faculty coordinators, proposal feedback, deliverables and timelines will be discussed.

Mid-term presentations (5%)

Presentation to the class, instructors, consultants defining the scope of the project and initial proposed solutions. This is an opportunity for broader feedback from the class and critical assessment of proposed solutions. 15 minutes to present capstone project and 5 minutes for Q&A. Rubric provided.

Final presentation (5%)

During the final presentation, students are expected to have incorporated the feedback received from the capstone instructors, their peers, and the external partners (if applicable), and present the problem, the solution, and what they learned during the capstone project. 15 minutes to present capstone project and 5 minutes for Q&A. Rubric provided.

Final project report (20%)

The project report documents the implementation of the capstone project proposal and should demonstrate multifaceted understanding of the problem addressed and new, useful knowledge combined with experience, context, and interpretation. The paper will provide the background and context of the healthcare challenge, analysis of proposed solutions and key findings, implications of implementing the proposed solutions, and forecasting future work needed to make the solution viable and sustainable.

If working in a group, the final report will be submitted as a single deliverable by the same group that submitted the previous capstone assignments. A draft of the report may be optionally submitted in advance of the final deadline if agreed upon by the course instructor. Template and rubric provided.

Students will work in groups (if students elect to work in smaller groups, the academic expectations will be the same, and students will be asked to acknowledge this as part of their group work contract). To ensure effective group work by all members, groups will submit a group contract agreement at the beginning of the course, and will submit a self-assessment and an assessment of each group member at the end of the course. Groups will be monitored intermittently during the term through formative feedback to ensure that the group is working well together. Each member of the group is expected to meet the learning outcomes for the course, and should be prepared to present and answer questions on all aspects of the project

Course Delivery Modalities

ACTIVITY	DELIVERY	DESCRIPTION	TOOLS
1. LinkedIn Learning Course	Asynchronous	Complete modules and upload exam results and/or certificates of completion	LinkedIn Learning and Avenue 2 Learn submission folders
2. Project Pitches	Synchronous (possibly hybrid)	Pitches and team forming	On campus and Zoom
3. Kick-off	Synchronous, hybrid	Presentation of capstone expectations	On campus and Zoom
4. Bi-weekly Meetings	Synchronous, virtual	Students provide progress updates to capstone faculty	Zoom
5. Group Work	Synchronous and Asynchronous	Group members' choice. MS Teams private groups are available.	Zoom, MS Teams, Google; onsite library rooms
6. Written Assignments	Asynchronous	Upload to A2L	Avenue 2 Learn
7. Presentations, Mid-term and Final	Synchronous, virtual	Presentation of capstone projects	Zoom

APPENDIX LINKEDIN LEARNING MODULE FULL DETAILS

Wk	Self-learning Module	Learning Outcomes (as per Course Outline)	References
1	Proposal Writing <u>Assessment:</u> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.	L1, L2, L3, L4, L6 This course provides guidance on writing a proposal, which is the first step of your capstone	LinkedIn course "Writing a Proposal" by Judy Steiner-Williams Length: 2h 11m + exam (https://www.linkedin.com/learning/writing-a-proposal/welcome?u=2155426)
2	Proposal Readings <ul style="list-style-type: none"> Miner & Miner (2013): Chapter 7 	L1, L2, L3, L4, L6 These readings provide	Miner, J. T., & Miner, L.

	<p>“Problem Statement”</p> <ul style="list-style-type: none"> • Miner & Miner (2013): Chapter 8 “Goals, Objectives, and Outcomes” • Miner & Miner (2013): Chapter 9 “Methods” • Miner & Miner (2013): Chapter 10 “Evaluation” • Miner & Miner (2013): Chapter 12 “Budgets” 	further guidance on writing a proposal, which is the first step of your capstone	E. (2013). Proposal Planning & Writing, 5th edition. ABC-CLIO, LLC. https://ebookcentral.proquest.com/lib/mcmu/detail.action?docID=1495754
3	<p>Leadership: Leading Projects</p> <p><i>Assessment:</i> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p>	<p>L2,L3</p> <p>In weeks 1 and 2, you will have completed the Project Proposal modules. Week 3 is an overview/refresher of important project management concepts and practices.</p>	<p>LinkedIn course “Leading projects” by Daniel Stanton</p> <p>Length: 2h 11min + exam</p> <p>(https://www.linkedin.com/learning/leading-projects/project-management-simplified?u=2155426)</p>
4	<p>Leadership: Leading with Emotional Intelligence</p> <p><i>Assessment:</i> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p>	<p>L2, L3, L5</p> <p>Managing ones emotions as a leader is essential to all aspects of working in a team. Self-reflection assists in improving emotional intelligence (EQ).</p>	<p>LinkedIn course “Leading with Emotional Intelligence” by Britt Andreatta, PhD</p> <p>Length: 1h + exam</p> <p>(https://www.linkedin.com/learning/leading-with-emotional-intelligence-3/lead-with-emotional-intelligence?u=2155426)</p>
5	<p>Team Building: Building the Team</p> <p><i>Assessment:</i> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p>	<p>L2, L3, L5</p> <p>This course provides insights in managing the four stages of team development and managing team meetings, including managing conflict and reaching consensus.</p>	<p>LinkedIn course “Building Your Team” by Izzy Gesell</p> <p>Length: approx. 1h + exam</p> <p>(https://www.linkedin.com/learning/building-your-team/building-an-effective-and-efficient-team?u=2155426)</p>
6	<p>Team Building: Inclusive Teams</p>	<p>L2, L3, L5</p>	<p>LinkedIn course “A</p>

	<p><u>Assessment:</u> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p>	<p>This course advocates inclusion is the foundation of a well-functioning team. Whether you are a leader, manager, or individual contributor, it's important to create a safe environment for all team members to participate.</p>	<p>Manager's Guide to Inclusive Teams" by Madecraft and Lia Garvin</p> <p>Length: 45m + exam</p> <p>(https://www.linkedin.com/learning/a-manager-s-guide-to-inclusive-teams/importance-of-inclusion?u=2155426)</p>
7	<p><u>Team Collaboration: Essentials of Team Collaboration</u></p> <p><u>Assessment:</u> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p> <p><u>Team Collaboration: Collaboration Principles and Processes</u></p> <p><u>Assessment:</u> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p>	<p>L2, L3, L5</p> <p>This course provides valuable tips on achieving team collaboration. This course also addresses relationship building in a team, and the role debriefing plays in that process.</p> <p>This course applies emotional intelligence to the work of collaboration.</p>	<p>LinkedIn course "Essentials of Team Collaboration" by Dana Brownlee</p> <p>Length: 31m + exam</p> <p>(https://www.linkedin.com/learning/essentials-of-team-collaboration/why-team-collaboration-is-necessary?autoSkip=true&resume=false&u=2155426)</p> <p>LinkedIn course "Collaboration Principles and Processes" by Prakash Raman</p> <p>Length: approx. 1h + exam</p> <p>(https://www.linkedin.com/learning/collaboration-principles-and-process/the-compassionate-perspective?autoSkip=true&resume=false&u=2155426)</p>
8	<p><u>Communication: Interpersonal Communication</u></p>	<p>L2, L3</p>	

	<p><u>Assessment:</u> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p> <p>Communication: Communicating with Diplomacy and Tact</p> <p><u>Assessment:</u> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p>	<p>This course offers advice for communicating in meetings. It also provides content on communicating in various scenarios, for example, tense or tricky situations.</p> <p>This course provides communications theory (encoding and decoding messages), to develop consultancy skills by applying theory to real-life scenarios.</p>	<p>LinkedIn course “Interpersonal Communication” by Dorie Clark</p> <p>Length: 37m + exam (https://www.linkedin.com/learning/interpersonal-communication-2020/interpersonal-communication?u=2155426)</p> <p>LinkedIn course “Communicating with Diplomacy and Tact” by Tatiana Kolovou</p> <p>Length: 1h 4m + exam (https://www.linkedin.com/learning/communicating-with-diplomacy-and-tact/becoming-more-diplomatic-and-tactful?u=2155426)</p>
9	<p>Design Thinking: Social Innovation</p> <p><u>Assessment:</u> Provide the certificate of completion</p>	<p>All Learning Outcomes</p> <p>This course introduces concepts from population health, specifically systems thinking at the Macro, Meso and Micro levels, and the interconnectedness between these levels. This course also focuses on equity-centered design, an objective of all healthcare programs.</p>	<p>LinkedIn course “Design Thinking, Social Innovation, and Complex Systems” by Scott Boylston</p> <p>Length: 1h + exam</p> <p>(https://www.linkedin.com/learning/design-thinking-social-innovation-and-complex-systems/working-with-the-iceberg-model?autoSkip=true&resume=false&u=2155426)</p>
10	<p>Design Thinking: Implementing the Process</p>	<p>All Learning Outcomes</p> <p>This course offers</p>	<p>LinkedIn course “Design Thinking: Implementing the Process” by Chris</p>

	<p><u>Assessment:</u> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p>	<p>practical content on the design thinking roles, tools, and creation of a user (customer) centric solution. In addition, this course highlights the importance of using metrics to determine if the solution is working.</p>	<p>Nodder</p> <p>Length: 45m + exam</p> <p>(https://www.linkedin.com/learning/design-thinking-implementing-the-process/applying-design-thinking?u=2155426)</p>
11	<p>Change Management: Foundations</p> <p><u>Assessment:</u> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p> <p><u>Change Management: Implementing Change Effectively</u></p> <p><u>Assessment:</u> Provide the certificate of completion</p>	<p>L2, L3, L4</p> <p>This course will assist in identifying stakeholders and communicating the benefits of your capstone project.</p> <p>This course provides actionable tips on planning change, as well as implementing it.</p>	<p>LinkedIn course “Change Management Foundations” by Scott Mautz</p> <p>Length: 45min + exam</p> <p>(https://www.linkedin.com/learning/change-management-foundations-10041380/change-management-foundations-course-overview?u=2155426)</p> <p>LinkedIn course “Implementing Change Effectively” by Madecraft and Eric Zackrisson</p> <p>Length: 1h</p> <p>(https://www.linkedin.com/learning/implementing-change-effectively/great-leaders-lead-change?u=2155426)</p>
12	<p>Design Thinking and Change Management: Learning Design Thinking to Lead Change in Your Organization</p> <p><u>Assessment:</u> Provide the certificate of completion</p>	<p>All Learning Outcomes</p> <p>This course is an in-depth approach to leading the implementation of design thinking in an organization that is new to this way of working.</p>	<p>LinkedIn course “Learning Design Thinking: Lead Change in Your Organization” by Turi McKinley and frog</p> <p>Length: 2h 8m</p> <p>(https://www.linkedin.com/learning/learning-design-thinking-lead-change-in-your-organization?u=2155426)</p>

			<p>www.linkedin.com/learning/learning-design-thinking-lead-change-in-your-organization/welcome?resume=false&u=2155426)</p>
<p>13</p>	<p>Consulting and Customer Relations: Client Management</p> <p><i>Assessment:</i> An exam accompanies the LinkedIn course. Provide results of the exam and certificate of completion.</p> <p>Consulting and Customer Relations: Managing Customer Expectations</p> <p><i>Assessment:</i> Provide the certificate of completion</p>	<p>L2, L3, L4, L6</p> <p>These two courses will provide skills to: think like a consultant, manage client's expectations, lead a kick-off meeting, and understand the necessity of developing and applying metrics for your capstone project's success.</p>	<p>LinkedIn course "Consulting Foundations: Client Management and Relationships" by E. (McLeod) Lotardo and Lisa E. McLeod</p> <p>Length: 45m + exam</p> <p>(https://www.linkedin.com/learning/consulting-foundations-client-management-and-relationships/relationships-in-consulting?u=2155426)</p> <p>LinkedIn course "Customer Service: Managing Customer Expectations" by Jeff Toister</p> <p>Length: 20m</p> <p>(https://www.linkedin.com/learning/customer-service-managing-customer-expectations/understand-the-impact-of-unpleasant-surprises-2?autoSkip=true&resume=false&u=2155426)</p>

