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Design Thinking in Health Sciences: Developing Solutions-Oriented Graduates Impacting Local Medical Communities Through Innovative Leadership

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Consultancy Project Executive Summary

Organization:	Gardner-Webb University School of Education
Project Title:	Design Thinking in Health Sciences: Developing Solutions-Oriented Graduates Impacting Local Medical Communities Through Innovative Leadership
Candidate:	Tracey T. Thurnes
Consultancy Coach:	Jeffrey Hamilton, Ed.D.
Defense Date:	July 2, 2019
Authorized by:	Tim Peeples, Ph.D. Senior Associate Provost for Faculty Affairs and Professor of English, Elon University

Amendment History

<u>Version</u>	<u>Issue Date</u>	<u>Changes</u>
1	April 10, 2019	Initial version.
2	May 20, 2019	Formatting.
3	May 22, 2019	Citation correction.

Approval

This consultancy project was submitted by Tracey T. Thurnes under the direction of the persons listed below. It was submitted to Gardner-Webb University School of Education and approved in partial fulfillment of the requirements for the degree of Doctor of Education at Gardner-Webb University.

Jeff Hamilton, Ed.D., Faculty Advisor
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Date

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Date

Abstract

Design Thinking in Health Sciences: Developing Solutions-Oriented Graduates Impacting Local Medical Communities Through Innovative Leadership. Thurnes, Tracey T., 2019, Consultancy Project, Gardner-Webb University, Digital Commons/Design Thinking/Health Sciences/Innovation/Leadership

Design Thinking in Health Sciences is a multi-year project that focuses on applying design thinking pedagogy across the health sciences in the undergraduate and graduate educational experiences through pop-ups and curriculum infusion at Elon University. In addition, the project serves to partner with local community organizations to provide “real-life” exposure on how design thinking can be implemented to serve the greater community. A convenience sample of graduate and undergraduate health science students completed a version of the INCODE-ICB-v5 survey that measures many of the same identified characteristics of The Ten Principles of Good Interdisciplinary Teamwork. Surveys were distributed pre and post design thinking pop-ups throughout the project’s 3-year period. There was statistical significance in the overall growth of the students post exposure as well as in the individual and interpersonal domains of the INCODE-ICB-v5. The results conclude that exposing undergraduate and graduate health science students to design thinking pedagogy aids in the development of creating multi-functional, high impact medical teams with strong leadership abilities that will make a sustainable impact on the local medical community. The importance of tailoring opportunities that made design thinking relevant and relatable to the participants’ disciplines was necessary for the success of this project. After all, “user-centered design means understanding what your users need, how they think, and how they behave – and incorporating that understanding into every aspect of your process” (Garrett, n.d., as cited in Yalanska, 2018, para. 24).

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1 Introduction

1.1 Project Purpose

Elon University is a premier student-centered engaged learning environment preparing graduates to be the ethical leaders the world needs. Elon students are ambitious, curious, and compassionate and inspired to be big thinkers and creative problem solvers (Elon University, 2018). Elon-by-design, an initiative launched by Elon University on September 21, 2016, seeks to create a comprehensive environment for the development of nimble, human-centric, solutions-oriented innovators who are prepared, sought out, and needed for today's world (Peeples, 2016). The initiative serves to integrate design thinking to aid in the development of successful graduates who have the ability to work in a team structure; make decisions; solve problems; communicate verbally with people inside and outside an organization; and to plan, organize, and prioritize work (Peeples, 2016).

This project addresses design thinking in the health sciences at Elon University in the undergraduate, graduate, and partnering communities. The primary goals of the project within the health sciences are to create multi-functional, high impact medical teams that are made up of members with strong leadership abilities and to increase interprofessional educational experiences to make a sustainable impact on the local medical community. This will be accomplished through the implementation of design thinking pop-ups (workshops offered on a no-credit basis to students, faculty, staff, and community members) and integration of design thinking principles into the graduate and undergraduate health science curriculums (Peeples, 2016).

Terminology

Design thinking. For the purposes of this project, design thinking is defined as a process used to generate insights about human problems in order to create innovative ways to solve them. It focuses on understanding the world and its problems before finding a solution for them. The five core elements of design thinking are as follows: empathize, define, ideate, prototype, and test (Hasso Plattner Institute of Design at Stanford University, 2019). The empathy piece focuses on learning the audience for which you are innovating and developing a deeper understanding of the challenge. The define element focuses on redefining efforts based on learning that occurred during the empathy piece to clearly define the problem, while the ideate phase is where brainstorming of as many creative solutions as possible occurs. Selection of one idea occurs and then building a reproduction of the idea happens and it is shared with peers, which is called prototyping. The final step is taking the item to the user group and testing it to solicit feedback for refinement (Hasso Plattner Institute of Design at Stanford University, 2019).

1.2 Associated Documents

Appendix A: Used Version of the INCODE-ICB-v5

Appendix B: Curriculum Infusion Qualitative Data

Appendix C: INCODE-ICB-v5 Survey Results in the Graduate and Undergraduate Health Sciences

Appendix D: Percent Change Within INCODE-ICB-v5 Domains (Individual, Interpersonal, Networking)

1.3 Project Plan Maintenance

Objectives and deliverables for this project were divided into two segments: pop-ups and curriculum infusion. In planning for this project, the deliverable work included formulating timelines, completion dates, and a detailed communication plan. Each project milestone was reviewed by Dr. Jeffrey Hamilton, and regular communication occurred throughout the process with the project advisor, Director of Design Thinking, and involved health science faculty and staff.

2 Project Scope

Elon's engaging intellectual climate is distinguished by supportive and collaborative human relationships that promote personal growth; and in 2013, work began on a new Intellectual Climate Strategic Plan. The question was raised by a group of students with a similar passion, "how might we improve the intellectual climate at Elon?" (Elon University, n.d.). This thought-provoking question led to smaller groups within the Elon community coming together to work on one common goal. The strategic plan is founded on four pillars: challenge, mentored experiences, student leadership opportunities, and community. The pillars that apply to this project are challenge and student leadership opportunities. The challenge pillar states that the underpinning of a solid intellectual climate begins with a challenge in the classroom and curriculum, which includes effective use of advanced and innovative pedagogies. Second, the student leadership opportunity pillar speaks to preparing students to actively and effectively shape the community in which they live through high-quality intellectual engagement (Elon University, n.d.). Elon-by-design was launched to introduce a novel, innovative pedagogy to create a set of opportunities that stretch across undergraduate and graduate experiences.

Acceptance criteria for this project include guidelines for both the pop-up and curriculum infusion portions. The pop-ups created must provide opportunities for students, faculty, staff, and community partners to be exposed to design thinking methodologies. Similarly, the curriculum infusion must include undergraduate and graduate students as well as community partners. This includes students in any health science related field of study on the undergraduate campus and physician assistant and physical therapy students in the graduate School of Health Sciences (SHS). The requirement that applies to both portions of the project is that for the purposes of the consultancy project, the pop-ups and curriculum infusion must be in place within a 3-year timeline that began in August of 2016.

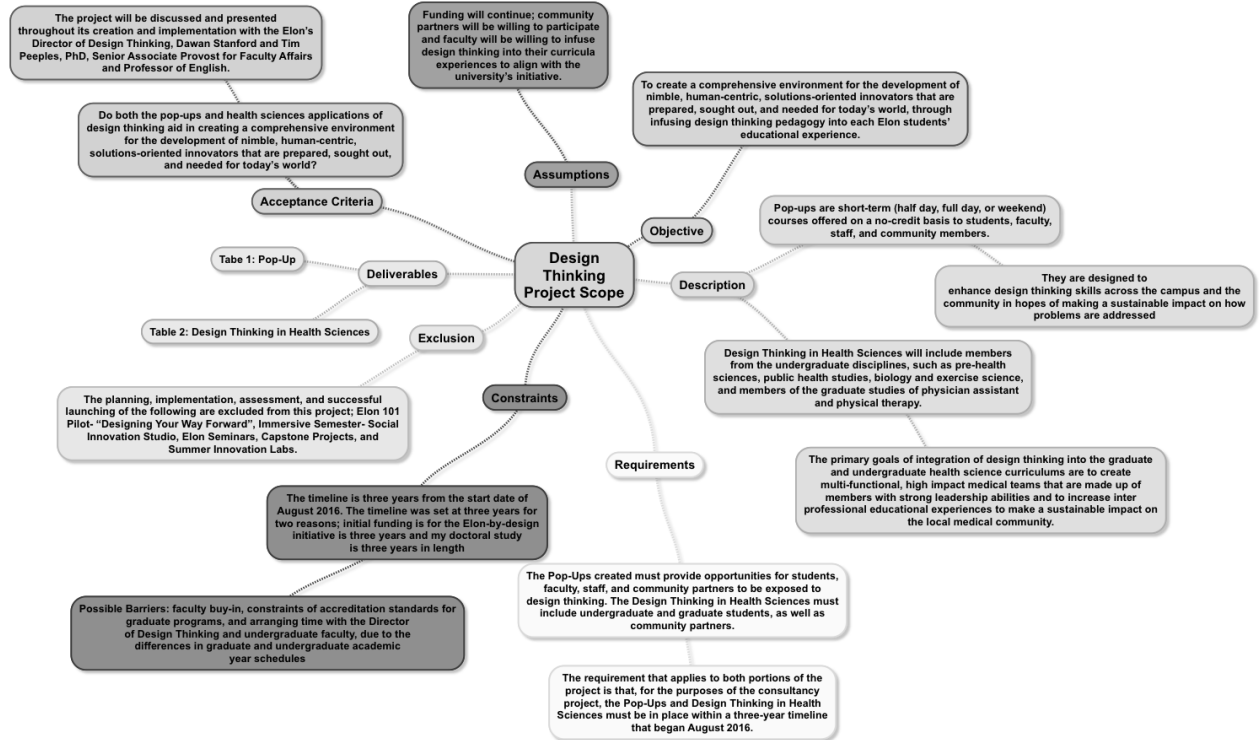


Figure 1. Design Thinking in Health Sciences Project Scope.

2.1 Outline of Partnering Organization's Objectives

2.1.1 Objectives

- Elon will be one of the first institutions to implement the design thinking approach across its curriculum and campus in hopes of touching each student while they are receiving their education, regardless of their discipline of study
- Elon faculty and staff will add to their already extensive list of pedagogies to ensure that students receive a comprehensive set of skills to be valuable members of society and to make sustainable change
- Strengthen relationships with community partners through design thinking pop-ups in shared efforts to identify innovative ways to solve challenges the community and organizations are facing

2.1.2 Success Criteria

- Recognition of Elon-by-design
- Course syllabi and learning objectives created to show areas of implementation of design thinking pedagogy
- Evidence of community partnerships strengthened through participation in design thinking pop-ups

2.1.3 Risks

A detailed risk assessment is covered in Section 9. The highest identified risk to the partnering organization since the launch of the Elon-by-design is the possibility of elimination or decrease in funding. A mitigation and contingency plan was set in place to ensure sustainability of the pop-up implementation and curriculum infusion within the health sciences in case this was to occur.

2.2 Outline of Student's Objectives

2.2.1 Objectives

- Implement a multi-year project that focuses on applying design thinking pedagogy across the health sciences in the undergraduate and graduate educational experiences at Elon University
- Partner with local community organizations through pop-ups to provide “real-life” exposure on how design thinking can be implemented to serve the greater community
- The primary goals and hypothesis of the Design Thinking in Health Sciences project and research are exposing students and community partners to design thinking pedagogy aids in
 - Creating multi-functional, high impact medical teams
 - Strengthening the leadership abilities of team members
 - Increasing interprofessional educational experiences to make a sustainable impact on the local medical community

2.2.2 Success Criteria

- Course syllabi and learning objectives created to show areas of implementation of design thinking pedagogy in the undergraduate and graduate health science curricula
- Evidence of more than one pop-up that includes health science students and a community partner to solve a current problem of the organization
- Institutional review board (IRB) submission and approval to measure the primary goals of the Design Thinking in Health Sciences project with the INCODE-ICB-v5 assessment tool
- Detailed analysis and report of collected data

2.2.3 Risks

A detailed risk assessment is covered in Section 9. The highest identified risks to the Design Thinking in Health Sciences portion of the project were the possibility of alienating faculty and a lack of interest in participation. A mitigation and contingency plan was set in place and executed throughout the project when needed.

2.3 Definitive Scope Statement

This project scope focuses on two portions of the Elon-by-design initiative, pop-ups and curriculum infusion within undergraduate and graduate health science programs. The primary goals of integration of design thinking into the graduate and undergraduate health science curriculums are to create multi-functional, high impact medical teams that are made up of members with strong leadership abilities and to increase interprofessional educational experiences to make a sustainable impact on the local medical community.

3 Deliverables

3.1 To Partnering Organization

The deliverables, noncontracted expected date of completion and completion dates for this project are depicted in the tables below.

Table 1

Deliverables for Design Thinking Pop-Ups

Task	Timeframe	Completion Date
Research and collection of design thinking pop-up resources	December 2016- March 2017	April 30, 2017
Reach out to community partners to identify concepts that may be beneficial to tackle	December 2016-March 2017	April 30, 2017
Identify topic for faculty pop-up	December 2016- June 2017	July 31, 2017
Identify topic for student pop-up	December 2016- June 2017	July 31, 2017
Plan and organize faculty pop-up	August 2017- December 2017	December 31, 2017
Plan and organize student pop-up	July 2017- November 2017	November 30, 2017
Hold faculty pop-up	January 2018- May 2018	May 10, 2018 (End of traditional academic year)
Hold student pop-up	December 2017	December 15, 2017 (During CYS II Course for PA)
Assess effectiveness of faculty pop-up	May 2018- July 2018	August 1, 2018
Assess effectiveness of student pop-up	January 2018- May 2018	May 31, 2018
Successfully launch faculty and student pop-ups	August 2018- May 2019	May 10, 2019 (End of traditional academic year)

Table 2

Deliverables for Design Thinking Curriculum Infusion

Task	Timeframe	Completion Date
Meet with Education Design Lab Consultant	November 2016	November 15, 2016
Present Development efforts to members of Elon's senior staff, education design lab consultants, and financial supporters of initiative	November 2016	November 18, 2016
Establish lead undergraduate and graduate faculty members of respected departments mentioned above to collaborate with on initiative	January 2017- May 2017	May 31, 2017
Meet with above members on topics that may be tackled, and design thinking pedagogy integrated into curriculums	January 2017- July 2017	July 30, 2017
Begin to integrate above strategies into undergraduate and graduate curricula	August 2017- May 2018	May 10, 2018 (End of traditional academic year)
Assess effectiveness and impact of curriculum implementation	May 2018- July 2018	August 1, 2018
Successfully Launch Design Thinking in Health Sciences throughout the curriculums identified in earlier steps	August 2018- May 2019	May 10, 2019 (End of traditional academic year)

3.2 From Student

All expected deliverables to the partnering organization and from the doctoral student are reflected in Tables 1 and 2. There were no additional deliverables.

4 Project Approach

4.1 Project Lifecycle Processes

Design Thinking in Health Sciences was initiated through the discovery of missing elements in the Elon-by-design initiative that was launched in 2016. Those missing elements included the exposure of design thinking in the health sciences and in graduate studies. This discovery led to the proposal to tackle a multi-year project on how to apply design thinking across the health sciences in the undergraduate, graduate, and partnering communities. Project approval was granted through the provost's office; and regular communication that included updates, revisions, successes, and challenges of the project were held throughout the 3-year duration.

4.2 Project Management Processes

The project management process was established in the original project proposal and detailed communication plans (Section 5). Figure 2 represents the cycle of the project management process for Design Thinking in Health Sciences.

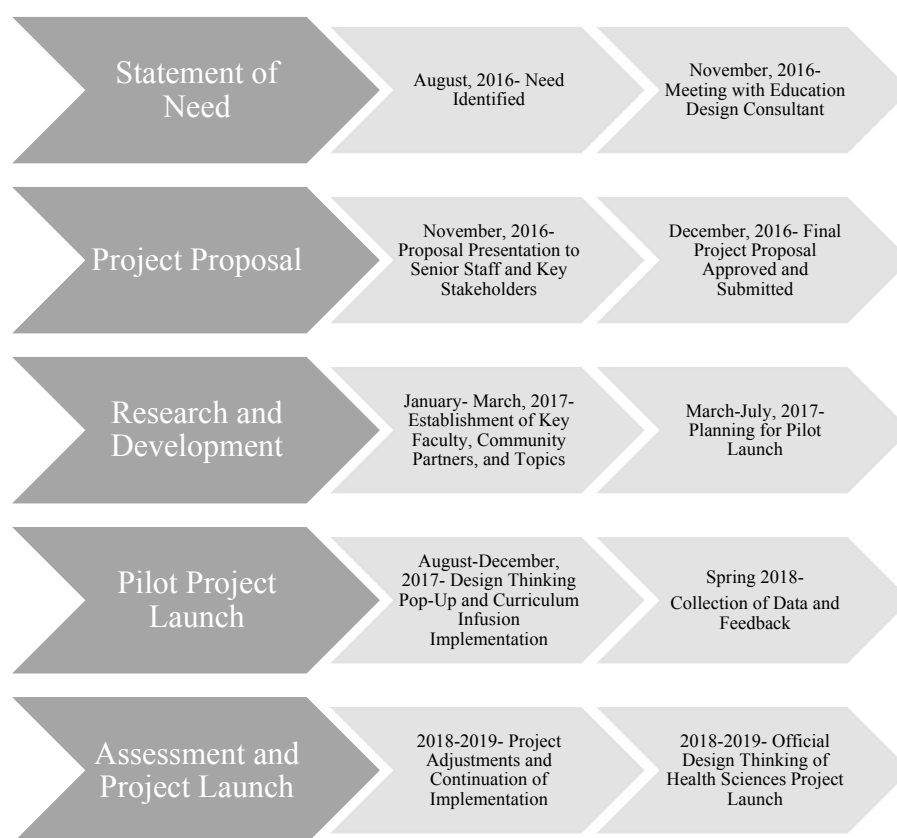


Figure 2. Design Thinking in Health Sciences Project Management Process.

4.3 Project Support Processes

This project was supported throughout its duration by the project site advisor, Director of Design Thinking, Dean of SHS, and involved health science faculty and staff. The support, collaboration, and mutual respect for this project from higher administration and influential faculty and staff members across campus have been vital components of sustainability for this project.

4.4 Organization

While there was no formal organizational structure for this project, key members were identified throughout the project development and implementation.

4.4.1 Project Team

- Doctoral Student – Project team leader, PA faculty member
- Senior Associate Provost – Project site advisor
- Director of Design Thinking – Budget manager and project consultant
- Health Science Faculty and Staff – Facilitators and participants
- Community Partners – Participants in pop-ups
- Graduate and Undergraduate Health Science Students – Participants in pop-ups and recipients of curriculum infusion

4.4.2 Mapping Between Elon University and Student

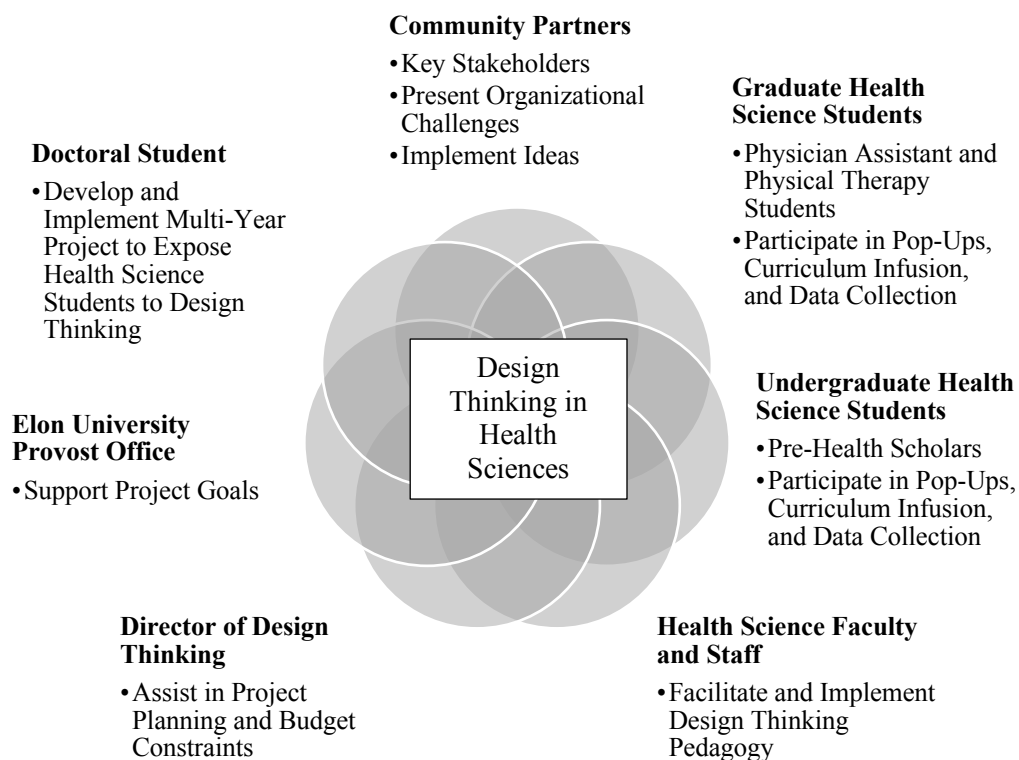


Figure 3. Design Thinking in Health Sciences Organizational Map. To be read counterclockwise beginning with doctoral student.

5 Communications Plan

The detailed strategies for this project were included in the preliminary work by establishing the project scope and SMART objectives (SMART Objectives, 2015). While establishing objectives, a detailed timeline and communication plan was formulated in coordination with the expected deliverables (Project Scope, 2015). Fortunately, this project remained on schedule, with only small adjustments throughout. The project also expanded in a positive way in that faculty members within SHS began to utilize design thinking pedagogy; therefore, Tables 3 and 4 reflect the communication plan along with completion dates of scheduled and added activities that have occurred since the original project proposal.

Table 3

Communication Plan for Design Thinking Pop-Ups

Objective	Deliverable/Stakeholders	Implement	Evaluate	Feedback/Report
To communicate with undergraduate and graduate health science faculty to identify a relevant and interesting topic to discuss during a faculty pop-up session by July 2017.	Identify topic for faculty pop-up PA Faculty (Tracey Thurnes) Executive Director of Design Thinking SHS Dean Chemistry Professor and Coordinator of Health Professions	Dean of SHS identified that the SHS mission statement needed to be revamped. This will include PA and PT faculty and staff The Pre-Health Scholars' program is in the process of formation and will serve as an avenue for delivering content in the 2018-2019 school year	Dean will send a survey out to faculty and staff regarding the SHS retreat and questions will be included about the design thinking experience	Planning and identifying topics went well. The decision was made to hold off on undergraduate pop-up until a better time of year and when needs were clearer Undergraduate Pre-Health Scholars pop-up occurred on 2-13-19 and focused on empathy mapping.
To communicate with a community partner to identify a system-level challenge to be tackled in a student pop-up session by July 2017.	Topic to be tackled in Student Pop-Up PA Faculty (Tracey Thurnes)	Open Door Clinic of Alamance County was identified Executive Director was direct contact	Pre and Post INCODE v.5 surveys to students and community partners will be dispersed in accordance with IRB approval	Positive and effective communication occurred with Executive Director
To effectively plan and organize the faculty and student pop-up sessions with the Executive Director of Design Thinking and identified community partner for planned launch in December 2017 (student) and Spring semester 2018 (faculty).	Faculty and student pop-up session agendas Executive Directors of Design Thinking and Open Door, Dean of SHS, PA faculty and PT faculty	Completed with Executive Directors of Design Thinking and Open Door, Dean of SHS, PA faculty and PT faculty	Review agendas with all leads and gain approval for final programs	Methods of planning and feedback were successful

To hold faculty pop-up session that will be open invitation to undergraduate and graduate health science faculty in the Spring of 2018.	<p>Faculty pop-up session discussing identified topics</p> <p>Dean of SHS PA faculty PT faculty</p>	<p>4-3-18: Faculty pop-up held within the SHS that included PT and PA faculty and staff to develop a new SHS mission statement</p> <p>5-11-18: A pop-up was held included graduate and undergraduate faculty, staff, athletics, community runner, community stakeholders, and others to begin planning for an Elon PT residency program</p>	<p>4-3-18: Dean sent out a survey out to faculty and staff regarding the SHS retreat and questions will be included about the design thinking experience</p> <p>5-11-18: Feedback elicited from Dean and PT faculty who were faculty leads on the project</p>	<p>4-13-18: Feedback was positive around the sprint. Suggestions were to lengthen the amount of time for the dedicated sprint</p> <p>5-11-18: Design Sprint was successful and feedback from lead faculty was positive. Learning points were that lead faculty needed to begin planning earlier.</p>
To hold student pop-up session that will include community partner and students in SHS in December 2017.	<p>Student pop-up sessions tackling identified system challenges</p> <p>PA Faculty (Tracey Thurnes) Executive Director of Design Thinking Director of Open Door Clinic Physical Therapy Faculty</p>	<p>12-5-17: Pop-up was held that included PA students and Open Door Clinic staff that addressed triage and medication adherence</p> <p>5-10-18: A pop-up was held with PT students and professionals from the community to discuss working in health care teams</p> <p>12-3-18 A pop-up with PA students and members of Cone Health Wellness Program was held to address how to improve the facility to make it more user-friendly and how to reach the community</p> <p>2-13-19 A pop-up was led by SHS faculty with the undergraduate Pre-health Scholars cohort. The pop-up</p>	<p>Pre and Post INCODE v.5 surveys to students and community partners were and will be dispersed in accordance with IRB approval for all events</p>	<p>Survey method was successful and data at this point is positive for meeting the three established goals reflected in project proposal.</p>

		focused on the importance of empathy in all health professions.		
Post faculty and student pop-up sessions, complete and review an extensive holistic assessment that includes organizers and participants.	<p>Assess effectiveness of faculty and student pop-up data through qualitative surveys</p> <p>PA Faculty (Tracey Thurnes)</p>	IRB approval occurred in November 2017 for a survey to be distributed to students and community partners pre and post pop-ups.	For PA students a survey will also be sent one year post-graduation to see if students are using design thinking in their career	Apply post-session feedback to re-launch both faculty and student pop-ups in the 2018-2019 school year, realizing that topics to be discussed may change year to year with current evolutions in health sciences.

Table 4

Communication Plan for Design Thinking Curriculum Infusion

Objectives	Deliverable/Stakeholders	Implement	Evaluate	Feedback/Report
To establish lead undergraduate and graduate faculty members of respected health science departments to collaborate on design thinking initiative by May 2017.	Named faculty willing to participate PA Academic Faculty PA Clinical Faculty PT Faculty Undergraduate Chemistry Professor and Health Professions Coordinator	Held individual meetings with all to discuss how to incorporate into the respective curriculums	Successful as faculty were identified	Improve outreach to undergraduate faculty
To hold the necessary amount of collaborative and informative meetings to review design thinking and its possible individual program applications during Summer 2017.	Planned meeting dates with PA Academic Faculty PA Clinical Faculty PT Faculty Undergraduate Chemistry Professor and Health Professions Coordinator	Topics to be implemented: Designing Your Life Design and Empathy Design and problem solving and interprofessional relations Design to tackle healthcare problems	Learning objectives around leadership development and interprofessional education were created to aid in program assessment and evaluation	Learning objectives were reviewed. Considering making more specific for design thinking
To begin integration of learning objectives and design thinking applications into the named undergraduate and graduate programs in the 2017-2018 school year.	Syllabi/Lesson Plans/Examples of integration into Health Science Curricula across campus PA Academic Faculty PA Clinical Faculty PT Faculty Undergraduate Chemistry Professor and Health Professions Coordinator	Process began in 2017-2018 school year within the PA and PT programs. In the 2018-2019 school year, the design thinking pedagogy was introduced in the undergraduate health sciences curriculum through the Pre-Health Scholars Cohort	Focus Groups will be the source for this data collection.	Lectures and activities reviewed with lead faculty

To complete a holistic evaluation to assess the effectiveness and impact of curriculum implementation of design thinking concepts following the 2017-2018 school year and apply data and feedback to re-launch design thinking in health sciences throughout the curriculums identified in above steps in the 2018-2019 and 2019-2020 school year.	<p>Data from program evaluation and conversations with lead faculty members</p> <p>PA Faculty (Tracey Thurnes)</p>	<p>Once the 2018 year was complete focus groups were held, in addition to regular conversations with lead faculty members</p>	<p>Focus Groups will be the source for this data collection.</p>	<p>Data reviewed and reported in analysis section</p>
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6 Work Plan

A detailed project organizational structure and management process is represented in Section 4, while Section 5 represents a detailed communication plan on how the project was carried out through completion. As the work expanded, tasks were delegated as needed throughout the implementation of the project.

6.1 Work Breakdown Structure

Work for this project was initiated and monitored by the project lead (doctoral student). Project proposal and key milestones were reviewed by the site advisor. Regular updates were provided to the site advisor, and feedback of the pop-ups was reviewed with the Director of Design Thinking. The project scope, deliverables, and communication plans were revisited on a semester basis to ensure completion.

6.2 Resources

Minimal resources were needed for project implementation. They included

- Access to the Design Thinking Center
- Design Thinking Resources (books, workbooks, etc.)
- Design Thinking Tool Kit
- Grant funds
- Microsoft Word, Excel, PowerPoint

7 Milestones

Table 5 represents the key strategic milestones throughout the entirety of the consultancy project, Design Thinking in Health Sciences, that began in August of 2016.

Table 5

Project Milestones

Milestone Number	Contents	Completion date
1	Statement of Need	15-Nov-16
2	Project Proposal	01-Dec-16
3	Project Goal and Objective Development	01-May-17
4	Project Scope Definition	21-Apr-17
5	Benefits Summary	05-Jul-17
6	Project Risk Assessment, Mitigation, and Contingency Plans	21-Nov-17
7	Project Assumptions and Constraints, Updated Objectives	29-Apr-18
8	Detailed Project Implementation, Updated Timeline/Status	13-Jul-18
9	Quality Assurance Plan	27-Nov-18
10	Overall Project Plan Performance	11-Feb-19
11	Executive Summary	10-Apr-19

8 Metrics and Results

Sections 2.1.1 and 2.1.2 discuss in detail the partnering organization's objectives and success criteria, while sections 2.2.1 and 2.2.2 identify the student's objectives and success criteria for the project. Tables 6 and 7 reflect the metrics and results of the agreed upon objectives.

Table 6

Partnering Organization Objective Results

Objectives	Success Criteria	Result/s
Elon will be one of the first institutions to implement the design thinking approach across its curriculum and campus in hopes of touching each student while they are receiving their education, regardless of their discipline of study	Recognition of Elon-by-design	<p>Elon-by-design continues to grow and be recognized for their work with students and the community. Within the design thinking initiative, students have layered experiences with design thinking methods that allow for personal and professional growth. Through this project, similar exposures have been made available to students across the health sciences in both the undergraduate and graduate levels.</p> <p>This specific project work was also recognized at a national level through a presentation at the Physician Assistant Education Association annual forum in 2018.</p>
Elon faculty and staff will add to their already extensive list of pedagogies to ensure that students receive a comprehensive set of skills to be valuable members of society and to make sustainable change	Course syllabi and learning objectives created to show areas of implementation of design thinking pedagogy	<p>Within SHS, design thinking's utilization has increased as faculty members have become more familiar and comfortable with its multiple levels of application to their disciplines. Physical Therapy and Physician Assistant faculty members have sought out ways to implement the pedagogy in their classrooms and seminar courses and have been pleased with the student responses.</p> <p>Qualitative feedback from graduate and undergraduate students, faculty, and staff also reveals that faculty and students have found value in the design thinking practices and find it applicable and useful to solve healthcare needs and/or "problems" as well as strengthening leadership skills, problem-solving and decision-making skills (see Appendix B).</p> <p>Elon University Leadership Faculty Scholars have utilized design thinking to design assignments and projects that incorporate leadership foundations and skills into their disciplines which include psychology, wellness, education, pre-law, and sports management.</p>
Strengthen relationships with community partners through design thinking pop-ups in shared efforts to identify innovative ways to solve challenges the community and organizations are facing	Community partnerships strengthened	Established relationships, such as the Open Door clinic, continue to be fostered through design thinking pop-ups and new relationships have been formed. New relationships include Cone Health Wellness, Elon Runs, and educational internships throughout the community.

Table 7

Student Objective Results

Objective	Success Criteria	Result/s
Implement a multi-year project that focuses on applying design thinking pedagogy across the health sciences in the undergraduate and graduate educational experiences at Elon University	Course syllabi and learning objectives created to show areas of implementation of design thinking pedagogy in the undergraduate and graduate health science curricula	Course Learning Objectives <ul style="list-style-type: none"> • Explain fundamental principles that guide design thinking. • Demonstrate key concepts that guide innovative use of design thinking in healthcare. • Examine approaches to design thinking and innovation practiced by various organizations. • Be able to apply leadership competencies in a healthcare related experience. • Complete team-based activity by applying leadership qualities to achieve effective leadership within healthcare.
Partner with local community organizations through pop-ups to provide “real-life” exposure on how design thinking can be implemented to serve the greater community	Evidence of more than one pop-up that includes health science students and a community partner to solve a current problem of the organization	12-5-17: Pop-up that included PA students and Open Door Clinic staff that addressed triage and medication adherence 5-10-18: Pop-up with PT students and professionals from the community to discuss working in health care teams 12-3-18: Pop-up with PA students and members of Cone Health Wellness Program to address how to improve the facility to make it more user-friendly and how to reach the community
The primary goals and hypothesis of the Design Thinking in Health Sciences project and research are: Exposing students and community partners to design thinking pedagogy aids in: <ul style="list-style-type: none"> • Creating multi-functional, high impact medical teams • Strengthening the leadership abilities of team members • Increasing interprofessional educational experiences to make a sustainable impact on the local medical community 	IRB submission and approval to measure the primary goals of the Design Thinking in Health Sciences project with the INCODE-ICB-v5 assessment tool Detailed analysis and report of collected data	IRB approval: The protocol 18-119. Exemption has been verified by the Elon University IRB as Exempt according to 45CFR46.101(b)(1): Educational Practices on 11/07/2017. See Methods, Analysis and Discussion, and Conclusion Section Below

Methods of Data Collection

A literature search using key terms such as innovation, leadership, teamwork, creativity, perseverance, communication, and higher education was conducted and the INCODE-ICB-v5 was selected as the validated assessment tool to use for assessment of this project.

Based on a study done by Penttilä and Kairisto-Mertanen (2012), innovation is a combination of individual, interpersonal, and networking constructs. These three tenants can also be described as stemming from the individual (individual), interaction among individuals (interpersonal), and interaction with society (networking). The INCODE barometer is meant to be used by teachers as a formative assessment during the design phase of a course or activities to engage students in their own reflection of what innovation competence entails (Marin-Garcia, Pérez-Peñalver, & Watts, 2013). The INCODE-ICB-v5 assessment tool is comprised of 25 items with the following distributions: 12 in individual, eight in interpersonal, and five in the networking dimension. The tool was validated in higher education institutions, private institutions, training centers, and businesses (Andreu-Andres, Garcia-Carbonell, & Marin-Garcia, 2013).

A convenience sample of health science students (n=98) was selected to evaluate if exposing students and community partners to design thinking pedagogy aids in (a) creating multi-functional, high impact medical teams; (b) strengthening the leadership abilities of team members; and (c) increasing interprofessional educational experiences to make a sustainable impact on the local medical community. IRB approval was granted through Elon University. Students provided a signed consent form and were given the opportunity to ask any questions. A version of the INCODE-ICB-v5 was distributed and students completed them at their own will and then they were collected by another faculty member (see Appendix B). Following the pop-up, the same survey was distributed and collected by the same faculty member. Data were de-identified and returned to the primary investigator.

Analysis

Pre (n=98) and post (n=95) survey data were collated and organized, and a frequency distribution table was formulated. A two-tail *t*-test showed significant growth ($p=0.0000072$) post design thinking pop-ups using the INCODE-ICB-v5 survey in the graduate and undergraduate health sciences (see Appendix C). There was statistical significance in the growth of the individual ($p=0.002$) and interpersonal ($p=0.009$) domains. While statistical significance was not established in the domain of networking ($p=.163$), a positive percent change was identified in all survey questions related to networking, yielding an average of an 8.6% increase within that domain (see Appendix D).

Discussion

In Ten Principles of Good Interdisciplinary Team Work, Nancarrow et.al. (2013) distinguished characteristics of a good interdisciplinary team. The INCODE-ICB-v5

survey measures many of the same identified characteristics such as leadership and management; communication; appropriate use of resources; clarity of vision; ability to work in multidisciplinary and multicultural environments; and individual characteristics that include knowledge, listening skills, and shared goals (Andreu-Andres et al., 2013). Both undergraduate and graduate health science students showed a positive percent change in all domains following exposure to design thinking principles, concluding that exposing students to design thinking pedagogy aids in creating multi-functional, high impact medical teams and strengthens leadership abilities of team members. Design thinking pop-ups held in regard to this project included medical community partners and interdisciplinary teams. Health science students showed a 23% growth in response to the survey question “I take action that yields to social community change.” This growth, along with others depicted in the data outcomes, leads to the belief that exposing students and community partners to design thinking pedagogy increases interprofessional educational experiences to make a sustainable impact on the local medical community.

Conclusion

A conclusion can be made that Design Thinking in Health Sciences, a multi-year project that focuses on applying design thinking pedagogy across the health sciences in the undergraduate and graduate educational experiences at Elon University through pop-ups and curriculum infusion, aids in creating multi-functional, high impact medical teams, strengthening leadership abilities of team members, and increasing interprofessional educational experiences to make a sustainable impact on the local medical community; meeting the overall goals and objectives of the project.

9 Risks, Constraints, Assumptions

9.1 Risks

In order to identify the risks for this project, several criteria were evaluated. First, risks were examined for the consultant and the organization. Then, risks were identified by considering the stakeholders who were recognized as the consultant, organization, students, faculty, staff, and community partners. Risks were then assessed on their threat to impact the structural and financial stability of the project. Using a risk assessment matrix shown in Figure 4, risks were then labeled as low, medium, high, or extreme. In order to determine the level, each identified risk was labeled on the x-axis by its likelihood of happening. These included the likelihoods of improbable, possible, and probable. The y-axis included the severity of the threat on the project. These included acceptable, tolerable, undesirable, and intolerable. Once risks were labeled as low, medium, high, and/or extreme, mitigation and contingency plans were formed. Below are the mitigation and contingency plans for identified medium and high risks. Fortunately, there were no risks that fell in the extreme category.

Mitigation and Contingency Plans:

Medium Risks

- a) Logistics of Physician Assistant (PA) and Physical Therapy (DPT) course schedules
 - i. Explanation: The PA and DPT programs at Elon University are not on a traditional undergraduate school schedule, meaning they do not have traditional semesters or summers off. Students in both programs are often away on clinical rotations as well, which can make scheduling even more difficult.
 - ii. Mitigation Plan: This threat can be avoided by early planning. If schedules can be reviewed several months in advance, there is ample time to find the overlap in undergraduate and graduate schedules so attendance can be maximized.
 - iii. Contingency Plan: The vulnerability of this risk is not finding a time in which all curriculums could overlap. The contingency plan would be to continue on with the project but to adjust objectives and deliverables so there would be no need for overlap. Explanations and/or modules of design thinking could be created for faculty in each curriculum area to use as needed within their curriculum.
- b) Delay in Timelines

- i. Explanation: This project includes two separate sets of timelines, one for curriculum infusion and one for pop-ups. It is certainly possible that one or both of the timelines could be delayed for any number of reasons. This delay would, however, be tolerable and timelines can be adjusted. In fact, the timeline for the faculty pop-up has already been adjusted to meet the needs of the project.
- ii. Mitigation Plan: It will be important to frequently monitor the timelines of each portion of the project and to have regularly scheduled check-ins so delays can be identified early, and timelines adjusted appropriately.
- iii. Contingency Plan: A contingency plan is needed for this risk as a delay in timelines could become detrimental to the project, especially if the delays cause an extension in the project over 3 years, which is the amount of time allotted for this project. It would be important to hold conversations with all participants to encourage continued use of design thinking concepts and pedagogy within their courses and programs. This would allow for the overall goal of exposing design thinking concepts to all parties to be met.

c) Undervalued Pedagogy

- i. Explanation: This threat refers to faculty and/or staff undervaluing the design thinking pedagogy. If there is a lack of understanding, respect, or value of the pedagogy, it will be difficult to have high numbers of willing participants. With such a well-versed faculty, there are a number of innovative pedagogies being explored at Elon University; therefore, it is certainly possible that the topic of design thinking could be undervalued and underused. This would affect the faculty pop-up portion of the project.
- ii. Mitigation Plan: The mitigation plan here consists of control use of upper administration. For the faculty pop-ups in health sciences, this would include communication and encouragement coming from the deans of the programs. PA and PT have the same dean, and language could also come from the Dean of Arts and Sciences. If the initial communication comes from the deans introducing the proposed topic and pop-up, it will automatically attach a certain level of value to the project. It will also be important to invite administration, faculty, and staff to other design thinking events that are being held so increased positive exposure will lead to innovative ideas and involvement.
- iii. Contingency Plan: The contingency plan would be the same as the above Delay in Timelines plan.

d) Ineffective Data

- i. Explanation: Currently, the second year of this project is held for piloting the proposed pedagogy and collecting data, which means that in

the third year, the design thinking concepts are to be deployed. If ineffective data are collected in the second year of the project, this will lead to having to pilot the program again in the third year, as ineffective data will not allow for reliable data to adjust the programs.

- ii. Mitigation Plan: In order to control this risk, it will be important to have well-established goals for the project and to research validated surveys that will address the desired outcomes. It will also be important to receive IRB approval, if needed, and to do a thorough review of the data with an unbiased approach.
- iii. Contingency Plan: If the project becomes vulnerable to ineffective data, the contingency plan would be to adjust timelines and re-pilot the project in the third year of the process. It would then be required to meet with a data team, all stakeholders, and upper administration to ensure that a quality survey is being dispersed in the third year.

High Risks

a) Alienating Faculty

- i. Explanation: The threat of alienating faculty is improbable but certainly undesirable. The lasting effect of this risk would affect the consultant and ultimately the university. If a faculty member feels alienated, they will be less likely to be open to the pedagogy and incorporating design thinking concepts into their curricula.
- ii. Mitigation Plan: To control this situation, careful steps will be taken to search for a topic for the faculty pop-up that is broad enough to incorporate as many health science faculty as possible. One thought is to consider a topic that is not a topic of research or curricular design to simply expose everyone to the use of design thinking. By doing this, no one should feel excluded and the topic can be diverse.
- iii. Contingency Plan: If this happens and the consultant is made aware, every step will be taken to apologize and ensure the faculty member that the alienation was not on purpose and encourage them to still participate in the pop-ups and curriculum infusion. The consultant will also speak with them on how and why they felt alienated, so the same mistakes are not repeated.

b) Lack of Interest

- i. Explanation: This refers to the probable risk of a lack of interest from faculty/staff to participate in design thinking pop-ups. This threat would be tolerable as the project could continue on, as topics are already being implemented.
- ii. Mitigation Plan: This mitigation plan would actually be less needed if special attention is paid to the above-mentioned risks and mitigation

- plans. If these areas are monitored and mitigation plans implemented, interest should be sparked by frequent communications from upper administration and multiple opportunities to experience design thinking.
- iii. Contingency Plan: Given the vulnerability of the project to a lack of interest occurring, it will be essential to find ways for the project to continue. This can happen with small incorporations of design thinking into the PA and PT curriculums as it will be easier to control conversations and situations.

c) Elimination or Decrease in Funding

- i. Explanation: The design thinking initiative was funded by an Elon Trustee. Their investment also included funds to hire a founding director of Design Thinking at Elon. If this funding was to be removed or not continued, which is improbable but undesirable, it would have lasting effects on the overall success of the project.
- ii. Mitigation Plan: If funding continues through year one and a half of the project, the project would be sustainable, as all ideas will have been piloted at that time and could be continued with the consultant's lead. If the funding is eliminated prior to that time frame and the Director of Design Thinking is no longer employed, it will be difficult to lead pop-ups for the first try. It will be important for the consultant to research and attend as many design thinking activities as possible to become an expert on the topic so proper instruction can be delivered in the director's absence.
- iii. Contingency Plan: As mentioned above, it will be imperative for the consultant to become an expert in the content area so pop-ups and curriculum infusion can still occur.

RISK ASSESSMENT MATRIX



RISK RATING KEY		LOW 0 ACCEPTABLE OK TO PROCEED	MEDIUM 1 ALARP (as low as reasonably practicable) TAKE MITIGATION EFFORTS	HIGH 2 GENERALLY UNACCEPTABLE SEEK SUPPORT	EXTREME 3 INTOLERABLE PLACE EVENT ON HOLD
LIKELIHOOD		SEVERITY			
		ACCEPTABLE LITTLE TO NO EFFECT ON EVENT	TOLERABLE EFFECTS ARE FELT, BUT NOT CRITICAL TO OUTCOME	UNDESIRABLE SERIOUS IMPACT TO THE COURSE OF ACTION AND OUTCOME	INTOLERABLE COULD RESULT IN DISASTER
	IMPROBABLE RISK IS UNLIKELY TO OCCUR	LOW Participant Success Moving too Quickly	MEDIUM Ineffective Data	MEDIUM Alienating Faculty	HIGH Decrease or Elimination of Funding
	POSSIBLE RISK WILL LIKELY OCCUR	LOW Community Partners	MEDIUM Delay in Timelines Undervalued Pedagogy	HIGH N/A	EXTREME N/A
	PROBABLE RISK WILL OCCUR	MEDIUM Logistics of PA/PT Course Schedule	HIGH Lack of Interest	HIGH N/A	EXTREME N/A

Figure 4. Risk Assessment Matrix.

9.2 Constraints

There were minimal constraints under which this project operated. Resources used to complete the constraints analysis include the project scope (Figure 1) and the risk analysis (Figure 2). Table 8 reflects the two project constraints along with a discussion of how they evolved throughout the duration of the project.

Table 8

Constraints for Design Thinking in Health Sciences

Constraints	Validated by:	Can it be proven false?	If false, will it affect project?	Convert to Risk?
The project will last three years	The timeline was set at three years for two reasons: initial funding for the Elon-by-design initiative is three years and with my doctoral studies being three years as well, the two matched well	Yes- The project could lose steam at any point	Yes- The longevity and sustainability of the project would be impacted, but data has been collected up to this point, that outcomes could be measured	This was originally coded as a medium risk. Now that project outcomes are established, it is no longer a risk.
Differences in undergraduate and graduate program schedules within the health sciences	The graduate health science programs at Elon University do not operate on a traditional undergraduate semester module. This makes scheduling for collaboration difficult	No- Schedules are final and planned at least a year in advance	Yes- If graduate and undergraduate faculty and students are unable to collaborate, the project could continue, but objectives and deliverables regarding curriculum infusion would need to be adjusted	This was originally a medium level of risk but as the project progressed it turned into a high risk as it was difficult to include undergraduate programs in program implementation.

9.3 Assumptions

A detailed summary of the key assumptions upon which the consultancy project, Design Thinking in Health Sciences, will be planned and executed is included in Table 9. The table includes the key assumptions, how they were validated, and their effect on project outcomes.

Table 9

Assumptions for Design Thinking in Health Sciences

Assumptions	Validated by:	Can it be proven false?	If false, will it affect project?	Level of Risk
Funding will continue throughout the 3-year projected timeline	Elon-by-design initiative is funded through a gift of approximately \$1.3M, covering capital costs (e.g., construction and equipment), the director's salary, consultants, internal grants, and pop-ups An Interactive Grant was also received for additional funding	No- Gift has already been provided	Yes- Program will need to be minimized, but could still continue	Originally this was coded as high risk if it occurred early in the process. The project then received enough traction and interest that it could continue without the funding of Elon-by-design
Community partners will be willing to participate	Successful community partnerships have already occurred throughout the project and more are planned	No- They have already occurred	Yes- Community partners could pull out of their schedule commitments	This continues to be a low risk as originally described
Faculty will be willing to infuse design thinking into their curricula	All faculty are asked to support university-wide initiatives, which Elon-by-design is	Yes- This continues to be a struggle due to time constraints and material that already needs to be covered in the health science curriculums	Yes- The portion of the project surrounding curriculum infusion depends 100% on faculty participation.	This was coded as high risk in early planning stages and the mitigation plan has been used along the way to ensure that this does not occur

10 Financial Plan

The majority of the Elon-by-design initiative is being funded through a gift of approximately \$1.3M covering capital costs (e.g., construction and equipment), the director's salary, consultants, internal grants, and pop-ups (Hagigh, 2016).

Approximately \$200K is available for general programming, of which this project is but one small portion. Specific budget constraints for this project will be constrained by this general programming budget and negotiated with the Director of Design Thinking.

For faculty support, an internal Design Thinking Interactions Grant was also awarded by Elon's Design Thinking Center that is funded through the above-mentioned gift. The grant funds are available to Physical Therapy and/or Physician Assistant faculty, staff, and students to partner with a member of the medical community to aid in creating multi-functional, high impact medical teams that are made up of members with strong leadership abilities and to increase interprofessional educational experiences to make a sustainable impact on the local medical community. The funds allow for up to \$300 per sprint, and two grants have been issued to date.

11 Quality Assurance Plan

The primary goals and hypothesis of the Design Thinking in Health Sciences project and research are exposing students and community partners to design thinking pedagogy aids in

- Creating multi-functional, high impact medical teams
- Strengthening the leadership abilities of team members
- Increasing interprofessional educational experiences to make a sustainable impact on the local medical community

Figure 5 reflects a quality assurance plan for the overall project.

Quality Assurance Plan			
Goal	Creating Multi-Functional High-Impact Medical Teams	Strengthen Leadership Abilities of Team Members	Increase Interprofessional Experiences to Make a Sustainable Impact on the Local Medical Community
Plan	To work with faculty in the health sciences to determine what topics would aid in development of high impact teams	Introduce design thinking pedagogy into health science programs at Elon to aid in the development of leadership skills of students	Work with community partners and other health science professions to create interprofessional experiences
Implementation	Hold pop-ups and infuse design thinking pedagogy into health science curriculums	Hold pop-ups and infuse design thinking pedagogy into health science curriculums	Hold pop-ups with community partners and health science students and professions to tackle real life and organizational problems
Evaluation	INCODE v.5 Survey and Focus Group Evaluations	INCODE v.5 Survey and Focus Group Evaluations	INCODE v.5 survey to students and feedback survey from community partners
Feedback/Report	2 Faculty Pop-Ups, 3 Student and Community Partner Pop-Ups, and curriculum infusion into the PT, PA and undergraduate health science programs has been accomplished	Survey results and qualitative data show that students feel that their leadership and communication skills are increased through design thinking experiences	Community partner feedback was positive and student survey results show an increase in wanting to take action in creating social community change

Figure 5. Design Thinking in Health Sciences Quality Assurance Plan.

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Appendix A

Used Version of the INCODE-ICB-v5

Pre-and-Post Student Pop-Up Survey

Beside each of the following statements, please indicate your competency using the Likert scale:

1. Very Poor
2. Needs to improve
3. Average
4. Good
5. Excellent

Likert Score	Question number	Question text
	1	My exposure to Design Thinking has been
	2	My confidence level in Design Thinking concepts is
	3	I present ideas that are suitable for the task at hand
	4	I present creative ideas
	5	I present new ways to implement ideas
	6	I evaluate the advantages and disadvantages of actions
	7	I identify relationships among different components of the task
	8	I approach the task at hand from different perspectives
	9	I use resources ingeniously
	10	I foresee how events will develop
	11	I show enthusiasm
	12	I persistently pursue goals
	13	I take daring yet reasonable risks
	14	I orient the task towards the target
	15	I transmit ideas effectively
	16	I listen to teammates
	17	I establish constructive group relationships through dialogue
	18	I collaborate actively
	19	I contribute to group functioning
	20	I take initiatives
	21	I move others to act
	22	I face conflicts with flexibility to reach agreements
	23	I apply ethical values
	24	I take into account the implications of the task for society
	25	I am able to work in multidisciplinary environments
	26	I am able to work in multicultural environments
	27	I use networking contacts to reach goals
	28	I take action that yields to social community change

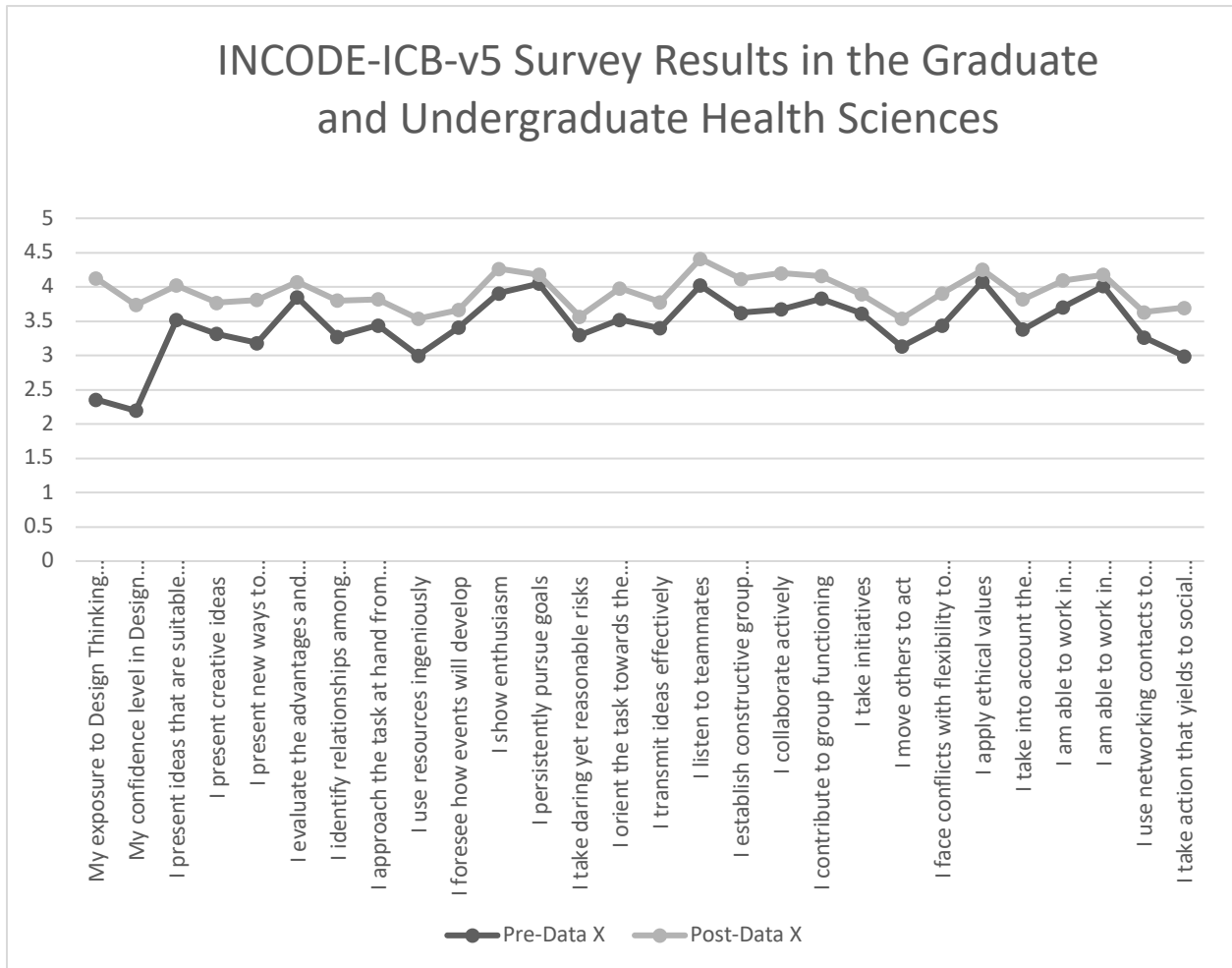
Appendix B

Curriculum Infusion Qualitative Data

Design Thinking Focus Group Themes					
Problem Solving <ul style="list-style-type: none"> • Whole perspective • Evaluate • Creativity • Define the problem • Exploring why • Reflect • More than one solution • Think through 	Decision Making <ul style="list-style-type: none"> • Tools • Realistic • Implementation • Causative relationship • Synthesize • Obstacles • Opportunity 	Teams <ul style="list-style-type: none"> • Better team member • Valuable asset • Unite • Diverse • Variety of groups • Respect • Consider team 	Leadership <ul style="list-style-type: none"> • Evolved • More confident • Manage tasks • Lead situations • Effective communication • Inquire • Effective leader 	Feelings <ul style="list-style-type: none"> • Chaotic • Freedom • Appreciate ideas • Creative • Value • Empowering • Respect • No judgment 	Value in Health Sciences <ul style="list-style-type: none"> • Patient experiences • Conflict resolution • Patient centered approach • Ethical dilemmas • IPE

Appendix C

INCODE-ICB-v5 Survey Results in the Graduate and Undergraduate Health Sciences



Appendix D

Percent Change Within INCODE-ICB-v5 Domains (Individual, Interpersonal, Networking)

