Designing a Model Food Systems Graduate Degree Program

A Thesis

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BY

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Dedication

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Abstract

We live in a Global Society where our business and cultures are connected across communities, countries, sectors, and disciplines. That means problems are more complex than can be addressed with a single tiered approach. In a society where communities are interconnected and interdependent across local and global markets, problems do not have simple solutions and fall under the category of wicked problems. These problems require evolving multidisciplinary collaboration across sectors, disciplines, and cultures to find solutions through continual adaptation to changes in society.

Issues like food waste, food insecurity, sustainability and climate change are wicked problems that need multi-pronged approaches that appreciate multi-disciplinary problems. Since wicked problems occur on a systems scale, understanding the functionality of systems is imperative. Right now, there are few professionals trained in systems that can tackle these wicked problems within our food system. A shift in higher education over the years towards specialization, linear thinking, and reductionist approaches has not only contributed the shift away from systems understanding but has also contributed to a skills shortage gap in employees entering the workforce. The shortage includes skills such as communication, building collaborative relationships, systems thinking, problem solving, interdisciplinary work, and facilitation.

This thesis is based on Participatory Action Research that combines action, practice, theory, and reflection to identify problems and potential solutions within the University of Minnesota graduate system. An anthropological approach used observations, qualitative data collection, and conversations with people of differing views to understand the issues within the current academic system from the perspective of fellow students, administrators, faculty, staff, alumni, and other professionals outside the university system. This methodology and write-up further recognize and support the value of the human influence on research design and interpretation while utilizing the first-person experience.

This project highlights the need for training of food systems students and young professionals to support the relevancy and impact of the nutrition discipline, in recognition of the absence of nutrition and food science in food system discussions and

activities, while advocating for multidisciplinary training through the creation of a model Food Systems Graduate degree program. This complementary approach allows reductionist thinking to confluence with systems thinking to promote more wholistic training for graduate students.

This Graduate degree program further supports flexibility to promote self-efficacy and interest for students, cohort-based experiential learning, and expanded levels of mentorship beyond faculty-student interaction through alumni involvement. The all-encompassing contribution of human influence, different sectors, disciplines, culture, socio-economic, and political perspectives are essential to an inclusive, holistic, and comprehensive education program, based on systems approaches. The Twin Cities is rich in food-related resources to support this Food Systems Graduate degree program.

The University of Minnesota has a unique opportunity to tackle the skills shortage gap along with the decline in student motivation, given the breadth, depth, and scope of the food system to gain student interest. To achieve this goal nutrition needs to be reinserted into the food system through dialogue and action by coherently connecting all three intellectual traditions of nutrition (Biological, behavioral, ecological) based on our food system, through situational analysis and design. The all-encompassing contribution of human influence, different sectors, disciplines, culture, socio-economic, and political perspectives are essential to an inclusive, holistic, and comprehensive education program, based on systems approaches.

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Preface: Re-setting my subjective dimension of research and application

From early on in our lives, we are often taught the importance of higher education, and for some it's not necessarily an option. My case was no different. I was never told that I had to go to college, but it was heavily implied throughout my life to the point of it being absolutely expected. For those of us that go from kindergarten to high school we become very familiar with how to follow rules and guidelines that have been made for us. We are expected to listen, observe, and to learn from those around us to avoid making mistakes. In my opinion, these valuable skills are placed at a higher importance than creativity, learning from our own mistakes, voicing, and supporting opinions, and partaking in discussions in which neither side is completely correct in their argument. So much value has been placed on following rules, listening, and sticking to guidelines that we have lost sight of the other skills that should hold equal weight. I believe this has inhibited many students from creating their own paths throughout their lives because they have grown comfortable with believing and doing what they are told to do without question.

When given a path to follow, it's easy to forget to reflect on and enjoy the process of learning. The empowerment that comes from choice, responsibility and ownership becomes absent. Instead, it becomes about getting that A or risk not being good enough. It becomes about pleasing others or fighting against the constraint of the rules placed around us. Students are taught to fit the standards and to aim for perfection. In this process students are not shown the importance of self-reflection and why learning is important. As students press on towards higher education these issues persist. In my case, I got so caught up in fulfilling the path dictated by our education system, that I did not stop to check in with myself to see if what I was striving towards made any sense for me. In the past, I gave up going to office hours after several attempts, since I usually left feeling unintelligent and more insignificant. Overall, I found myself in a toxic, competitive, scientific environment with an incompatible advisor. The result was anxiety, three undergraduate degrees, (which I felt resentment towards), and a perpetual fear of taking future risks.

While working in a research position at the University of Minnesota, I began taking nutrition courses also at the University of Minnesota. In one of those courses, I met my

future advisor who taught in a way that was so different than I had experienced before. In a conversation after the first lecture, he made me feel empowered as a student and gave me hope that my academic experience could be so much more than I had been used to. He told me it was okay to carve your own path and to fight for your education. This conversation led me to pursue a graduate degree in Nutrition. I soon realized the university system had once again confined and configured my educational path that failed to align with my background, goals, interests, and desired experiences. My goal was to learn about nutrition as a part of the food system, not just the biochemical aspects. I wanted to know how nutrition related to socio-cultural, political, economic, and other fields of study. In my mind and intent, I had moved on from basic nutrition research to a more systems-focused approach.

The way our graduate nutrition program was designed made it difficult for me to explore the topics in which I was most interested and had a strong desire to improve. In the current curriculum format (university, college, and departmental), I would have had to add more courses on top of what was required, ultimately adding more time and money to my program. As a graduate student, so much time and money has already been spent on education that it is difficult to do both the required courses and the courses that help students to go where they desire to go, aligned with the purpose and direction of their career. Those required courses became another obstacle for me to get what I wanted out of graduate school.

In this process I was encouraged by my advisor and other graduate students to petition the department to allow me to replace those required courses with courses focused on developing those personal attributes, professional skills, and abilities that I knew I needed to pursue for my chosen career path. As I petitioned, I saw what it meant to be supported and what it was like to push past comfort zones to fight for oneself. In this process I learned how to successfully argue and defend my worth as a student and as a professional who knows myself well enough to know what I wanted and needed to learn. After conversations with the Department head and the director of graduate studies in nutrition, they approved my request, and I was able to register for classes that focused on my areas of interest. During this critical step, I was able to take charge of my education. It was the

most impactful and important decision that I have made during my academic career. I finally felt empowered and excited to learn. I became proud of my education. Something I had not felt in a very long time. I was no longer taking courses to fulfill requirements. I was taking courses because I truly wanted to take those courses. I found that the simple change of taking charge of my own education made me a stronger student, more active in my courses, more excited to study, and I retained more of the subject matter from my courses. I developed a sense of ownership and pride over my education. At the same time, I became proud to be a part of the University of Minnesota because I knew that at least some members had my back, some knew what I was capable of doing, and some genuinely wanted me to succeed.

Though having the freedom to finally choose courses that I wanted to take, I found that some of the courses I wanted to participate in didn't exist at the University of Minnesota. I was looking for graduate level courses that addressed the relationship between nutrition and sustainability, food and agricultural policy, food systems, systems thinking, and courses prioritized and focused on multi-disciplinary approaches to learning. In identifying this gap, I began to design a course that would address some of these topics while also bringing in alumni as guest speakers and potential non-academic mentors for student development. During this process, and after considerable dialogue, I found that I was trying to fit too much into one course. This process transformed my thinking. Instead, I decided to design a degree program that more thoroughly addressed the vacancies that I had identified in my own and other students program needs, wants, and desires. Thus, what might a multidisciplinary degree program look like, if it was more flexible, while accommodating the individualized and professional needs of students and the 21st century workforce?

In my experience, education has heavily focused on institution learning requirements, the prestige of education, and the jobs obtained afterwards. I believe more focus should be placed on the individual students, their journeys in the process of learning, the decisions they make, and the beneficial skills and connections that will carry them into their future. In my journey, I found a lack of training in professional development, confidence and decision making, as well as application of technical skills to diverse and innovative

situations. My goal in this thesis is to identify and discuss some limitations of our academic system and consequently the food system, including corresponding training for professionals entering or currently employed in the food system. To address some of the issues I identified, I designed a model food systems graduate degree program that the University of Minnesota could implement.

Participatory Action Research Statement

This is a Participatory Action Research (PAR) project, which combines action, practice, theory, and reflection (Bradbury, 2015). Rather than simply understanding a research topic, PAR involves engaging with the research (roles, functions, and activities) which can help identify points of relevance to the world within and beyond academia (Bradbury, 2015). The below figure illustrates the frame that I will use to tell this story. PAR is not

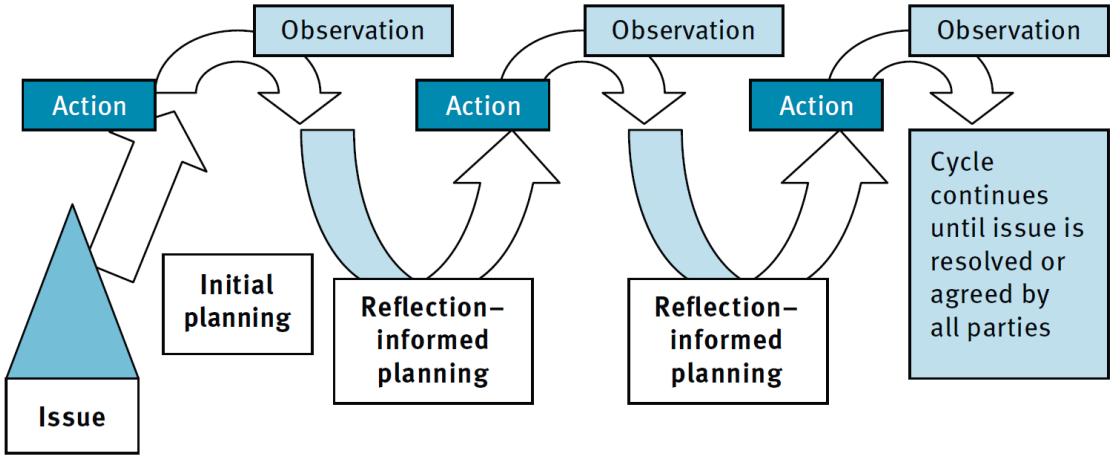
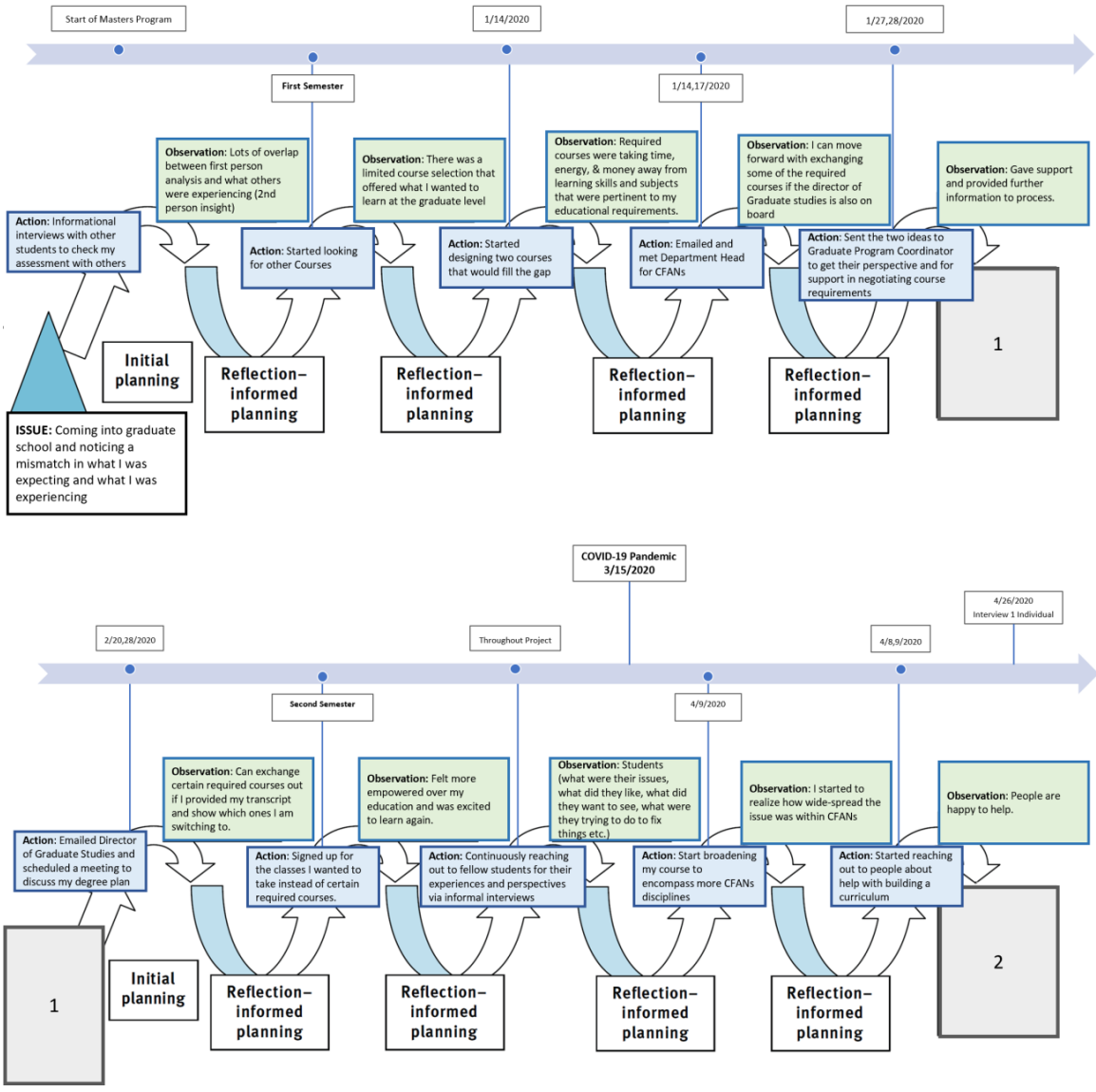
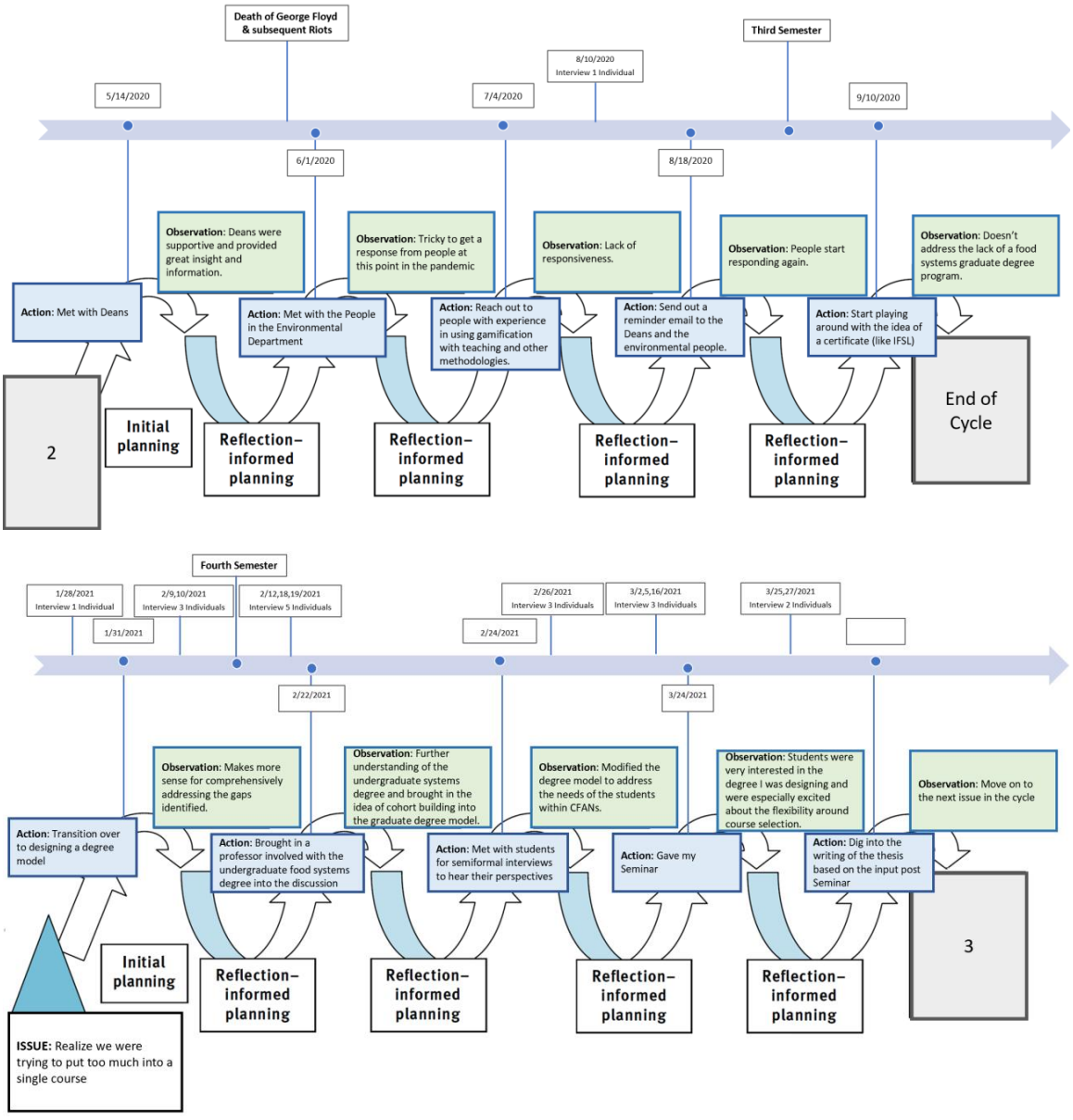


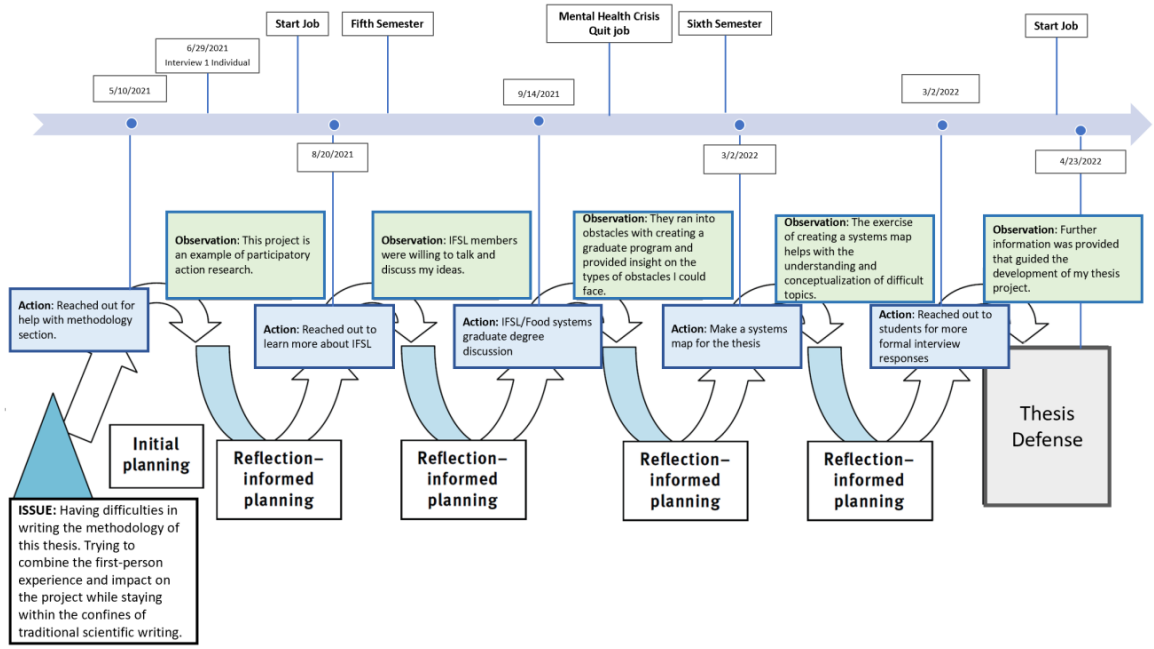
Figure 1. The iterative cycle of participatory action research (PAR)

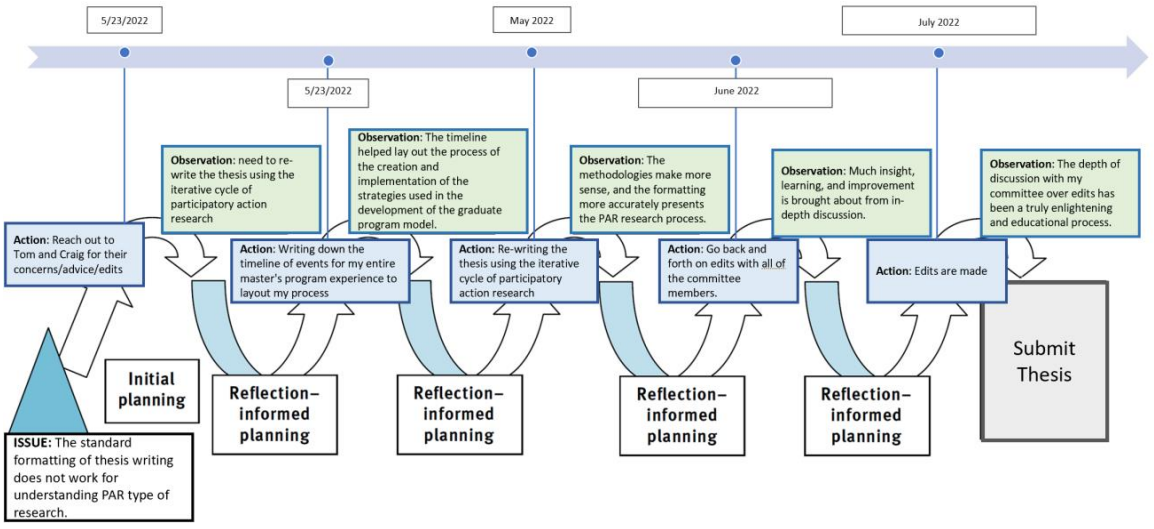
outcome-oriented, as is commonly the case with conventional research. Rather, PAR uses a cyclic pattern starting with an issue and cycling through various iterations of planning, acting, observing, and reflecting until the issue is resolved (Bradbury, 2015)(Kagan et al., 2006)(Wheatley & Hartmann, 2013). The process-based focus of this research is similar in concept to the theory of experiential learning proposed by David Kolb (Kolb, 1984). My thesis project has undergone many iterations of this cycle and will be described using the iterative cycle of participatory action with a corresponding timeline to give you, the reader, a frame of reference as you read through this thesis.

Figure 2. Graduate Program Timeline:




Death of George Floyd & subsequent Riots
Third Semester
8/10/2020 Interview 1 Individual
5/14/2020
7/4/2020
9/10/2020
6/1/2020
8/18/2020
Observation: Deans were supportive and provided great insight and information.
Observation: Tricky to get a response from people at this point in the pandemic
Observation: Lack of responsiveness.
Observation: People start responding again.
Observation: Doesn't address the lack of a food systems graduate degree program.
Action: Met with Deans
Action: Met with the People in the Environmental Department
Action: Reach out to people with experience in using gamification with teaching and other methodologies.
Action: Send out a reminder email to the Deans and the environmental people.
Action: Start playing around with the idea of a certificate (like IFSL)
2
Initial planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
End of Cycle
Fourth Semester
1/28/2021 Interview 1 Individual
2/9,10/2021 Interview 3 Individuals
2/12,18,19/2021 Interview 5 Individuals
2/26/2021 Interview 3 Individuals
3/2,5,16/2021 Interview 3 Individuals
3/25,27/2021 Interview 2 Individuals
1/31/2021
2/24/2021
2/22/2021
3/24/2021
Observation: Makes more sense for comprehensively addressing the gaps identified.
Observation: Further understanding of the undergraduate systems degree and brought in the idea of cohort building into the graduate degree model.
Observation: Modified the degree model to address the needs of the students within CFANs.
Observation: Students were very interested in the degree I was designing and were especially excited about the flexibility around course selection.
Observation: Move on to the next issue in the cycle
Action: Transition over to designing a degree model
Action: Brought in a professor involved with the undergraduate food systems degree into the discussion
Action: Met with students for semiformal interviews to hear their perspectives
Action: Gave my Seminar
Action: Dig into the writing of the thesis based on the input post Seminar
Initial planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
3
ISSUE: Realize we were trying to put too much into a single course


Start Job
Fifth Semester
Mental Health Crisis
Quit job
Sixth Semester
Start Job
6/29/2021
Interview 1 Individual
5/10/2021
9/14/2021
3/2/2022
8/20/2021
3/2/2022
4/23/2022
Observation: This project is an example of participatory action research.
Observation: IFSL members were willing to talk and discuss my ideas.
Observation: They ran into obstacles with creating a graduate program and provided insight on the types of obstacles I could face.
Observation: The exercise of creating a systems map helps with the understanding and conceptualization of difficult topics.
Observation: Further information was provided that guided the development of my thesis project.
Action: Reached out for help with methodology section.
Action: Reached out to learn more about IFSL
Action: IFSL/Food systems graduate degree discussion
Action: Make a systems map for the thesis
Action: Reached out to students for more formal interview responses
Thesis Defense
Initial planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
ISSUE: Having difficulties in writing the methodology of this thesis. Trying to combine the first-person experience and impact on the project while staying within the confines of traditional scientific writing.


5/23/2022
May 2022
July 2022
5/23/2022
June 2022
Observation: need to re-write the thesis using the iterative cycle of participatory action research
Observation: The timeline helped lay out the process of the creation and implementation of the strategies used in the development of the graduate program model.
Observation: The methodologies make more sense, and the formatting more accurately presents the PAR research process.
Observation: Much insight, learning, and improvement is brought about from in-depth discussion.
Observation: The depth of discussion with my committee over edits has been a truly enlightening and educational process.
Action: Reach out to Tom and Craig for their concerns/advice/edits
Action: Writing down the timeline of events for my entire master's program experience to layout my process
Action: Re-writing the thesis using the iterative cycle of participatory action research
Action: Go back and forth on edits with all of the committee members.
Action: Edits are made
Submit Thesis
Initial planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
ISSUE: The standard formatting of thesis writing does not work for understanding PAR type of research.

Introduction:

We live in a Global Society in which our business and cultures are connected across continents, countries, and rooted in local communities. That means problems and issues are more complex than can be addressed with a single tiered approach. Global and local issues related to food waste, food insecurity, sustainability, and climate change require multi-pronged approaches that appreciate multi-disciplinary participation across sectors and diverse cultures.

These complex problems are also referred to as wicked (Kolko, 2012). A wicked problem is a multifaceted problem that is social or cultural and is either difficult or impossible to solve due to incomplete or contradictory knowledge. Complexity is introduced into the situation or circumstance due to the extent of people involved, socio-economic burden, and the interconnected nature of the problem (Kolko, 2012). Situations that fall under the umbrella of a wicked problem, "can't be fixed" as we understand it because there is not a single right answer to correct the problem. Rather the goal is to allow the problem to become less burdensome by managing the situation. Since wicked problems are intricately and dynamically interconnected, and interdependent with other wicked problems occurring on an enormous scale, they are constantly adapting and changing with the situation at hand. This means that we as professionals, and within the general population, also need to be adapting and changing as we learn to manage wicked problems. At the same time, these problems are multi-disciplinary because they occur at the systems level and therefore require collaboration across sectors (government, industry, non-profit and academia), disciplines, and cultures, which extend into our communities, both locally and globally. Problems and issues embedded in the socio-cultural norms of diverse cultures, communities, and society, along with the economic and political implications, further complicate our ability to simply solve these massive problems.

Similar to wicked problems, environmental ecosystems are excellent examples of a complicated system that requires multifaceted solutions that are flexible and adapt to a constantly fluctuating environment. Ecological research shows us that biodiversity is

essential for a sustainable ecosystem (Primavesi, 2020). Monocultures, which are a dominant feature of commodity crop production in our current US agricultural system, can slowly starve themselves out and struggle to survive. On the other hand, ecosystems with strong biodiversity flourish and are more resilient and sustainable. This is a concern as corn and soybeans serve as primary crops supporting our domestic and international food supply, rather than relying upon a diverse crop system and practices allowing diversity, resilience, and sustainability within our agricultural system. The same concept can be applied to teams working on wicked problems. A team consisting of all economists will tend to focus on solutions from an economic point of view. A team with professionals coming from many areas of the food system will have a more wholistic perspective to tackle the same issue with renewed imagination, creativity, and innovation.

Strong ecosystems are able to fluctuate, adjust, and maintain a natural balance. A classic example is the predator prey relationship. In an ecosystem containing both rabbits and wolves, we see the populations of those species fluctuate in response to each other. When the rabbit population is high, the wolf population can increase due to an abundance of food. As the wolf population increases, the pressure on the rabbit population increases which subsequently decreases the rabbit population over time. With the decrease in rabbit population, the wolf population therefore decreases allowing the rabbit population to increase once again. This is a simplified example of a predator pray relationship within an ecosystem, yet it demonstrates the natural fluctuation that occurs within a system. This can be applied to a variety of species including human models.

The ecological model can be extrapolated to human endeavors including (human-made) environments such as academia, industry, politics, social structures, and institutions. Disciplines are often separated and compartmentalized into the form of academic departments to focus on specialization to increase technical knowledge and expertise. While specialization holds value for advancing knowledge within the discipline, when this tendency becomes predominant to the extent that we lack interdisciplinary input from diverse perspectives, preventing us from bouncing ideas and concepts off each other, innovative concepts grow stale and become fragmented (Anonymous University of Minnesota faculty member, personal communication, March 16, 2021). In politics,

people are separated by parties which creates a divide demarking one group from another. This separation can make it difficult to work with people from other groups due to competition, misunderstanding, mindset, ideology, and diverse perspectives. This tendency to create environments where we are working against each other, rather than learning how to work together, hinders the natural evolution and creation of something greater within our businesses, communities, and society. Working in collaboration across the food system allows participants to explore and manage solutions that account for more aspects of the system than can be found through siloed, reductionist, linear approaches.

As human beings we are creatures of habit, often getting caught up doing something the "right" way. From my experience, one of the things our society emphasizes as the thing we should strive for, among others, is perfection. The problem is that most of the time there isn't one single way of doing things, especially when working to solve wicked problems. There are ways to make things better, but that can come in many forms and is constantly evolving. When a population striving towards perfection is combined with compartmentalization of disciplines, it tends to create an "us versus them" mentality. "Our way is the right way" because if it is not, we don't get the grant, the published paper, or the prestige. This push towards perfection also fosters the ideology of "we are the experts" which we need to work towards breaking down to promote more innovation in our communities and society at large (Anonymous industry representative, personal communication, February 10, 2021). Though striving for perfection within a competitive environment has provided scientific progress, I have found in my own experiences and from the experiences of peers that it can also inhibit potential progress that could have been made through collaboration and a willingness to simply make mistakes without fear of being punished for it.

All parts of an ecosystem need to be present to function at its best. The same goes for the professional world. All disciplines are essential for the food system to function at its best. At the same time, it is natural for an ecosystem to be in constant flux as different parts of the ecosystem become more prevalent at certain points, while giving way to other parts of the ecosystem at other points in time. The system(s) is meant to fluctuate, just as there is

fluctuation in which certain disciplines are more prevalent at different times and places within the food system.

The COVID-19 pandemic highlighted the many issues inherent in our food system (Worstell, 2020). Food insecurity, food waste, climate change and sustainability are only a few of the systemic issues that were amplified in the face of the pandemic. In 2019, more than 35 million people were food insecure in the United States (U.S.) (Unglesbee et al., 2020). In 2020, 38.3 million people lived in food-insecure households in the U.S. (Economic Research Service, 2022), and even though many people are food insecure, each year 80 billion pounds of food is thrown away in the U.S. alone (RTS, 2021). The answer is no longer simply a "more food" approach (Béné et al., 2019). There are plenty of food calories available for the world's population. However, the crux of the matter depends upon food distribution practices along with the nutrient content of that food, as influenced by food justice, food sovereignty, and environmental quality (Béné et al., 2019). Food justice is a movement that strives to alleviate injustices in the entire food system in part by eliminating disparities and inequities within the food system to ensure that benefits and risks are shared fairly (Robert Gottlieb, 2018). "Food sovereignty is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts the aspirations and needs of those who produce, distribute and consume food at the heart of food systems and policies rather than the demands of markets and corporations (Nyéléni, 2007)."

Climate change, an ever expanding population, along with a dire need for environmental sustainability, challenges our current food system to grow, process and deliver the quantity and quality of food to sustain our people and planet (Worstell, 2020). In 2019, the second warmest year was recorded, culminating with the warmest decade on record (United Nations, n.d.). Our ability to feed our global population while maintaining our human and planetary health will require a new mind-set, new approaches, and collective action across the food system. These major challenges necessitate a dramatic shift from simply producing more food, to improving our assessment, monitoring, and governance of the food system (McDermott & de Brauw, 2020). Thus, attention needs to be directed

toward the training and nurturing of actors and key drivers within the food system to identify viable paths forward.

Many issues highlighted by the pandemic, including actors and drivers within the food system have an impact on, or are affected by sustainability and the sustainability movement (Worstell, 2020). Since there are several meanings behind sustainability depending on the context, it is important to define it for use in this paper. As discussed earlier, sustainability is a grand challenge that includes a broad spectrum of interconnected concepts, functions, and activities, which might serve as a contextual working definition for specific use in this paper. There are four main types of sustainability: those being human, social, economic, and environmental (Goodland, 2002). Human sustainability refers to individual human capital maintenance that occurs during one's lifespan (Goodland, 2002). Social sustainability is the maintenance of social capital which includes investments and services that makeup the framework for society (Goodland, 2002). Economic sustainability refers to the maintenance of economic capital. Environmental sustainability improves human welfare by protecting natural capital which includes natural resources such as water, air, land, minerals, and ecosystems (Goodland, 2002). Each of these types of sustainability focuses on a subsection of the overall world system yet each affects the other components when observed from an overarching global perspective. Even smaller systems such as the food and academic systems discussed in this paper include all four types of sustainability as stated by Goodland et al. For the purpose of this paper, the term sustainability refers to the combined affects and interworking's of the four categories of sustainability synergistically working together.

The goal of this thesis is to develop a model of a graduate level program, through the use of Participatory Action Research, that the University of Minnesota can use to remain relevant and address the learning gaps (Burner, 2019) while increasing student interest and retention through integrated interdisciplinary educational experiences. This degree will address the horizontal part of the T-shaped model described by Ringling (Ringling, 2020) to complement the technical learning students have gained during their undergraduate experiences. The thought is that the undergraduate program can focus on technical skills and knowledge, whereas the food systems graduate degree will be

directed toward allowing students to learn how to use their technical skills with systems thinking and apply it to food systems-related issues. This program is intended for students who desire to learn about how different disciplines and practices are connected and operate together within a system. The aim is to bring in students from diverse disciplines to discuss complex topics from varying perspectives and learned backgrounds while encouraging students to go beyond understanding and remembering, based on levels of Bloom's Taxonomy (Armstrong, 1956), reaching toward application, analysis, evaluation, and creativity.

Students would be allowed the freedom and flexibility to apply their knowledge across food and nutrition topics related to climate change, environmental sustainability, health, economics, policy, mental health, and soft system modeling. This program would provide a more wholistic approach beyond what is currently offered to students in the traditional degree programs currently available. In addition, this program emphasizes facilitation skills and will have a continuous undertone that focuses on workforce preparation and professional development.

Description of Methodology:

This project used an anthropological approach through qualitative data collection. Anthropology is a holistic science that explores the complexity of human interaction and culture through observing diverse perspectives (Hyman, 1953). Anthropologic data collection often includes observation and conversation with people from different social categories (Hyman, 1953). Many of those people have varying relationships to the phenomena being studied and interpret the phenomena in different ways (Hyman, 1953). In this project the referred phenomena is the food systems graduate degree program including the goals and ideals behind the conception of this program. The four main forms of qualitative data collection that researchers use for anthropology include: participating in the setting, observing directly, interviewing in depth, and analyzing documents and material culture (Macuha et al., 2011). All four of these methods were used in this project. In STEM fields, qualitative data collection is often viewed as lesser data and is regularly ignored or skipped during the process. This can be referred to as a

form of epistemic injustice which is where some forms of knowledge are overlooked, and others are augmented (Bradbury, 2015). By disregarding certain areas of knowledge, important information can be missed, and it becomes difficult to see how specific research projects fit into the bigger picture. Stepping back and observing several types of knowledge is important to identify new research goals that highlight what might be important and what might be missing. Thus, anthropological data collection is useful to help guide and highlight how quantitative research fits into the overall vision, goals, objectives, methodology and outcome or benefits, as it relates to the specific project within context of the situation, time, and place. This approach allows us to recognize and embrace the added value contributed through anthropology and qualitative observation in STEM fields.

Participatory action research (PAR) is one approach to identify practical solutions and application for conventional research by using a combination of action, practice, theory, and reflection (Bradbury, 2015). In contrast with conventional research, PAR includes the human interaction and process which might address the disconnect between "mainstream scholarship, and practice (Bradbury, 2015)." At the same time, action research may clarify issues of relevance for conventional research allowing clarity around why, how, and what research might be undertaken. Rather than simply understanding a research topic, PAR involves engaging with the research (roles, functions, and activities) which can help identify points of relevance to the world within and beyond academia (Bradbury, 2015). Thus, in a project that is meant to address the human experience within the University of Minnesota and the food system, it makes little sense to remove the people and human interaction from the observations and data collection process.

Throughout this project, I used participant observation (Methods, 1995) allowing firsthand involvement in the university setting, specifically within the College of Food, Agriculture, and Natural Resource Sciences (CFANs) and the Food Science and Nutrition (FScN) department. This immersion within current programs offered at the University of Minnesota allowed me to experience the reality of being a student within the graduate program. Through this process, I was able to learn from my peers and their experiences within the academic system, and to reflect on my own experiences as well. Being a

student also helped with the informal and conversational interview process to understand the student culture within our department as well as common frustrations with the overall academic experience.

In addition to participant observation, in-depth interviewing was a large part of this project. In-depth interviewing proceeds more like a conversation than a formal interview and rather than consisting of specific predetermined questions, there is an overall purpose to the interview (Methods, 1995). The purpose was to describe the interviewee's perspectives on the topic and to gain useful information to direct the project. In this case, the goal was to explore a range of perspectives on the food system, the relationship between nutrition and the food system, the academic environment within CFANs, whether students are getting what they need from the University, as well as how a food systems program might function within the University of Minnesota. These interviews were carried out with students within CFANs as well as public health, professors in several departments, adjunct instructors, people who work in university extension, administrators, deans, student counselors, and members of the food systems community outside the University of Minnesota. The wide variety of people interviewed was intended to allow diverse perspectives and to elicit a more holistic view of topics discussed.

The interviewees for this project consisted of undergraduate students (within CFANS of varying disciplines), graduate students (within CFANS and Public Health of varying disciplines), faculty members within CFANS, faculty members working in extension, faculty in Applied Economics, administrative members within the University of MN, and industry professionals within the food system in the US (mostly in MN). The gathering of input was an endless process and has continued throughout the whole of this project. These interviews were in the form of formal and informal interviews with students, and formal and semi-formal interviews with University of Minnesota faculty, staff, or Industry Professionals. Another type of information was collected in the form of observations while I was in the workforce. These observations mainly consisted of industry perspectives on graduates entering the workplace.

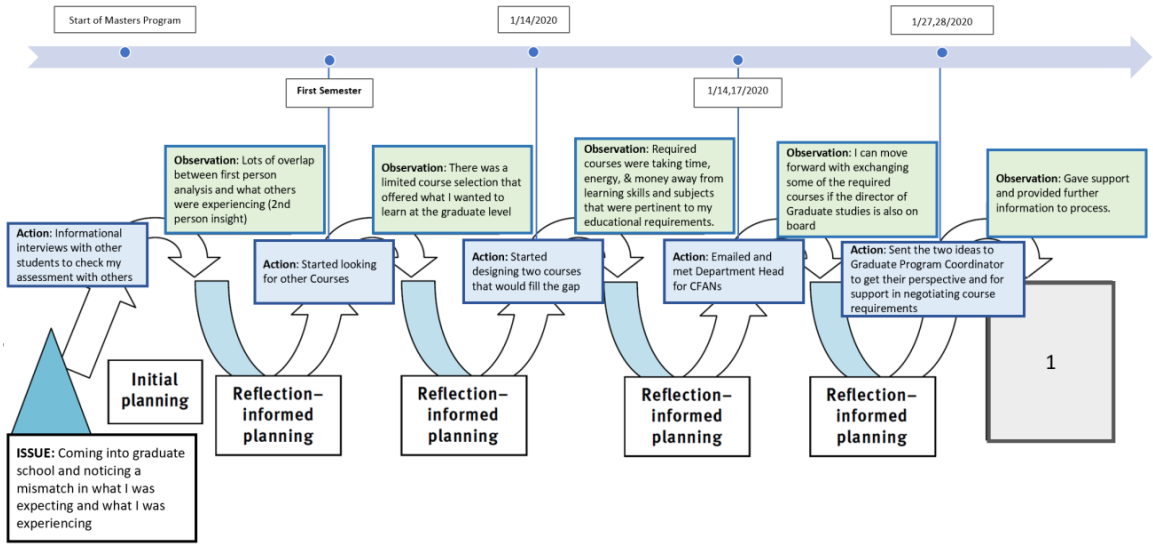
A specialized form of in-depth interviewing is when the interviewee is considered an elite (Methods, 1995). That can include anyone who is considered influential or well informed in an organization and can provide information on governance, organizational and financial structure, along with political and cultural perspectives (Methods, 1995). For this project, interviews were conducted with an associate dean and several other pertinent administrative figures within the University. The use of thoughtful questions and conceptualization of the problem helps establish capability and credibility on the part of the facilitator which is important in these types of interviews (Methods, 1995).

During the course of this project, I was in discussion with fellow students about their personal experiences with the academic system in general and more specifically their graduate experience. This was through the informal interviews and conversations that naturally occur between students and their peers. During this time, I noticed that many students were voicing similar concerns and grievances to the ones that I had experienced and continued to advocate for change. This influenced the design and topics of the course initially and then the graduate degree program. These informal interviews led to scheduling more formal interviews with members of the University's staff and faculty (including some deans) to get the perspectives, advice, and information from individuals extending beyond the student body. Naturally, due to the sensitivity of the issues brought up in these interviews, several people requested anonymity due to the political nature of the academic system, which is typical of the culture for most organizations.

In addition to members of the University of Minnesota's community, I interviewed members of industry, non-profits, and the food systems workforce to understand perspectives extending beyond the traditional boundaries of the University. Keep in mind that these interviews flowed through natural dialogue in which the direction of the conversation emerged and were directed by the content brought up during the interview. These discussions were organic processes that evolved based on the individual being interviewed and the specialties, expertise, and experiences they provided from their unique perspectives. The questions that set the foundation for these interviews are provided in Table 1. Semi-Structured Interview format is located in the appendices. The questions directed towards individuals outside of the University system were designed

initially as networking interviews but evolved as I realized the value of the learnings from those interviews for the development of the graduate program. Understanding the background that led each interviewee to the position they were in during the time of the interview, understanding the type of position they were in, and what kind of training and experience they found useful in their career journey is useful information for understanding what kind of training and experiences would be valuable in a graduate program. The information from those interviews also provided the perspective of the interviewee and offered a deeper understanding of how and why they responded to the questions about the program. The types of questions that typically form a networking interview can provide insightful feedback for universities to adapt their training and education for their students to best prepare those students for an evolving workplace.

Figure 3. Cycle 1. *The Foundations for course development*



As alluded to in the preface, I came into this master's program with a strong background in biochemistry, molecular biology, chemistry, and related research. In preparation for the thesis and in case I wanted to go the direction of a registered dietitian, I enrolled in and completed a long list of undergraduate level nutrition-based courses to add to the plethora of courses in my background leading into my thesis program. These nutrition

courses allowed me to transition from my biochemical background toward an orientation of applied food, nutrition, and environmental and human health. Entering the graduate program, I expected to continue this path focusing on nutrition and food systems, and less on biochemistry-related courses. This brings me to my initial issue that begins the iterative cycle of PAR. The nutrition master's program did not allow for a nutrition food system focus as I was anticipating, rather the prescribed program brought me back to the heavy biochemistry-related coursework I was hoping to transition away from. I started to feel trapped, like I felt in my undergrad, and started to ask around to see what other students within my program were experiencing. This initial probing informed, incentivized, and reflects my choice to eventually conduct informal interviews with fellow students to ascertain their experiences within the academic system. In these interviews I found that I was not alone in feeling trapped within the curriculum requirements, the expectations and reality of the FScN Nutrition graduate program within CFANs, and the lack of freedom and ownership in our educational paths. In one conversation I remember a friend pointing out that their advisor was requiring them to take biostats II on top of the curriculum required courses even though it didn't directly help my friend's thesis project and they weren't interested in it. At what point are these courses helpful versus harmful when you balance out the stress to benefit ratio? Through informal interviews, I found that there were many people who were unhappy with the Nutrition department, many of them being students. Based on my observations and these interviews, the Nutrition department needs to make changes to maintain student interest and improve the student experience. Student interest leads to higher enrollment and less students matriculating into other universities and colleges or choosing to study in other departments. There were several students that I knew either left or verbalized leaving our Nutrition department to go to the Public health department because they offered the type of Nutrition courses that they had signed up to take in graduate school. I found this difference in expectations versus reality interesting and a bit confusing until I realized that the undergraduate nutrition program pushes students down the Didactic Program in Dietetics (DPD) route, but in graduate school, pushes towards life-science nutrition. Those students coming from the undergraduate degree in Nutrition often have better options in the Public Health department than the Nutrition department for courses related

to their interests. This is a pressing issue for our Nutrition department as graduate student enrollment, satisfaction, and retention hinges on quality and added value courses as viable curriculum options. Thus, the public health program, currently has more variety (breadth, depth, and scope) of nutrition classes than the nutrition department for graduate school (See table 2 in the appendices for a Comparison of Nutrition related graduate level course offerings between the department of Public Health (PubH) and the department of Nutrition (NUTR)).

Offering a variety of courses tailored to a wider population of nutrition students will help the Nutrition department and CFANs attract more students while enhancing student fulfillment and retention. For many STEM programs, there are a list of required courses that students must take to graduate. These lists of required courses limits students' ability to choose courses that makes sense for what they want to learn and what they need to focus on as an individual.

> "The nutrition program is narrowly focused on clinical dietetics and should be broader to encompass the myriad of opportunities for individuals with a nutrition degree" (Anonymous graduate students, personal communication, April 27, 2022).

Lists of required courses are useful when students are all coming in with the same academic background and work experience. The problem with this format in graduate level programs is that students come from diverse backgrounds and disciplines which make some requirements more or less relevant. The existing Nutrition program has a heavy biochemistry and research focus and is not a good fit for some potential students. For example, students, such as myself, may have a strong background in biochemistry, biology, and chemistry in addition to research lab experience coming into the nutrition master's program that requires mainly biochemistry and research methods courses. Offering an alternative path that allows those students to take other courses that supplement and expand upon their previous knowledgebase and skill-sets, while building their personal attributes can be a great opportunity to attract additional students that may have otherwise gone elsewhere.

This led to the next step in this cycle of iteration in the form of reflection informed planning. I brought up some of my concerns with my advisor who worked with me to create the educational experience that I was seeking. We explored the idea of adding a systems minor and identifying electives that would address my broader interests and goals. We found that I either had to limit myself in what I could take or extend the amount of time that I would be in graduate school, therefore adding more time and cost than I was able and willing to give. Also, during this exploration, I realized there was a limited selection of graduate level courses within CFANs that covered food systems, especially how nutrition related to the food system. I'm keeping in mind that a "Food System" type of undergraduate program already exists within CFANS focused on farming, food processing, distribution, markets, consumption, recycling/sustainability, with touches of biology, technology, economic, and social aspects of the food system. Though CFANs has a food systems degree for undergraduate students, there are very few options for graduate students to take higher level courses in food systems as part of their graduate program. At this time, I was still trying to identify a project for my thesis, so I decided to design a course that filled the gap that had been highlighted by my own search and by the needs of my peers up to this point.

I was especially disappointed that there wasn't a course that connected Nutrition to environmental sustainability (Eco-nutrition), so I used that as a starting point for the initial course design. As I looked further into this problem, I identified other important aspects of how nutrition related to the food system that were absent or barely touched on in the current curriculum for Nutrition training within CFANs (Policy, systems, agriculture, etc.). I started with two courses to try and cover the gaps that I had seen through my own experience, observation, and from the informal interviews with my peers. The scopes for these two courses are as follows:

> One idea was to create a class that brings in alumni from the workforce to serve as guest teachers to talk about "real world" nutrition policy, regulation, environmental impact, connection with agriculture, economics, etc. based on their experiences. Some of the main goals for this course would be to teach students about different aspects of Nutrition in a more interdisciplinary and applied way. It

would also be a great way to involve alumni in the department while also using them as great resources of knowledge for our students. I was also thinking about how to incorporate field trips in which the students could go to a place of work in the real world and get tours with alumni.

The other course I considered addressed the extensive focus on the hard sciences in the Nutrition department, for instance, courses including Nutritional Biochemistry, Nutritional Genetics, Nutritional Physiology, and Vitamins and Minerals Biochemistry. The thought would be to create a conjoined version of these courses where key concepts are integrated into one class. This class could cover how those hard sciences connect to Nutrition without getting too bogged down in the details. This class would be designed for students who are focused on behavioral, ecological, or systems Nutrition, whereas the life-science branch of Nutrition requires more in-depth knowledge. This would allow students exposure to the life-science tradition of Nutrition while allowing those students to put more time and effort into other areas of the food system or other traditions of Nutrition. It would allow students to know how the field of Nutrition is part of each discipline of science and how it connects through application and practice. The class could even be taught by the professors who teach the full versions of those classes where each professor teaches their own section. Thus, allowing the confluence of disciplinary sciences to focus on the key principles of nutrition as a foundation of understanding and application.

Eventually through research, planning, and reflection, I decided to focus on designing one course for my thesis project that would address the topics identified as missing in the nutrition curriculum. I started with the creation of a course (CFANS 5XXX: Eco-Nutrition) that could be taken by nutrition students at both the graduate and undergraduate level. Reference the course syllabus in table 3 in the appendices.
My reflective process that led to designing this course prompted me to petition the department to let me exchange some required courses in lieu of pertinent courses that were in line with my academic and career goals. I was looking for an individualized education that allowed me to learn the necessary skills I would use for the path I was

interested in taking after graduation. As it was originally designed, the Nutrition degree plan within CFANs focuses mainly on nutrition in the form of the hard sciences.

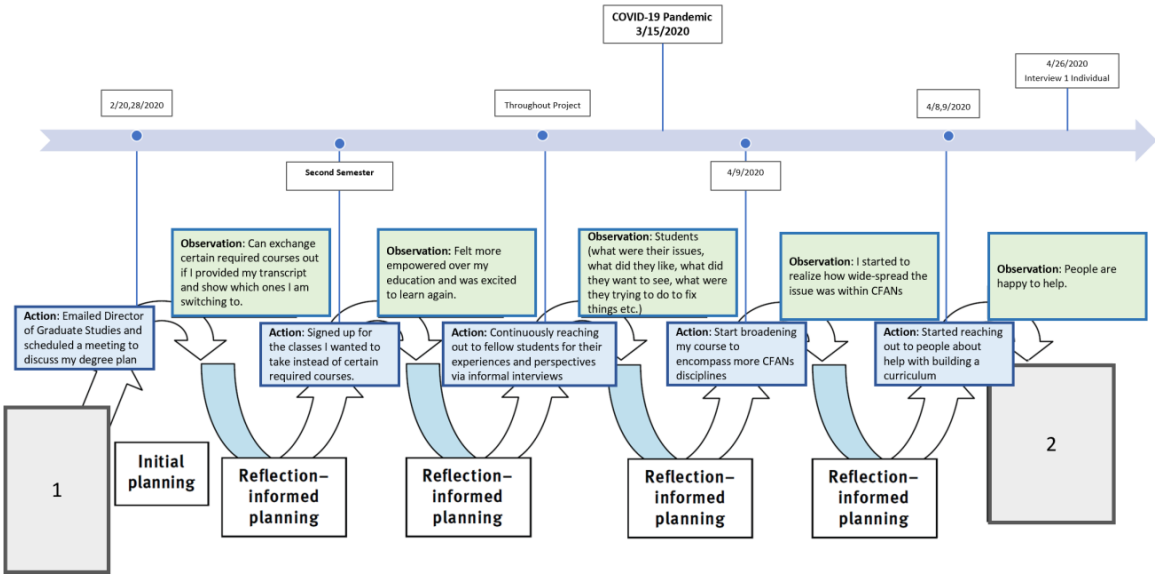
Coming into this Nutrition Master's program, I already had a solid background in biochemistry and research methods in the form of three undergraduate degrees and considerable work experience. To provide context, some of the relevant courses that I took before entering this program include: Human and Animal Physiology, Principles of Nutrition, Food and Nutrition Management, Advanced Human Nutrition, Life Cycle Nutrition, Social and Cultural Aspects of Food Nutrition, Food: Safety, Risks, and Technology, Chemistry I&II, Organic Chemistry I&II, Inorganic Chemistry, Descriptive Inorganic Chemistry, Biochemistry I&II, Biology I&II, Human Anatomy, Microbiology, Molecular Biology, Physical Chemistry, Quantitative Analysis, Ecology, Medical Microbiology, Advanced Scientific Writing, Genetics, Evolution, Cell Biology, Calculus I&II, Physics I&II, Undergraduate Seminar I&II, Communication in Biology, Cell Biology of Human Disease, and Chemistry Undergraduate Research.

Understanding that the required courses presented to students currently are very important for individuals intending to go along the research/academic route, I was more interested in nutrition policy, environmental sustainability as it relates to nutrition, and how nutrition is connected and interdependent within the larger food system. I am interested in being the person who connects academics research with real world application and issues. To accomplish this goal, it necessitates that I learn how to work with policy and regulatory issues and understand its application as to how nutrition plays a role in the big picture of food systems. There were three courses that I didn't believe made sense for me to take with regard to my present and future goals. Having a background in the hard sciences and having had experience working as a biochemist for the Environmental Protection Agency, a chemist for a wastewater treatment facility, a work hand and researcher at cedar creek ecosystem science reserve, and working in two different university labs as both an undergraduate researcher and as a lab technician, I believed I had enough experience working with research methods, and I did not need to take the required research methods course which appeared redundant. I also do not believe it was necessary to take Nutrition Genetics and Vitamins and Minerals

Biochemistry given my background and work experience with genetics and biochemistry. There are many experts out there who focus on genetics and biochemistry. I recognize that it is important to have highly specialized individuals in those areas, but I also believe that as long as you know who to contact, you can figure out what you need to know with basic foundational knowledge. I personally don't need to be an expert in those areas when I know people who are and who are more interested in those topics of exploration. We are in dire need of people who can connect the actions of experts in different sectors, disciplines, and cultures to allow things to happen. Also, I believed that my graduate work would be spent more wisely both studying in my areas of interest and in working on developing one or two courses that would help the department fill these gaps related to systems approaches, policy and regulatory issues as it relates to real-world wicked problems.

To begin the petition process, I formed a plan with my advisors, along with advice from other graduate students, I decided which classes made sense to negotiate and potentially substitute, based on my previous course work and relevant work experience prior to attending graduate school. Following this plan, I reached out to the FScN department head to discuss student concerns and questions regarding course requirements within the nutrition graduate curriculum, specifically regarding the potential of expanding course options to include more multi/inter-disciplinary learning experiences. In this meeting, I was not only able to defend my case on exchanging courses for ones that more appropriately attended my academic and career goals, but I was also able to highlight the importance of allowing students flexibility in their course degree plans. With the go-ahead from the department head, I then reached out to the Graduate Programs Coordinator to discuss their thoughts on these proposed changes as well as the course being designed and the possibility of success. They were excited to support me in taking ownership over my education and thought that the course I was designing was a step in the right direction for our department.

Figure 4. Cycle 2. *Personalized degree plans and course curriculum development*



Following this conversation with the Graduate Programs Coordinator, a meeting was set up including the Graduate Programs Coordinator, the Director of Graduate Studies, and my advisor to get the final okay to exchange courses. I felt that my concerns about the lack of options for students who do not fit within the designated path set by the department (and who also do not fit within the public health nutrition route), had a strong enough foundation to move a program designed for their needs forward. The course exchange that took place is demonstrated in Table 4.

Table 4. Course exchange for the author's personal program requirements.

Remove	**Add**
NUTR 5622 Vitamins and Minerals Biochemistry (3 credits)	APEC 5451 Food Marketing Economics (3 credits)
NUTR 5624 Nutrition and Genetics (2 credits)	APEC 5832 The Business of food systems (1 credit)
Research methods course requirement (2 credits)	PUBH 6901 Foundations of public health nutrition leadership (2 credits)
Other potential Courses to add to meet credit load requirement	
PUBH 6101 Environmental health (2 credits)	
PUBH 6113 Public policy and risk: strategies for effective decisions and discourse (3 credits)	
PUBH 6134 Sustainable development and Global public health (2 credits)	

My resume and transcript were required to support the foundation that I had the background required by the graduate program through prior courses and work experiences. The Departmental Administration then agreed to allow me to swap out specific courses for ones that I preferred to take. This process of petitioning the department to take ownership over my education was the most empowering thing I have ever done and certainly influenced the inherent flexibility in my degree, as later designed into my program, with hopes that other students could experience this same feeling of ownership over their graduate education.

Table 5. illustrates graduate degree courses chosen by three students obtaining a Nutrition Masters / Doctoral degrees at the University of Minnesota who desire more than just the life-science tradition of nutrition in their education. Students 2 and 3 added to their required list of courses mandated by the University, thereby increasing the time and money needed for their graduate degrees. Student one, representing my coursework, represents the resulting degree plan after petitioning the department to allow me to exchange certain courses more germane to my education goals.

Table 5. Examples of students creating personalized degree plans within the restrictions of the current Nutrition graduate program.

Student 1	Student 2	Student 3
• Nutritional Biochem • Presentation Skills • Biostatistics I • The Business of Food Systems • Nutritional Physiology • Advances in Nutrition • Food Marketing Economics • Sustainable Agri Concepts • Public Health Nutrition Leadership	• Nutritional Biochem • Presentation Skills • Biostatistics I • Nutritional Physiology • Advances in Nutrition • Vitamins and Mineral Biochem • Plant Reading Principles • Using risk analysis tools • Food Marketing Economics • Nutrition and Genetics • Public Health Research • Surveillance of food borne disease	• Maternal and Infant malnutrition • Qualitative research methods • Policy on child and adolescent weight health • focus group interviews • directed study: evaluating writing community-based grants • +nutrition core classes

In my experience, the academic system has grown comfortable handholding students from kindergarten through graduate school by instructor led required courses, that tend toward black and white solutions or answers. It is important to allow graduate level

students to explore their interests through courses while creating a safe environment for them to grow (Zull, 2011). When students venture into the workforce, they are unfamiliar and generally unprepared when making independent decisions that may be uncertain, risky, and/or may result in negative feedback, if their response does not meet management expectations. A learning environment emphasizing freedom, flexibility, and a sense of wonderment on the part of the student might be best suited to allow character development, confidence building, while meeting curriculum competencies and program requirements.

Failures, mistakes, and missteps are all essential experiences and situations for students to encounter if effective learning is to be transferred through real-world scenarios. Students need to learn how to struggle and cope with issues that don't have one right answer (wicked problems) and learn how to be okay with failure and mistakes while continuing to seek solutions by failing forward. (Being told what to do eliminates the core of this learning process. It also detracts from student's opportunity to build self-efficacy during their program of study.) Making decisions about one's education gives students responsibility for those decisions and leaves room for making those mistakes that they can then learn and move forward (Lopez-garrido, 2012). These concepts are the foundation of the graduate program that resulted from the evolution of the course design. The resulting graduate program design aspires to allow students the latitude to explore decision making in a safe environment while empowering them to take charge of their future by carefully building in freedom, flexibility and student ownership into program design and basic requirements.

At the same time, this program provides purpose and direction through examples, lists of courses students can choose from, and guidance from the students' graduate committee. Student guidance from the graduate committee should be best delivered in the form of advice and not commands. The distinction between advice and command is important because students are more likely to take responsibility for their choices when it's based on advice (Lopez-garrido, 2012). When those choices are based on a command, the responsibility stays with the person giving the command and therefore leaves less room for self-growth within the student. The hope is that this format can not only empower

students and improve their self-efficacy during their program of study, but also to bring those skills with them well beyond the University and into their future.

De-emphasizing formal tracks allows students to design a curriculum that addresses their interests within the scope of the program. Some core courses will address systems thinking, yet the goal is to emphasize an interdisciplinary program that allows students to adapt their personal interests, areas of expertise, and learning goals and style (conscious intentions) within the broader scope of the food system. Since students are paying tuition to the university to learn, it is imperative they participate in the decision making and design of their degree programs. Students should have the opportunity to develop personal and professional skills of interest rather than focusing on required courses that may or may not pertain to what students need, want, and desire.

Although my thesis project slowly evolved from a course into designing a graduate degree program, at this point in time I was still focusing on designing a course and was continuously interfacing with students via informal interviews. These informal interviews were essential to help create a course that would best fit the needs of the students within our nutrition graduate program who felt trapped, out of place, or unrecognized (meaning that student needs were not being met). Given the number of issues and gaps within the FScN program, brought up by students, evolved to the extent that I had to broaden my focus of the course to encompass more concepts, disciplines, and perspectives within CFANs. One of the major gaps brought up by students within our Nutrition department and well supported in the literature, was a lack of connection between Nutrition and other disciplines within the food system.

The study of nutrition is the observation and understanding of nutritional processes as well as the components of food and their interactions and balance within the body in relation to health and disease (National Library of medicine, n.d.). A basic system is a set of things working together as parts of a mechanism or an interconnecting network (Lexico, n.d.). These nutritional processes are smaller systems within larger systems and have far reaching effects that go beyond the biochemical interactions within the body. Some of those effects include food choices that impact environmental sustainability, governance and economics of food production, culture, food waste, and agricultural

practices (Baker et al., 2020). These issues are all part of the food system which is a complex web of activities involving the production, processing, transport, and consumption of food (Oxford Martin Programme on the Future of Food, n.d.).

The food system is a complex adaptive system which is comprised of a network of interactions that are dynamic and therefore make it difficult to predict the behavior of the components when placed together in an ensemble (Nesheim et al., 2015). One characteristic that makes the food system adaptive is the number and variety of actors (Nesheim et al., 2015). Those actors include human actors (such as farmers, workers, researchers, and consumers), institutions (such as universities, governments, organizations, and corporations), and organisms (such as insects, animals, microorganisms, and plants) (Nesheim et al., 2015). The second characteristic is the feedback loop. A feedback loop occurs when changes to a component downstream affects interactions and components upstream (Nesheim et al., 2015). As an example, when consumers downstream in the food system increase their purchase of organic foods, farmers are likely to increase production of organic foods due to increased demand. The third major characteristic of an adaptive system is the idea of interdependence (Nesheim et al., 2015). Since many of the mechanisms within the food system work across multiple levels (including the biological level, social context, and physical food environment), they often depend on multiple players within the food system as they interact to carry out their activities (Nesheim et al., 2015).

Much later into my program when I had transitioned from a course to a graduate degree program, one of my advisors suggested I create a systems map. As you read through this thesis you can see the evolution of those smaller diagrams being combined into a larger more complex diagram that can be used to emphasize the complexity of the topics that I have been covering while also trying to make it easier for you, the reader, to follow along when reading this paper. Initially the complexity overwhelmed me, but once I focused on small sections that I later combined to create a larger system diagram it became more manageable. The most difficult part was to identify the right amount of detail. Too much detail and it becomes difficult to follow, too little detail and it becomes over simplified. The process of contemplating, exploring, and discussing, the creation of a systems map

was a great learning experience and really allowed me to test my understanding of what I have been generating and learning. These diagrams are not perfect and have many areas in which they can be adapted and improved but have been a wonderful and challenging tool to help me connect the issues that I have been learning.

The first diagram is a Food Systems Elements diagram modified from an adaptation by Christy Shi (Figure 5) illustrates the standard elements typically included in food systems discussions (Christy Shi, Wilkins, J. and Eames-Sheavly, n.d.) and the elements that are minimally mentioned or entirely excluded in the training of Nutritionists within CFANs. Those elements include food production, distribution and aggregation, food processing, marketing, markets and purchasing, preparation and consumption, along with resource and waste recovery (Christy Shi, Wilkins, J. and Eames-Sheavly, n.d.). Notably, nutrition is not included in this diagram and is often excluded from the number and variety of actors. Since nutrition is connected to and influences many parts of the food system, this is a critical issue which limits the overall impact of the nutrition discipline in terms of its efficiency, effectiveness, while it dramatically limits efficacious outcomes and benefits for general and targeted populations (Baker et al., 2020). Clearly, this not only necessitates that nutrition be explicitly included in the overall food system discussion from a life science, behavioral and ecological perspective, but also shows that the topic of food systems needs to be brought into the training of Nutritionists so that they can effectively participate in this discussion.

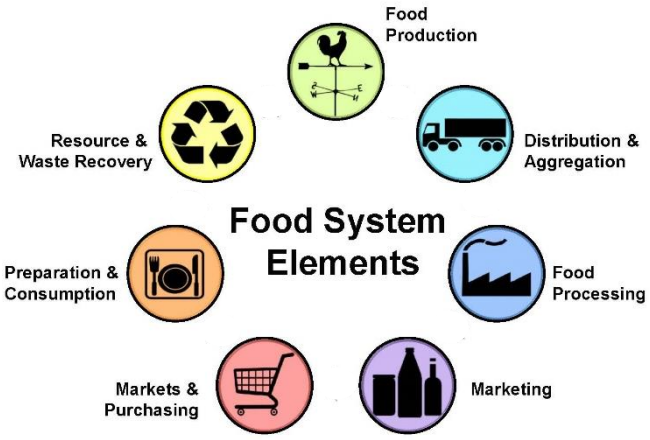


Figure 5. Food System Elements Diagram Modified from an adaptation by Christy Shi, Center for Environmental Farming Systems.

From: Wilkins, J. and Eames-Sheavly, M. Discovering the Food System; An experiential learning program for young and inquiring minds. Cornell University, Departments of Nutritional Science and Horticulture. http://www.discoverfoodsys.cornell.edu/

Fortification is a prime example of nutrition research being effectively integrated into the food system with a resultant efficacious outcome and benefit for the general population. The term fortification refers to the process of intentionally adding one or more micronutrients into a food or food product to increase its nutritional quality (World Health Organization, 2022). Through processing, important micronutrients can be removed from products, as exemplified by refined flour. Through research and observation, nutritionists were able to identify those micronutrients needed to be reintroduced into diets to replace the health benefits of certain foods. This example highlights how nutrition researchers were able to demonstrate cause and effect relationships between vitamins and minerals and the subsequent prevention/cure of nutritional deficiencies on a public health scale. This demonstration of effectiveness showed professionals within the food system (including, but not limited to, researchers, public health experts, and people within government, industry, and academia) that scaling-up the efficiency, effectiveness and efficacious outcomes would require a systemic approach by introducing key vitamins and minerals into the food supply.

How do we allow nutrition to become an integral component within our food system that allows access, availability, and consumption of foods that people want to eat because not only is the food nutritious and healthy, but it is also culturally desirable, tastes good, is affordable, and is sustainable for both people and planet? Rather than a simple cause and effect approach, we now need to address nutrition issues from a multifactorial, multidisciplinary, and economically sound approach, while being socio-culturally and politically astute in the integration of food through our food system in an imaginative, creative, and innovative manner. One way to do this is to address the imbalance in recognition and value placed on the three distinct intellectual traditions constituting the nutrition field. These traditions consist of life science nutrition, social nutrition, and eco-nutrition (T. Lang & Barling, 2013). Life science nutrition is the dominant domain, highly specialized and hyper-focused on molecular and genetic detail which is used to "explain phenomena by ever more refined biochemical understanding (T. Lang & Barling, 2013)." Being the dominant tradition, the extra attention to the traditional specialization and focus within the domain of Life science might partially explain why nutrition is often left out of food system discussions. Hyper specialization may fail to

consider variations in the food system that are outside the parameters of the focused study. This zooming in on the genetic and biochemical detail is important, yet when specialization and hyper-focus alone become paramount, at the expense of nutrition as a whole disciplinary field, it becomes easy to see how nutrition has become disengaged from our food system. The specialization and hyper-focus within the life science domain should fully complement the other two traditions to be most effective. The second tradition is social nutrition, which focuses on "how nutrition is embedded within culture and ways of living, a function of socio-economic processes, ranging from culture to class and income (T. Lang & Barling, 2013)." The third tradition is eco-nutrition which connects nutrition to the biophysical environment and recognizes nutritional dependency on biophysical factors such as biodiversity, water, soil, and climate (T. Lang & Barling, 2013). As shown in Figure 6., the combination of these three traditions allows for the synergy of multifactorial and multidisciplinary related approaches necessary for the effective integration of nutrition into the current food system.

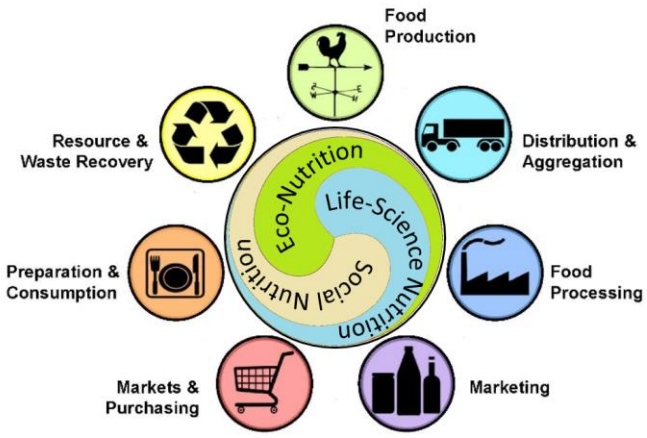


Figure 6. Food System Elements Diagram adapted from a diagram by Christy Shi, Center for Environmental Farming Systems to include the three Nutrition traditions.

From: Wilkins, J. and Eames-Sheavly, M. Discovering the Food System; An experiential learning program for young and inquiring minds. Cornell University, Departments of Nutritional Science and Horticulture. http://www.discoverfoodsys.cornell.edu/

Each tradition offers valuable insights for policymakers and poses questions as to chronic disease and sustainability, which we are currently struggling with in our diverse communities, and overall society. This is imperative because those complex issues demand a holistic picture of all three traditions, not just the dominant tradition of Life science, to generate value for policymakers to make effective change (T. Lang & Barling,

2013). Therefore, it is essential to encourage the training of all three traditions for future Nutrition professionals.

All three nutrition traditions are imperative to take into consideration when making

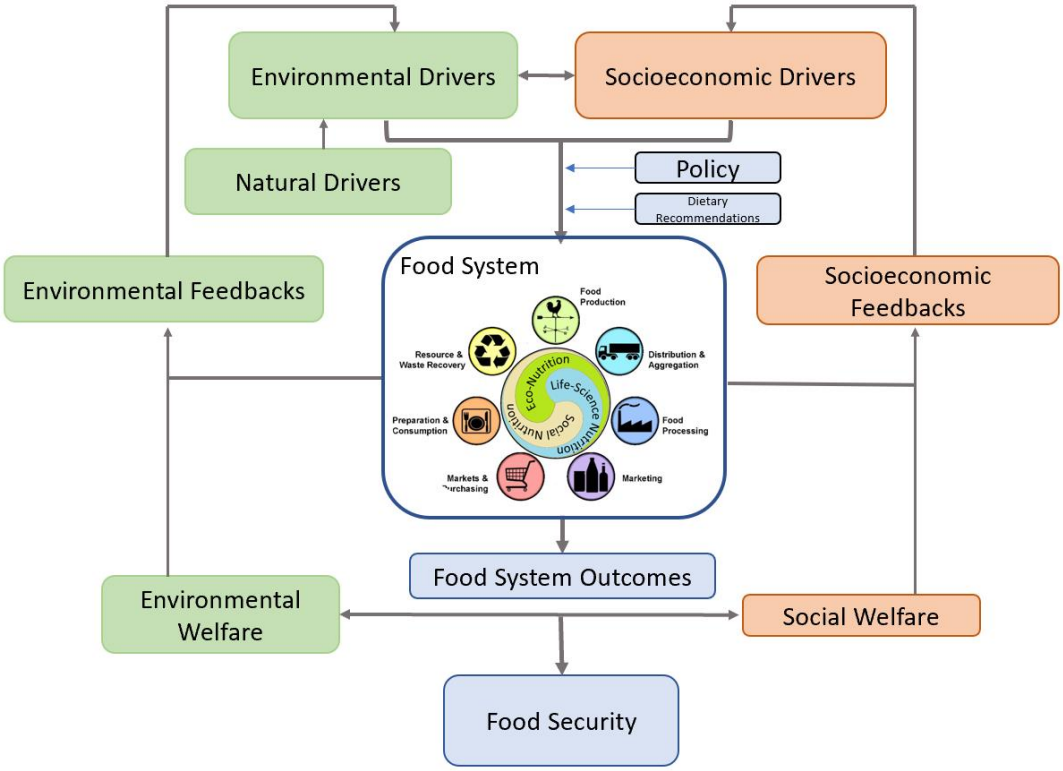


Figure 7. Food systems diagram

Adapted from https://www.futureoffood.ox.ac.uk/what-food-system and incorporating a modified diagram from Wilkins, J. and Eames-Sheavly, M. Discovering the Food System; An experiential learning program for young and inquiring minds. Cornell University, Departments of Nutritional Science and Horticulture. http://www.discoverfoodsys.cornell.edu/

dietary recommendations because our dietary choices are complex in practice, along with intended and unintended consequences, directly impacting health, while also contributing to environmental impact (Rose et al., 2019). Figure 7 shows my attempt at laying out the connections between diverse factors in our food system ranging from policy, environmental and socioeconomic drivers, to dietary recommendations. A primary goal of the U.S. Dietary Guidelines is to reduce noncommunicable diseases in the U.S. by influencing consumers' food and beverage choices, based on current scientific evidence that is useful in providing the general population with advice that encourages healthy eating practices. (UDSA, 2020). Dietary health and environmental health are mutually dependent. In turn, dietitians and nutritionists have a responsibility to support the

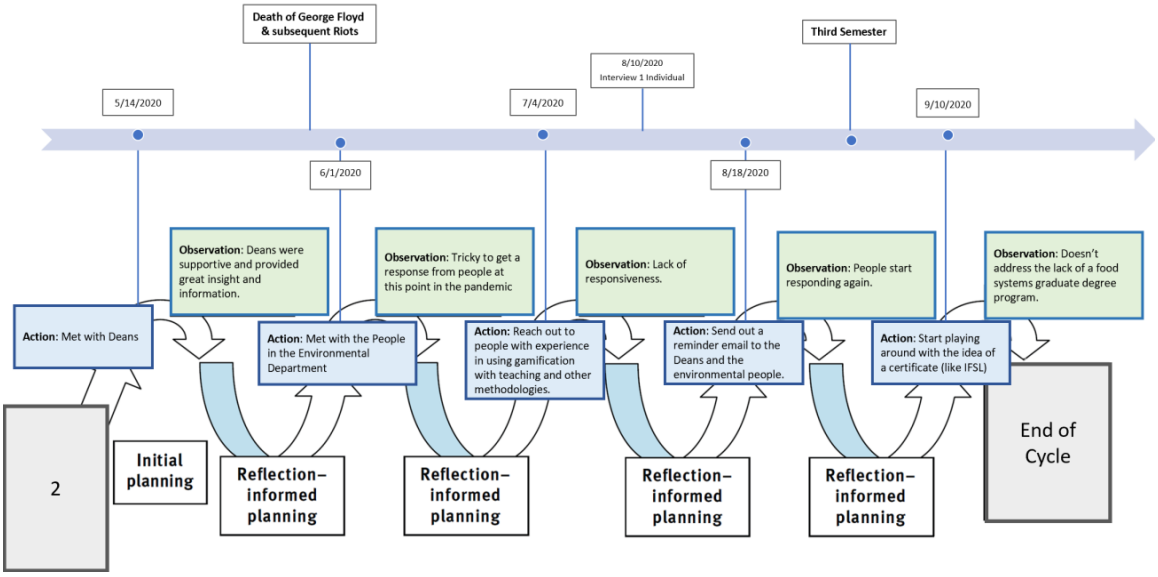
environmental sustainability movement when making recommendations to consumers. Choice's consumers make based on advice given by the nutritionist/dietitian, are influenced by, and in turn, will affect agricultural production, marketing, economics, climate change, food waste, water use and beyond. Currently, sustainability is not an integral part of the training program for dietitians and nutritionists, making it difficult for them to make educated recommendations with sustainability in mind. As early as 2014, the nationally representative American Climate Values Survey found that about half of Americans are interested in dietary advice that includes how their food choice could affect the environment (Rose et al., 2019). In order for professionals to effectively provide consumers, clients, and patients with food and environmental advice, professionals need to be trained in sustainability. Academic institutions can play an instrumental role in this learning process related to food and nutrition by introducing interdisciplinary sustainability topics while training nutritionists and dietitians in both graduate and undergraduate studies (Rose et al., 2019). University led training could also be provided for current professionals in the form of professional development workshops.

Given the impact of dietary recommendations on the environment, food and nutrition professionals have a significant role and responsibility within the realm of the sustainable movement. When discussing food sustainability, it is important to define a sustainable diet. The current working definition of a sustainable diet is "those diets with low environmental impacts which contribute to food and nutrition security and to a healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources (T. Lang & Barling, 2013; T. I. M. Lang, 2014)." Importantly, all three of the nutrition traditions are encompassed within this definition. It's now time a sustainable diet is translated into population-specific nutritional advice. In the past, dietary recommendations did not include dietary effects on environmental sustainability. However, an attempt was made to incorporate language focusing on sustainability as part of the USDA's US Dietary Guidelines of 2020 but was removed before final publication. Among other factors, macro-economic thinking and lobbies have interfered with these

attempts to include detailed, coherent sustainable dietary advice into dietary recommendations (T. Lang & Barling, 2013).

These complex dynamics and system effects that intertwine with the nutrition discipline highlighted the need for understanding curriculum design for such a multileveled and multifaceted course. Though I had been researching curriculum via literature, I started reaching out to more experienced individuals in curriculum development. This is where more formal interviews started to pick up in frequency because I wanted to pull on the vast depth of knowledge of curriculum development that is present within our university system.

Figure 8. Cycle 3. *Learning from others*



In addition to help with curriculum, I also wanted to reach out to different officials, administrators, faculty, and staff within the University of MN to see what kind of obstacles I would run into in the development and implementation of a course like the one I was designing. At the same time, I wanted to hear some perspectives about the academic system and course requirements from members of the University beyond the student body. Some of the main obstacles that were highlighted during these interviews include money or funding, competition for resources, politics, policies, difficulty to implement change, and communication.

The topic that was brought up the most when interviewing individuals about obstacles for course implementation was the topic of money. How would funding a course like this work? Later when this course evolved into a degree, it became how would the students get funding for their program? This is a huge issue that will need more input and perspectives than I am able to provide alone. One suggestion that I have for both the course and the degree program is to use our alumni. Pull in experience and mentorship from outside the university. There are many alumni who are willing to help in ways other than funding, like mentorship and volunteering. This addresses hands on or applied experience, as well as part of the funding issue.

As resources become extremely rare in higher education, we can emphasize the power of Students and Alum working together to breath quality into our graduate programs. The University of Minnesota, CFANS, and FScN needs unique resources or programming, such as the proposed graduate course or degree program, focusing on Food Systems approaches to recruit graduate students. This course is an example of how I am, with the help of alum advisors, developing a course that evolved into a graduate degree program, that utilizes resources outside the University during a critical period, as resources have been limited (acutely or chronically) to support quality graduate education at the University of Minnesota. This course was attempting to bring richness to CFANS graduate programs by allowing outside talent, via alum and local experts (representing sectors, disciplines, cultures, community, societal perspectives). Real world experiences, highlighting outside talent, brings purpose, meaning and quality to our graduate programs. It takes a Community Systems approach to raise an enlightened graduate student, rather than our default reductionist approach (Anonymous Faculty member, personal communication, May 1, 2020). This thesis project demonstrates the power of students and alum stepping up to the plate together, as we all contribute toward creating unique opportunities to elevate the quality of graduate education at the University of Minnesota.

Another related issue is the competition for resources. Allowing students to take courses outside of the department takes away money from the department. However, even if you allow students to take courses outside the department, you can protect student credit hours in the department by ensuring half of the courses are taken within the department.

This is also less of an issue for graduate programs than undergraduate programs because the number of students is smaller (Anonymous Faculty member, personal communication, March 16, 2021). This degree is hoping to pull in or retain students who wouldn't come at all or decide to leave because the current programs don't provide what they are looking for. This degree is not meant to take students away from current programs but instead is hoping to supplement with a few more students joining some courses in different departments. An example of this format working is the Land and Atmospheric Sciences program. The change in format for the Land and Atmospheric Science Program came from the need to recruit more students and they saw a change from ~5-7 applications to upwards of 30 applications. Also, the number of grad students admitted increased from 22 students to ~35 or 40 students a year (Anonymous Faculty member, personal communication, March 16, 2021).

The other major issues that were brought up by students include politics within the academic system, policies created to limit student development, such as limiting accessibility of courses from other departments, difficulty in implementing change due to inherent risk associated with change within a bureaucratic organization, and lack of effective communication between departments. From what I was hearing and observing, I found a general breakdown in communication, particularly between departments. Due to the competition for resources and some of the politics in play, I noticed tension between departments that inhibited collaboration and created a perception and reality of individual silos rather than a community. These obstacles that I was running into to implement this program highlighted why we need a program like this.

Beyond the challenges of designing and implementing a course, there was an immense amount of support from administration, alumni, staff, and faculty within the University. They recognized many of the issues that I had identified and agreed that something needed to be done to address these issues. Of those individuals, they each had their own personal experiences that allowed them to provide me with more context and detail about how and why things are the way they are. These interviews were essential in the design and planning of the course and later the degree plan as the project evolved.

The meeting with the deans, in which we discussed the development of our systems course that provides students with the opportunity to apply their knowledge and develop problem-solving skills across topics of how food and nutrition relates to climate change, environmental sustainability, health, economics, policy, mental health, and soft system, led to an introduction with staff within the environmental department. The deans thought there was a strong potential point of intersection and collaboration between my course and the goals of the Ecosystem Health project.

The focal point and potential intersection of food and environmental stems from its considerable ecological impact. Understanding the environmental impact of food systems further challenges nutrition science to draw upon the three distinct intellectual traditions constituting the field of nutrition. Life sciences, socio-cultural considerations and environmental challenges are all required to be integrated and operationalized within the food system if a solid foundation of scientific support and effective policy engagement is to translate into coherent recommendations for the public. The task of revising current nutrition policy to become sustainable dietary advice must begin at local, national, and international levels (T. Lang & Barling, 2013). This is where food policy can be useful in providing purpose and direction to align, unite, and catalyze actions towards a common goal. Policies are more effective when they are coordinated and include knowledge, skills, finance, institutions, and demand in the creation process. When policies are coordinated in a holistic fashion with a common (mutual) goal, the actions of policy makers are more likely to complement each other's activities rather than counteract each other's intentions (Fagerberg, 2018). Sustainability issues offer unique opportunities for nutrition science to play a more central role in policy analysis of future food systems.

Current food production was designed to provide large quantities of cheap, calorie rich, and shelf stable foods fortified with micronutrients to feed the world population (Kennedy et al., 2021). Although these production systems have decreased hunger in many parts of the world and provide essential nutrients, this approach has not taken into consideration the environmental footprint, diet quality and nutrition, or socioeconomic imprint of the supply chain (Béné et al., 2019). As climate change influences rainfall patterns, soil quality, and overall reduction in the productivity of important crops around

the world, the problem has shifted from an issue of quantity to one of food quality (Béné et al., 2019). It is no longer about the number of calories produced but also about the micronutrient content and nutritional value of food. Since the micronutrient content in our food is dependent on the soil quality, we need to not only focus on human health but also on environmental health.

To allow this focus on inclusivity and focus on food quality, more attention needs to be paid to governance, actors, and drivers within the food system (Béné et al., 2019). Even if enough food is produced in the world to feed the world population, we need to consider the issues of distribution, food justice, and food sovereignty. Without considering these critical socio-cultural, economic, and political aspects of food when designing policies, we run into problems such as food waste in some communities, hunger in other regions, and wide-spread chronic disease (McDermott & de Brauw, 2020). These diverse problems, issues, and situations vary widely within the food systems, and certainly need to be taken into consideration while conducting research, translating findings into policy, and implementing a coherent and constructive plan of action. The number of nutrition science academics engaged in policy remains small, leaving much potential for future involvement at all levels of policy development with a focus on sustainable food and diets (T. Lang & Barling, 2013). This is a critical issue, since modern food policy necessitates multi-level, multi-sectoral and multi-disciplinary engagement to be effective. (T. Lang & Barling, 2013). We are in desperate need for trained professionals who can take nutrition research and translate it into language that is relevant to policy makers, and ultimately serve as practical and applicable advice for consumers (Vignola et al., 2009).

Sustainability also serves as a means to increase mainstream public interest. Since the environmental movement is already focusing on climate change through the food system, it provides opportunity for the nutrition discipline to piggy-back on the momentum to become more involved and potentially increase public interest. Professionals within the environmental field have long recognized that an ecosystem is a complex web of connections. A change in one area of the ecosystem can affect something that does not appear to be related further along in the system and cause some unexpected or unintended consequence. We need people in other areas of the food system, such as nutrition,

economics, policy, and agriculture, to be trained in systems to better address these wicked problems. Systems thinkers equipped to see, think, feel, and take-action across sectors, disciplines, and diverse cultures will allow the food system to be more fully integrated into community and society while working in harmony with our planetary environment.

Due to our focus on including the environment and sustainability as a major part of the course design, the people within the environmental department thought this course sounded like a great opportunity for students interested in sustainability and saw the important connection of our course to ecosystem health. They provided us the option to advertise the course, or a related opportunity, to their Sustainability Studies Minor students and others on their newsletter list. They also mentioned potential to connect us with the curriculum development aspects of the NIFA grant project they were working on (Anonymous Faculty Members, personal communication, June 1, 2020).

After this promising discussion, summer hit. The combination of summer and the culmination of COVID pandemic caused a dramatic reduction in the response frequency with interviews within the University system. Around this time, I was also exploring the idea of using gamification in the form of dungeons and dragons for bringing experiential learning into the classroom. Since the response rate had dramatically slowed from the people within the University, at this time I looked into the Integrated Food Systems Leadership (IFSL) certificate program. The IFSL certificate program covered many overlapping topics that I wanted to incorporate in my course and showed potential for learnings and advice that I could use in my course design.

The conversations with the people within the Environmental department and my interest in the foundation of the IFSL certificate program sparked further inspiration that propelled me to continue my investigation. This investigation incorporated the relationship between the environment, our food system, and types of well-rounded professionals who were capable of interfacing across disciplines and sectors. In this exploration, I further established my understanding that climate change is a major driver in agriculture, especially since we are vulnerable relative to biodiversity (Berry et al., 2006). At the same time agriculture policy has a large role in either mitigating or

reinforcing climate change (Berry et al., 2006). Any change in one area of the food system can impact other elements within the system.

Given the interdependence between sectors, disciplines and cultures it is essential to more fully account for varying perspectives when planning strategies and making policy decisions (Berry et al., 2006)(Cattaneo et al., 2021). For example, when proposing changes in agricultural policies, consideration should be given to the intended and unintended impacts they will have on climate change and biodiversity. Those impacts may not only affect the other two sectors, but they can also cause negative feedback loops within the agricultural sector as well. These policies should also take into consideration the people involved in these sectors and rationalize any conflicts that may emerge between them (Berry et al., 2006). Those roles include individuals ranging from farmers, plant geneticists, marketing, economists, environmentalists, to consumers.

Considerable research is being conducted within the food system, yet only a small portion of that research is used strategically in policy decisions. Communication, or lack of effective communication, is a driving force creating the gap between science and policy recommendations. Communication not only relays the science but also conveys the human influence on the science whereby body, mind, heart, and soul are expressed through intellect, feeling, emotion, and spirit behind the interpretation and application by the scientist, policymaker, and finally the resident. The type of language used can also cause confusion between groups of people. Every profession has its own form of jargon or way of describing and disseminating knowledge. Thus, it becomes apparent that training may be necessary for both scientists to improve on the translation of their results and establish a profession that specializes in the translation and communication of science and policy across sectors, disciplines, cultures, and socio-economic strata (Vignola et al., 2009). This process of training people across the food system who can interpret and translate science, is essential if research is to become relevant for policy and other forms of application, including regulatory decisions and education (Cattaneo et al., 2021).

Given that researchers are often not practiced in translation of heavily technical information into an understandable medium that the general public and policy makers can

understand and use it may make more sense to give the responsibility of communication to a professional who specializes in this translation. Having a professional dedicated to the communication and translation of scientific findings allows the scientists to focus on their research, at the same time as ensuring a steadier and more consistent of communication. An example of this type of professional is a "boundary spanner" who focuses on the science-policy interface. A boundary spanner is a professional as described by Bednarek et al. who ultimately translates research to the level of the general public. The necessary attributes, abilities and skill set far exceed an improvement in scientist's communication skills (Bednarek et al., 2018). A boundary spanner can be an individual or organization that concentrates on aiding in the creation and maintenance of effective relationships between science and policy within practice (Bednarek et al., 2018). The core features of boundary spanning described by Bednarek and colleagues not only include more effective communication of research results, but also includes the use of the researcher's conception of usefulness to address socially relevant research questions and advocating for policy changes that reflect the results of that research (Bednarek et al., 2018). The last two core features are especially important for making research more relevant because decision-makers rarely make those decisions based on research evidence alone (Bednarek et al., 2018). Most of the time decision-makers take into consideration other forms of knowledge like traditional knowledge in addition to the technical knowledge obtained through research (Bednarek et al., 2018).

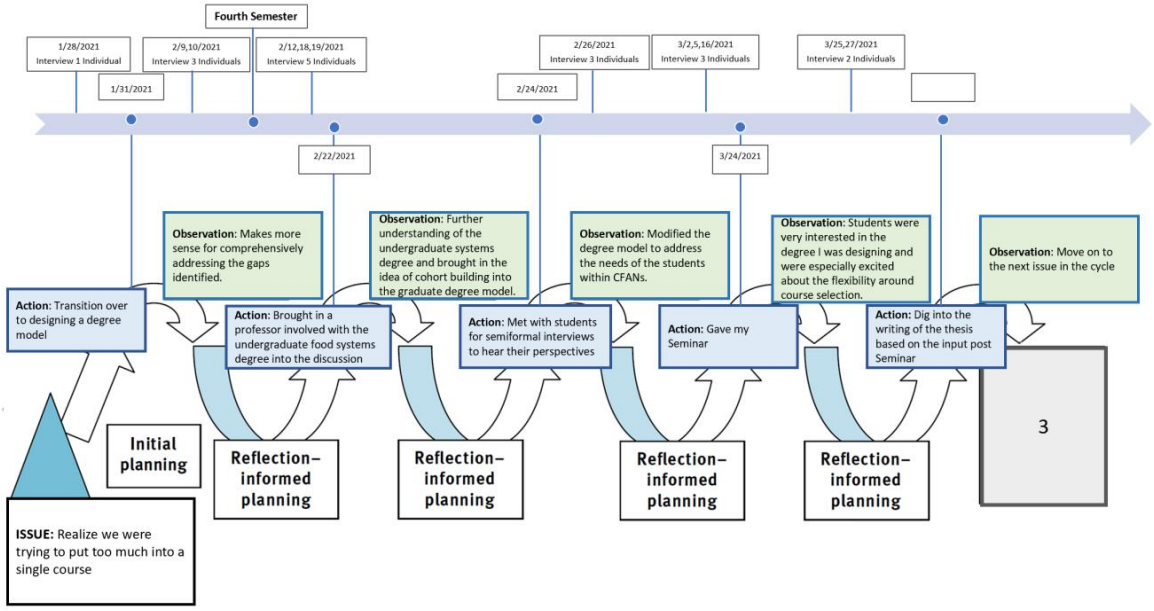
When tackling wicked problems, it is essential to include the multi- dimensions of knowledge and learning within the food system including all diverse actors involved (Bednarek et al., 2018). The way in which people obtain and interpret knowledge can impact how they interact with other actors working on an issue. The context surrounding each actor also plays a role in the dynamic interactions between actors when working on that issue. The context or background of the actors includes how they are affected by or engaged with those issues as well as their political and institutional incentives (Bednarek et al., 2018). These factors contribute to their personal and professional perspectives, the decision-making process, as well as the credibility and application of available evidence (Bednarek et al., 2018). Each actor views the cause of the issue differently because their personal context varies. In addition, it is important to keep in mind that the actors may

interpret and understand evidence in various ways. All these factors play a role in how each actor views potential solutions, their viability, and their relevance (Bednarek et al., 2018). This is partly why scientists struggle to effectively communicate to decision-makers, particularly when it is situated within context of the food system and its influence on society.

While it remains important to improve the scientist's abilities to communicate, it seems prudent to establish a profession, such as boundary spanners to more effectively bridge the gap between science and policy. A productive knowledge exchange must include the broad context of actors, values, perspectives, decision-making history, power dynamics, and contested evidence (Bednarek et al., 2018). For this process to be successful, regular knowledge exchange or dialogue needs to commence around understanding and appreciating the usefulness of establishing mutual understanding (Bednarek et al., 2018).

The rationale for opening communication between parties and scientists increases the social robustness and legitimacy of science (Bednarek et al., 2018). When science-related issues include or recognize other actors from the community, through effective communication, relevant data is made available for policy decisions, the general public is less likely to question the value of the science within public discourse (Bednarek et al., 2018). Thus, when the science becomes more relevant to manage societal challenges and issues, the science is often more accepted among the diverse non-scientist actors within the community (Bednarek et al., 2018).

Figure 9. Cycle 4. *Transition from a course to a degree*



After much discussion with various individuals within the university to figure out how this course would best be implemented, I realized that I was trying to fit too much into a single course. The project began to take a different direction, as it evolved into designing an overall graduate degree program rather than a single course. This is also the part of the project development when I began to reach outside of academia and to conduct formal interviews with professionals working within industry and/or within the food system. These formal interviews with members beyond the realm of academia provided context and perspective from outside of the academic system especially with regard to complex problems beyond the university. Wicked problems are seldom amenable to narrow, instrumental and technical approaches and often cut across many disciplinary boundaries.

Given a local, domestic, and international need to focus on and manage wicked problems along with an increasing gap between science and policy, the importance of properly trained professionals has become paramount. At the same time, employers are finding it more difficult to hire employees that have the necessary character, confidence, and competence to solve their problems. This is leading some companies to recruit recent graduate students that they can train themselves (Anonymous industry representatives,

personal communication, September 16, 2021). This raises the question, why are institutions struggling to find professionals who can fill the roles, functions, and activities to solve wicked problems as part of our current day workforce? Open ended responses from the global skill shortage (SHRM) survey conducted by the Society for Human Resource Management found that HR professionals feel candidates are lacking certain skills shared across all education systems (Burner, 2019). Those skills include professionalism, business acumen, critical thinking, and lifelong learning. This survey found that "51% of respondents say education systems have done little or nothing to help address the skills shortage issue." (Burner, 2019) Since universities train the food system work force, this is a critical issue. It seems that higher education is missing the mark between the training currently available to students and young professionals, and the training that needs to be done as the professional climate shifts. This need for making changes to the current training offered to young professionals is one of the main reasons I expanded the breadth and scope of my project from designing a course to developing a full program that would be better able to address-skill shortage gaps.

Due to a more comprehensive approach to my project and to better accommodate Nutrition students focused on a graduate level food systems degree, I wanted to reach out to someone who was involved in the undergraduate food systems degree at the University of Minnesota. Their expertise and insights provided me with important information related to the development of the program and the way the curriculum of the undergraduate program is formatted (Anonymous faculty member, personal communication, February 22, 2021). This was important for me to shed some light on how my graduate degree program could work in tandem with the undergraduate degree program and not to repeat the work they were already doing.

In addition to reaching out to someone connected to the undergraduate food systems degree, I also wanted to investigate teaching methodologies and the history of teaching practices that may have led us to the point we are today. That literary research led me to the concept of reductionist thinking and systems thinking. University training has shifted over time to focus more on reductionist thinking and backing away from systems thinking (Orgill et al., 2019). This transition away from the systems perspectives may

provide some insight as to the challenges our society now faces with the current training for our young professionals. This concern remains consistent within and across university training programs irrespective of disciplines and area of study.

Systems thinking is an approach that examines real-world systems more holistically by focusing on patterns and behaviors that emerge from the dynamic interrelationships between components (York et al., 2019). By introducing systems thinking back into our education programs, we can develop professionals who are better prepared to tackle the complexity of wicked problems. Unlike systems thinking, reductionist thinking simplifies the context of complex problems into a form that is more easily understood. This often consists of isolating or taking a component out of a system to understand how that specific part works on its own. In science education, reductionist thinking was initially implemented to increase student interest in science and technology (Orgill et al., 2019). Standardized assessment methods, development of cognitive strategies, technologies, and increased measurement capabilities are also benefits of using reductionist thinking (Orgill et al., 2019).

Though reductionist thinking has been useful for advancing science education and allowing progress in STEM fields, there are limitations to using reductionist thinking as a primary means of operation. A major limitation when focusing on a single component or section is that important interrelationships between working components are missed or overlooked and it disregards the unique properties and behaviors that result from those interactions (Orgill et al., 2019). The simplification of a topic is useful for students to initially grasp a concept, however that component needs to be reinserted back into the system for the observation and connection of the relationships and interactions that occur within the whole system. With that lack of connection, students can have a harder time generalizing what they have learned and struggle with the application of that knowledge and corresponding skills to new contexts. This becomes apparent when students exit the university into the workforce where they are asked to apply their skills and knowledge to manage (solve) diverse problems and issues.

Another limitation of reductionist thinking is the claim of an objective view of scientific knowledge. The issue with claiming an objective view of scientific knowledge is that by

doing so, we ignore the human influence on how the science was designed, completed, and interpreted. Since humans are the ones influencing scientific decisions, it's important not to ignore the human connection, because it's easier to miss how human interaction has influenced and impacted the scientific data and interpretation (Orgill et al., 2019).

Systems thinking can be used to address the limitations of reductionist thinking when used in a complementary manner. Where reductionist thinking simplifies complex behaviors and phenomena, systems thinking uses a holistic perspective to enhance our understanding of those behaviors and phenomena within and between systems. Through systems thinking, one can see higher-level behaviors and phenomena that may not have been visible when only viewing the sum of components within a system (Orgill et al., 2019). Through systems thinking, students can also learn how to utilize the knowledge they learned from reductionist thinking and apply it to other situations and contexts in which it will be useful (Hurst, 2020). More holistic training that incorporates both reductionist thinking and systems thinking is needed to not only better prepare students for entering the workforce but also to address the skills shortage gap that employers are fully aware. Our communities, businesses, and society at large depend upon professionals who are trained in systems thinking to address the skills shortage gap and provide future generations with the necessary experience to tackle wicked problems.

Professionals trained in systems thinking can take many forms depending on the specific needs of a community, and desired outcomes and benefits. One example of a professional trained in systems thinking is a food systems analyst. A food systems analyst uses collaborative relationships and multi-criteria analysis to address issues within the food system with potentially more effective interventions (Ingram et al., 2020).

The skills that are expected of a food systems analyst are portrayed in Figure 10. and defined by Ingram and colleagues. Those skills range from effective communication, systems thinking, to transdisciplinary collaboration (Ingram et al., 2020). These same skills were identified as important for recent graduates to have when entering the workforce by members of industry (Anonymous industry representatives, personal communication, February 12, 2021 & Anonymous University of Minnesota faculty member, personal communication, February 19, 2021). A food system analyst not only

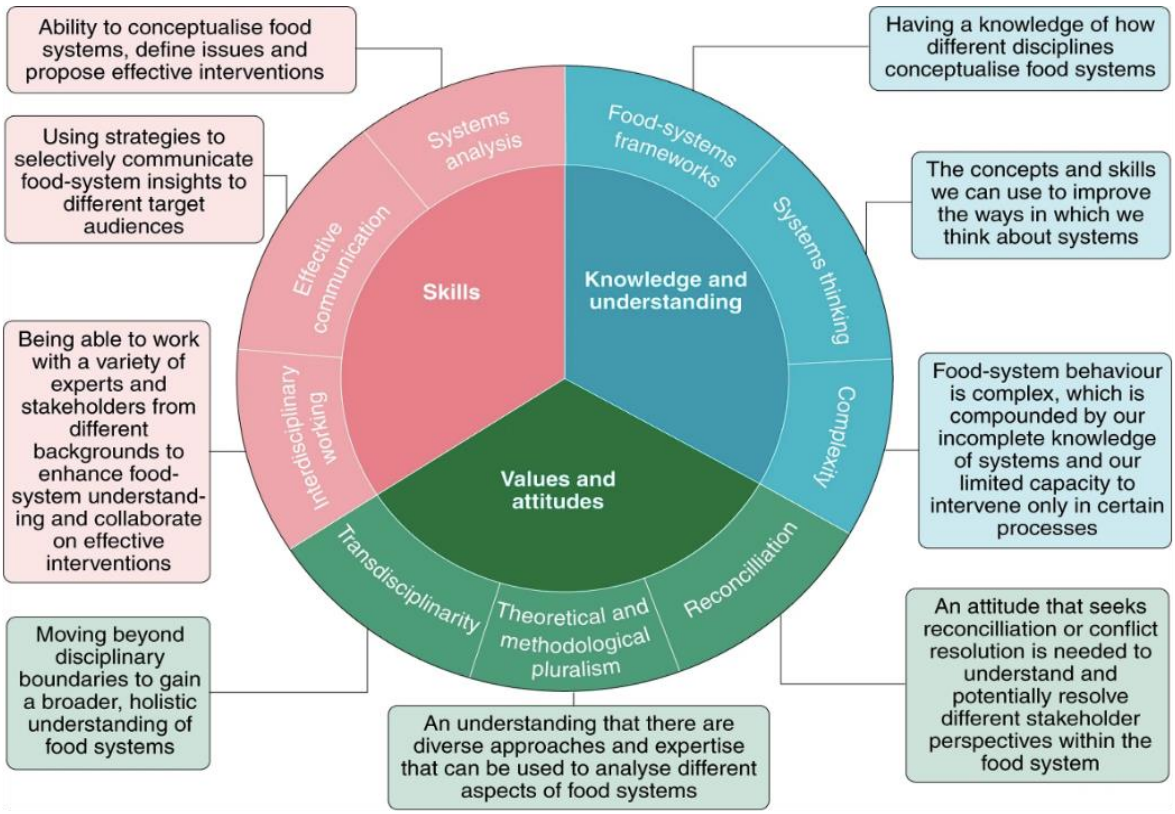


Figure 10. Food systems analyst diagram of skills, values and attitudes, and knowledge and understanding.

Ingram, J., Ajates, R., Arnall, A., Blake, L., Borrelli, R., Collier, R., de Frece, A., Häsler, B., Lang, T., Pope, H., Reed, K., Sykes, R., Wells, R., & White, R. (2020). A future workforce of food-system analysts. *Nature Food*, *1*(1), 9–10. https://doi.org/10.1038/s43016-019-0003-3

needs to have a depth of technical knowledge but also complementary skills and experiences that enable them to work with people across disciplines. This type of professional utilizes the T-shape professional concept illustrated in Figure 11. that incorporates both depth of technical knowledge and a wide range of skills that allow that professional to adapt their technical knowledge to address complex, multi-faceted problems (Ringling, 2020). Currently, most of STEM fields focus on the depth of technical knowledge and barely touch on the breadth of professional skills and experiences across disciplines. Traditionally the idea is to focus and specialize on one thing, while personal relations and other professional development skills are considered less important. In some cases, this makes sense if some people are also trained using the T-shaped model to bridge the gap between specialists and those from other fields. The

issue remains that very few people are being trained to serve as the bridge to span the gap.

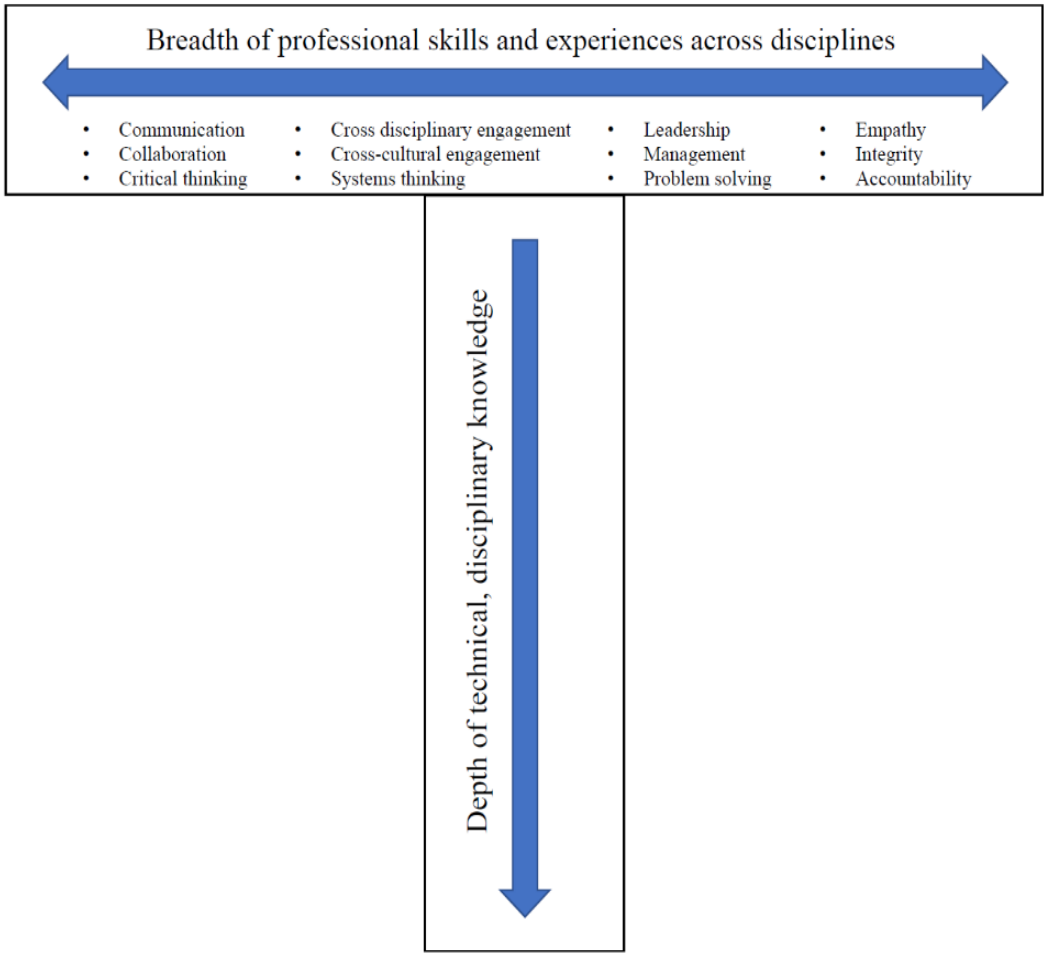


Figure 11. T-Shaped Model

Ringling, K. (2020). *Interdisciplinary , Cross-Supply Chain Approaches to Food Systems Improvement* (Issue October).

Universities train the workforce, which means they have a responsibility in addressing the skills shortage gap and better preparing their students. The University of Minnesota is a land grant university that is set up wonderfully for training students in the food system with reductionist thinking in complement with systems thinking.

The University of Minnesota fits under the agricultural focus of the original mission for land grant universities and has an agricultural experiment station for research. The goal of these universities was to provide practical education for the working class and receive federal support to carry out these functions. (Association of Public & Land-Grant

Universities, n.d.). The practical education includes both agriculture and the mechanic arts to encourage the development of scientific methods within agriculture (Britannica, 2017). Land grant universities are not only there for the students and faculty, but also surrounding Minnesota communities. As a land grant university, the University of Minnesota has a responsibility to conduct research that makes sense for the future of agriculture and properly prepares students with cutting edge education for the Minnesota workforce. By failing to address the skills shortage gap the University of Minnesota, as well as other land-grant universities, risk cuts in funding and/or risk being less competitive against other institutions.

At the University of Minnesota alone, we have departments that cover most if not all parts of the food system. As shown in Table 6., these departments include Agronomy and Plant Genetics, Bioproducts and Bio Systems Engineering, Food Science and Nutrition, Applied Economics and the Carlson School of Business, School of Public Health, and the Institute on the Environment (Ringling, 2020).

Table 6. University of Minnesota Department list of contributions to the food system.

Ringling, K. (2020). *Interdisciplinary , Cross-Supply Chain Approaches to Food Systems Improvement* (Issue October).

Department / College	**Contribution**
Agronomy and Plant Genetics	improving crops and developing sustainable farming practices
Bioproducts and Bio Systems Engineering	develops methods for processing raw materials into food ingredients
Food Science and Nutrition	evaluates end-use, sensory, and nutritional qualities, and safety of raw materials and finished products
Applied Economics and the Carlson School of Business	evaluate the production and supply chain economics
School of Public Health	can evaluate the broader health implications of production and consumption

Institute on the Environment	can assess sustainability impacts

These departments range from crop improvement, food production, understanding nutritional quality and assessing economic impact and sustainability. Also, Extension programs connect university research with Minnesota communities. This is highly relevant, as the University of Minnesota is located in a food hub, surrounded by large food corporations like Cargill and General Mills, as well as local farms, grocery stores, and farmers markets. This strategic location positions the University of Minnesota in an abundant environment for hosting an interdisciplinary food systems graduate degree program that incorporates systems thinking. The University of Minnesota might benefit by leveraging this unique opportunity to participate in inter / transdisciplinary research because major advances in science generally stem from dynamic interdisciplinary interactions (Anonymous University of Minnesota faculty member, personal communication, March 16, 2021).

Although the University has resources in place to provide cross-college interdisciplinary programs, for the most part the University programs continue to focus on traditional disciplinary programs within individual departments. Departments and colleges as previously mentioned, address the breadth and scope of the topics within the food system, yet tend to function as silos with little crossover among disciplines. This mind-set and traditional practice severely limit student exposure to that interdisciplinary interaction necessary for addressing the complex issues within our food system. The traditional governance and organizational functions inherent to universities limit interdisciplinary interaction, also contribute to student frustration with the university system.

> The Department of Food Science and Nutrition could greatly benefit from integrating a policy component into the curriculum or policy-oriented experiential learning opportunities. Policy is wildly important in the world of food and nutrition, and this is an area that is barely touched upon in the current curriculum. From nutrition labeling to food safety regulations, the food regulatory field represents a major employment opportunity for Food Science and Nutrition

> students, yet there is very little training in this area. Other areas that are absent from the Nutrition department at the University of Minnesota that would be beneficial are intellectual property (IP), business and economics, and introductory economics (supply and demand, marketing, etc) (Anonymous graduate student, personal communication, April 24, 2022)

Due to my transition from a single course to a graduate degree program, I also wanted to reach out to students once again to hear their perspectives on this type of degree program. Students are voicing their discontent as they are conscripted to take required courses to fulfill departmental, college and university mandates in the form of program requirements. The crux of the matter appears to lay in the variety (or lack thereof) and number of required courses mandated as part of degree programs which limit what students can register for, thus obstructing individualized educational goals. Students are often taking courses focusing on subject matter to fulfill departmental requirements rather than student desire or belief that these courses will benefit their careers into the future.

Given these limitations within the university system, how do we shift our focus so that graduate students feel some ownership over their education? With ownership, there becomes passion which leads to better retention, creativity, and innovation, allowing students to learn in their own unique way, and to spark curiosity and wonderment in their graduate program (Hanstedt, 2018). When you are paying money as a graduate student, courses should not feel like a waste of time. Each course should provide useful knowledge and training that pertains to each individual student's interests, desires, and career path.

> There were very few classes offered in the department that provided a 'big picture' context for nutrition. It was difficult, given the standard curriculum playbook provided by the university, to see how nutrition fits into the entire agri-food system. (Anonymous graduate student, personal communication, April 24, 2022)

Students in our Food Science & Nutrition department have already accommodated (petitioned) desired courses and unique experiences into their graduate program to fulfill these knowledge, skills, and ability gaps into their graduate programs (Anonymous

graduate students, personal communication, February 23, 2021). I am just one of many students who are looking to build and personalize their graduate education. In speaking with several graduate students about their experiences during graduate school, they identified that most of their experiential learning that has proven most useful in the workforce came from collaborative, systems-based projects provided outside of the classroom working on real world problems (Anonymous graduate students, personal communication, April 24, 2022 & May 1, 2022). In my case, I proactively petitioned to change several "required" biochemistry-based courses to food systems and nutrition policy courses which more closely met my personal attributes, professional goals, and career direction. With a background in biochemistry, my desire was to expand my knowledge of nutrition beyond biochemistry into a more wholistic understanding and appreciation of nutrition and how it fits within the food system. For example, Keagan Ringling has led the way as he wrote his thesis based on his experiences throughout the food system, ranging from plant genetics to production, economics, and the need for training of system spanning professionals. Keagan has added inspiration to my own learning journey as well as set an example of what can be done within the university system when students push the boundaries within the realm of possibility. Adding or changing courses to personalize student's degree paths is only the beginning of what the University of Minnesota can do to meet the needs, wants, and desires of today's students, while meeting the needs of our workforce, communities, and society. "Within the University of Minnesota, there are a lot of barriers for students that limit them from pursuing individualized education and career paths" (Anonymous University of Minnesota representative, personal communication, February 26, 2021). In its current form, students must add to their workload or petition though the departmental, college, or university systems to make changes in their program. The University would benefit through access and availability of systems and policy courses to a broader population of students.

> The DPD curriculum is incredibly rigid and prescribed with a heavy clinical focus. When speaking with my colleagues and future colleagues, they are opting for the public health graduate degree because of the courses. (Anonymous graduate student, personal communication, May 1, 2022)

Student focused learning that is individualized and personalized allows transformational change through interaction with diverse faculty. Not only does that interaction with diverse faculty help students grow, but it also often allows faculty to come together in unique and innovative ways by building and strengthening new relationships, creating new ways of doing, and exploring basic and applied science in a cooperative and collaborative manner. The interactions between students and a wide variety of faculty members allow for more opportunities to not only improve professor's skills as mentors, teachers, and leaders, but also for the students through those experiences. This professional development is an essential part of a college education that students are paying for (Anonymous University of Minnesota faculty member, personal communication, February 9, 2021).

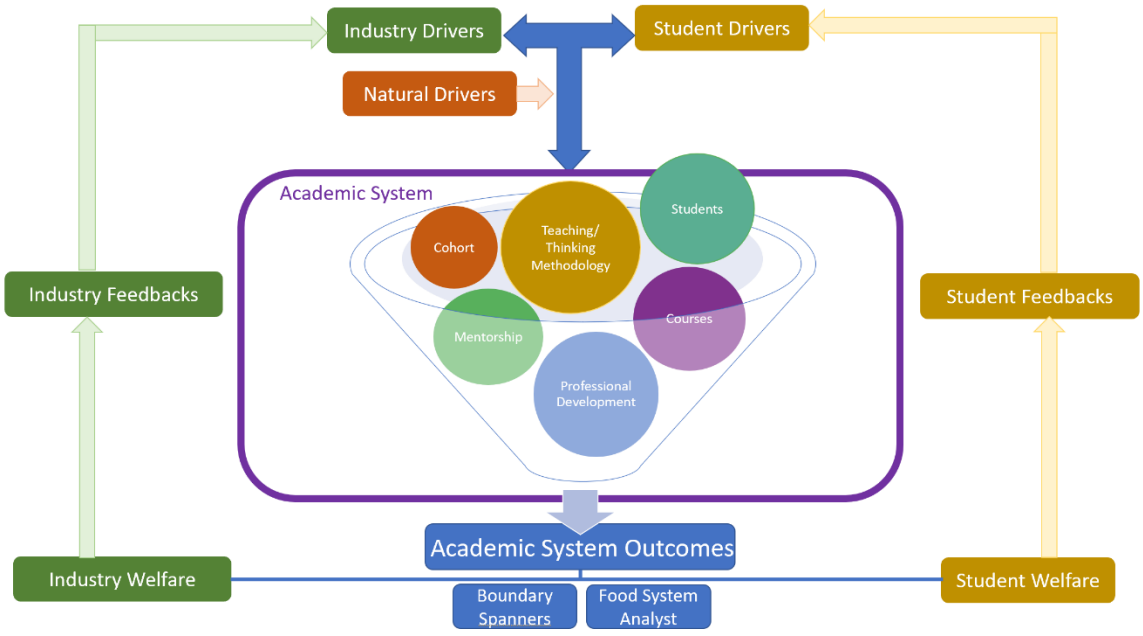


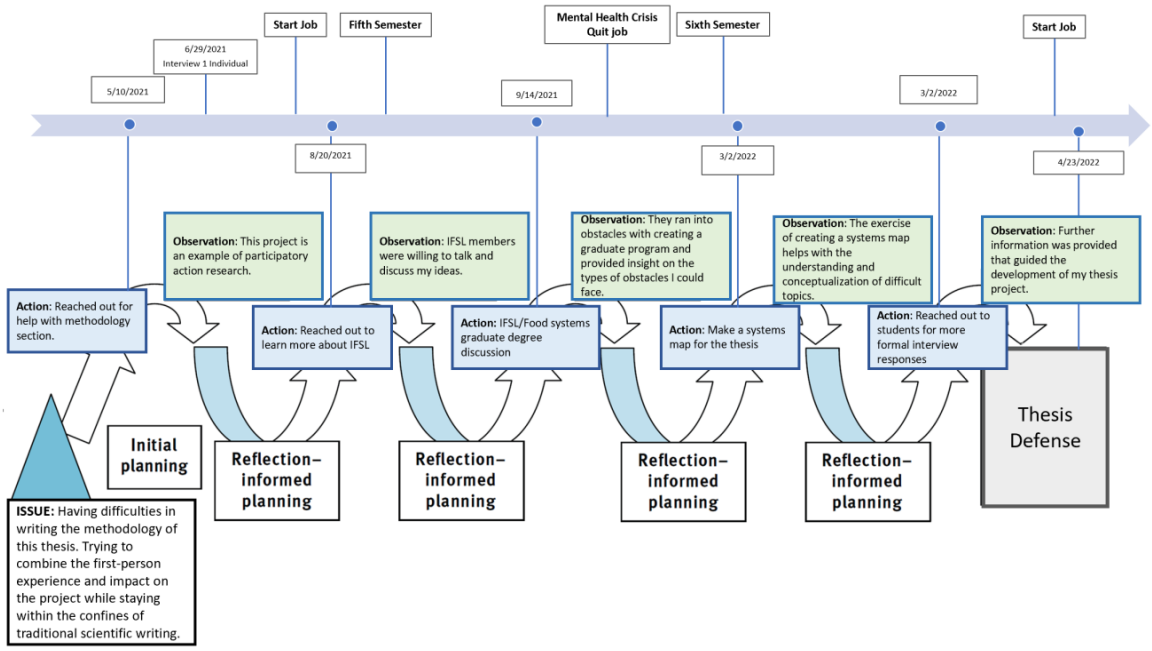
Figure 12. Academic System Diagram

There are many factors that contribute to students' academic experiences and outcomes. Figure 12. displays only a fraction of the complex web that makes up and affects the academic system, but it highlights the portions emphasized in this thesis. Depending on the factors that are emphasized, there are different individual outcomes that affect both student and industry welfare. At the same time, both industry and student drivers impact

the academic system in a feedback loop fashion. This illustrates the complex dynamics of the academic system in relation to both students and industry influences.

As required by the Master's Nutrition program at the University of Minnesota, I presented my thesis project to my peers and other University members via our seminar course (FSCN Graduate Seminar). This was a great opportunity to show the people that I had interviewed, as well as others, how their input has helped my project evolve. It was also an opportunity to receive feedback on the program design, at that point in time, to assess which parts were supported and what might be improved upon, added, or removed. This seminar and the corresponding feedback reinforced what I was already finding that students were interested in learning more about the type of degree I was designing. They were particularly supportive of the flexibility around course selection and ownership over their graduate degree plan.

Figure 13. Cycle 5. *Grasping the concept of PAR*



As I was writing the body of the thesis and modifying the design of the degree program, I encountered difficulties when writing my methodology section. My project was different from any other research project that I had previously encountered and did not know how

to proceed. At the same time, I was exploring the use of first-person experience in the body of the thesis to include and recognize the human influence on the research decisions and findings. This inclusion of the first-person experience has been discouraged as part of my previous training and within the realm of scientific writing. Due to this obstacle, I reached out to a professor who had previous experience with similar projects. Dr. Hassel introduced me to Participatory Action Research (PAR). He helped me frame and conceptualize the methodology section, and he also suggested the addition of the preface and postscript. The preface sets the stage for the subjective dimension of research to become more explicit, whereas the postscript allows for first person reflections, lessons learned, recommendations, and for critiques of the graduate experience as voiced in the students' own words. This approach allows the thesis to be conducted in a more acceptable third person voice for faculty who otherwise might have objections to I statements (Anonymous Faculty member, personal communication, May 7, 2021).

Following this exploration with PAR, I reached out to the administrators, coordinators, and instructors within the Institute for Food Systems Leadership (IFSL) certificate program. I was curious about the certificate design and subject matter in the program. The certificate program had the substance of material that I was interested in for systems and professional skill development. Due to the breadth, depth, and scope of the program, it didn't make sense that IFSL only consisted of a certificate upon completion and not a full graduate degree. To better understand the IFSL story, including the struggles and obstacles they faced, I reached out to obtain advice and experiences that could be learned from or adapted for the design of my program.

Late into my program, due to the natural evolution of the project, I realized that I needed to collect more formal statements from students and other individuals. I recontacted several people for formal interviews, who I had informally discussed topics related to my thesis. The questions for these more formal interviews are included below:

1. Can you briefly explain your experiences in the Food Science and Nutrition department, particularly with course selection?

2. Do you feel that the University of Minnesota has prepared you in the skills and the knowledge that you were most interested in learning? Do you feel they

prepared you well for the workplace? (If there are certain skills or things you felt they did well on or did not do well on, please explain)

3. Is there anything else you want to note about systems training, problems with the academic system, degree structure, or anything else you think worth noting?

Inspiration for this program's design was taken and adapted from a combination of the Land and Atmospheric Sciences program (Anonymous University of Minnesota faculty member, personal communication, March 16, 2021), Water Resource Management program, and MBA programs at the University of Minnesota. It was also based on personal experience within the current Nutrition Master's program design as well as fellow students' suggestions, ideas, and constructive feedback relative to our current

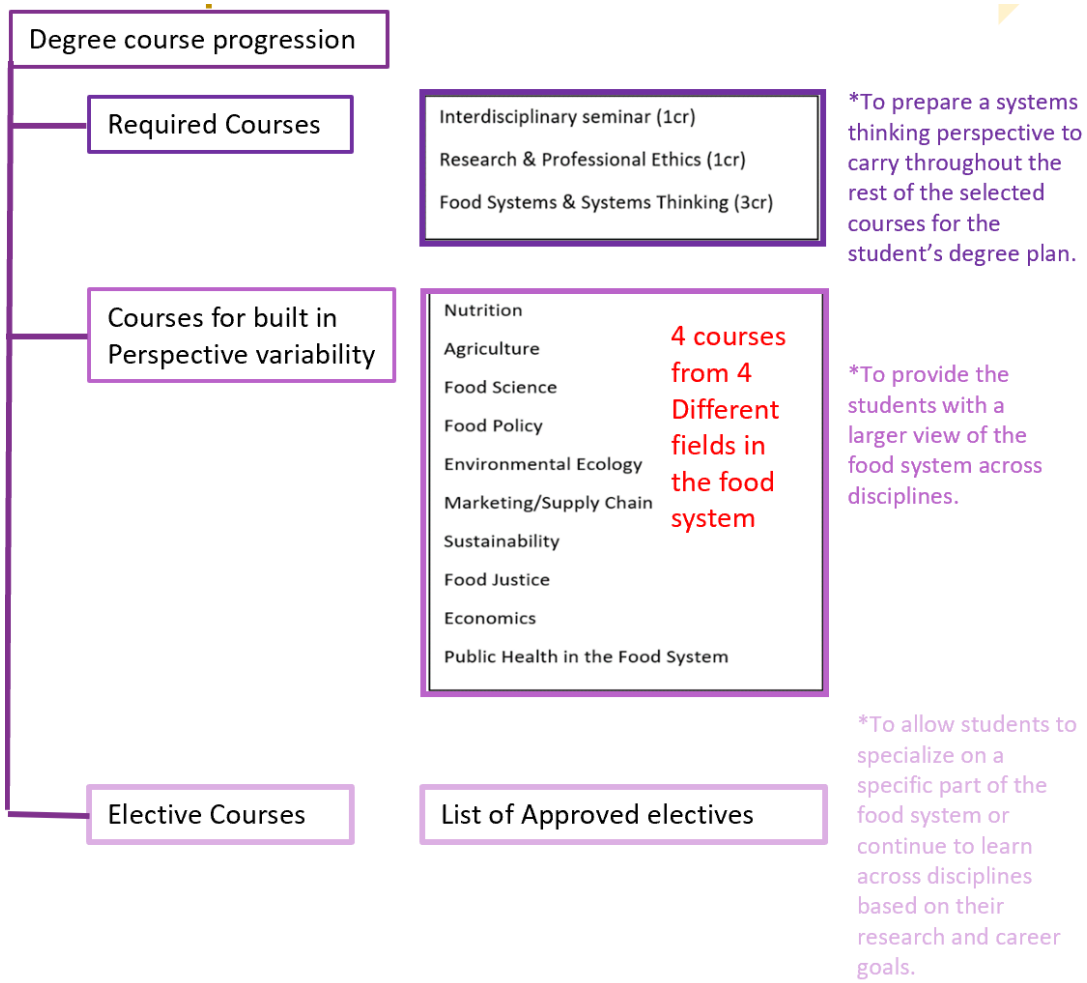


Figure 14. Food System graduate degree program course format.

program. The rationale for minimal required courses sets the stage (foundation and backbone) for students to develop their own personal/individualized degree program. The required courses include a Food systems and systems thinking course, a Research and Professional ethics course, and an Interdisciplinary seminar.

Figure 14. illustrates the formatting for the Food Systems graduate degree program. The food systems and systems thinking course familiarizes students with the food system as a whole and how to examine, analyze, and design systems. At the same time, this course introduces students to systems thinking and allows them to apply their previous knowledge and skills within context of a larger food system. It also emphasizes synergies and connections through experiential learning opportunities, while students develop their interpersonal and professional (soft) skills. The goal is to allow students to develop a systems mind-set based on diverse interdisciplinary approaches and experiences through project-based peer interactions while systems skills and practice will carry over into their enrollment in courses complementary to the degree program. This dynamic approach focuses, prioritizes, and leverages each student's unique individualized approach to their education and future employment.

The research & professional ethics course is intended to introduce students to research and design within context of moral and ethical dilemmas, accountabilities, and responsibilities. This approach focuses on research-based issues, while simultaneously addressing moral and ethical issues through science and its application in advancing our society. The interdisciplinary seminar is designed so students can present their projects to their fellow students as well as to interface with guest speakers, advisors, and mentors from various sectors (university, government, industry, non-profit, advocacy / activist groups) different disciplines and world perspectives. The intention is to allow students to be exposed to diverse fields of study, networking, and professional communication through real-world scenarios.

The next section of course "requirements" allows students to take courses from at least 4 different areas relative to the food system. This ensures that students are participating across disciplines, yet it allows them to choose which courses best suit their needs.

The elective courses allow students the flexibility to specialize in an area of interest or continue to diversify their skillset and knowledgebase while completing the required number of credits for the program. Based on the recommendation by a designer of the Land and Atmospheric Science degree program at the University of Minnesota, choice of courses should be tailored to student's research projects to help hone specific skills for use in their research goals (Anonymous University of Minnesota faculty member, personal communication, March 16, 2021). Elective courses will be chosen from the list of approved electives. If the student finds a course that is not listed in the approved electives, they may choose to explain why it pertains to their focus in the food system and how it helps them progress in their program. This conversation would occur with the student's major advisor and/or committee since courses will be chosen through discussion with the student's advisory committee. Often these elective courses are chosen based on the students' project and relative interests.

Given student course options are available across university departments, to allow a sense of community, while emphasizing teamwork and collective solutions, students will participate in a cohort-based research group. Traditionally a cohort refers to a "group of students who begin a program of study together, share the same sequence of classes, faculty members, and instructional activities toward a completion of a specific degree or certification" (Mccarthy et al., 2004). For the purpose of this program, a cohort refers to a "group of students who begin a program together, develops a collaborative project with self-directed goals, and a network of academic and social support" (Mccarthy et al., 2004). Faculty and alumni mentorship are advisory to the cohort. This component of the

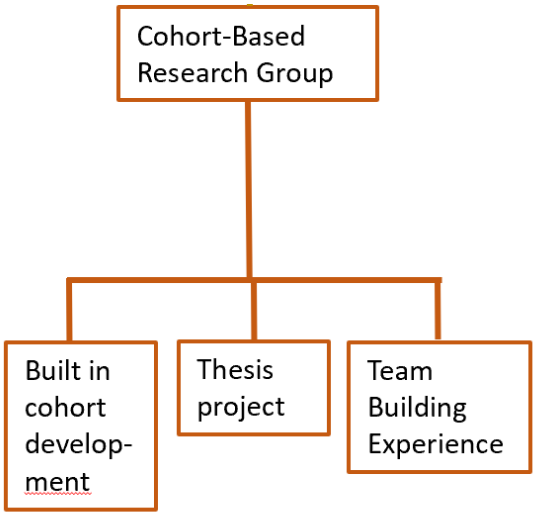


Figure 15. Food system graduate degree Cohort-Based Research Group components.

program, as shown in Figure 15., will be initiated during the first semester with consistent cohort participation throughout the entire grad experience. The cohort will have a feel of a "traditional lab group," yet it will operate without the confines of a focused disciplinary lab. The purpose of this cohort is to provide a safe environment for students to interact with their peers, to learn how to work together on their personal and professional development skills, such as facilitation, communication, and teamwork within the context of managing real world problems and issues (Lake et al., 2018). At the end of the program, the students will be encouraged to reflect on what the student learned while participating in the process. What did the student get out of working with their team? What skills did they learn? If mistakes were made, what did they learn from them? This cohort allows for the formation of a student unit working as a collective community within this program that encourages students to reach out beyond their program.

Since each cohort member will have diverse backgrounds and interests, along with exposure to an array of courses within the food system, there will be a rich base of student knowledge and experiences at their disposal to address research questions. This intentional process will allow students with different focuses to come together, which provides room for personal and professional growth through varied and collective experiential learning opportunities. The goals, process, outcomes, and benefits would be tightly tied to reinforce course curriculum. The aim of this cohort is to allow enough freedom, flexibility, and wonderment that personal and professional principles, values, abilities, and skill sets are allowed to coalesce into a collective team effort through the confluence of individual contributions.

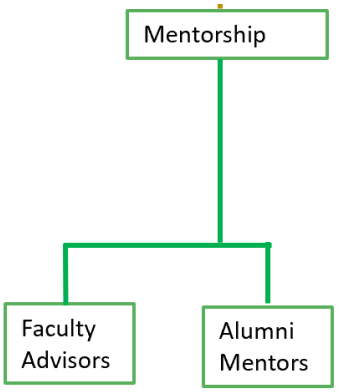
> Providing students with a safe, open environment to pursue experiential learning opportunities will greatly improve their education. The best way to learn a system is to dive into it and work on a problem. It would be great if there were more project-based experiential learning opportunities that allowed students to work together to solve/manage a problem. (Anonymous graduate student, personal communication, April 24, 2022)

Ultimately, this project will serve as the basis for each students' individual thesis. Although the cohort is working on the same wicked problem, each team member will be

responsible for writing their own thesis, based on their chosen area of interest and specific contribution to the overarching research question. Thus, every individual thesis will address how each personal cohort member played a role in executing their work and in accomplishing the principal goal as a collective cohort. To build and maintain community and team spirit within the cohort, regular meetings to create meaningful dialogue, as students share their work with the cohort and discuss ways to use their individual expertise and project contributions to address their overall research question. These meetings would be similar, to traditional lab group meetings, yet the dialogue would expand on the breadth and scope of discussion across sectors, disciplines, and cultures.

> A foundational component of graduate training is the relationship between an advisor and advisee. If I was not allowed freedom and flexibility by my advisor, there is no chance I would make it through the program or have a systems perspective. Many of my peers have expressed that their advisors are not supportive, and it negatively impacts their mental health and confidence. (Anonymous graduate student, personal communication, April 24, 2022)

The intention and design of the initial cohort model requires broad-based and in-depth perspectives from university departments, colleges, and centers, in full cooperation with the sectors (government, industry, non-profits, advocacy groups), disciplines, and cultures, while considering a wide array of socio-economic and political viewpoints. Additionally, an organizing committee representing diverse perspectives can provide guidance in aligning and uniting the curriculum and research activities that will develop student character, confidence and competencies to help solve wicked problems in our 21st century world. Since many forms of guidance and mentorship are needed to effectively prepare students for the workforce beyond the university, Figure 16.

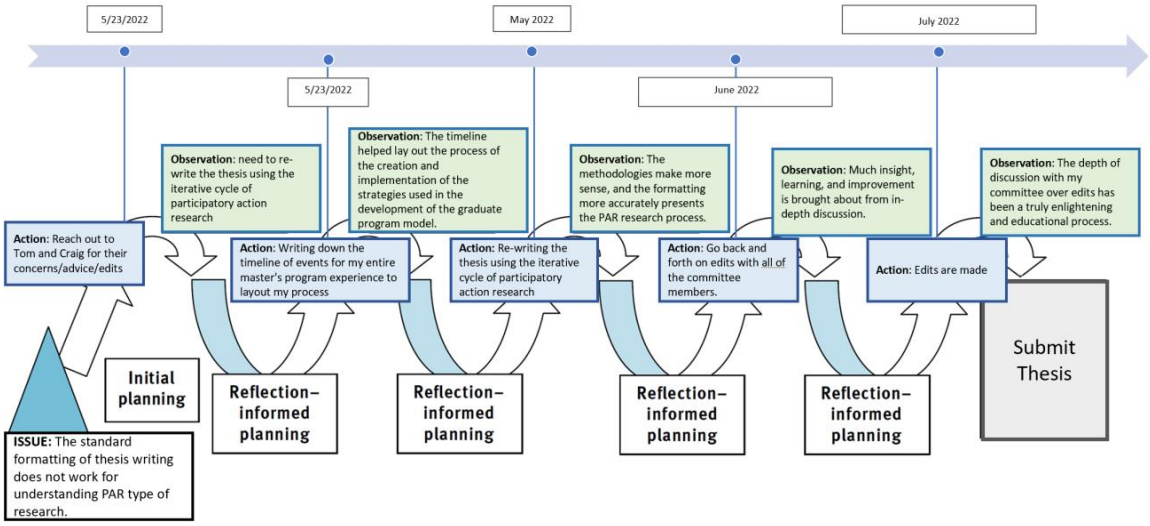


*To provide the students with guidance from both academic and industry perspectives. These mentors will help guide and inform the students in the design of their degree plans as well as help guide the thesis/group project.

Figure 16. Food system graduate degree program forms of mentorship.

illustrates the mentorship component of the Food Systems graduate degree program. An initial step is to assemble a pool of qualified faculty including diverse research specialties and interest areas so students can choose an advisor / mentor who can guide them in their individualized academic goals and interests. The collective of these selected professors will make up only a part of the cohort committee moving the student toward graduation. In addition to the main cohort committee, there is opportunity to bring in alum to act as mentors from various sectors and disciplines. Alumni are an invaluable resource for individual and group mentoring as students pursue individual interests within the food system and will require a wide array of experts to provide guidance. Mentorship is a valuable way to give back to the school and provide students with the knowledge and guidance best suited for them. Bringing in individuals from beyond the University to mentor also brings in different perspectives and world knowledge beyond those points of views held within the University.

Figure 17. Cycle 6. *Thesis Defense reflection and evolution*



The master's thesis defense. Referring to my master's graduate degree program thesis defense, as a "Defense" does not fully describe and may not be applicable to my graduate experience. Rather than defending my research and experiences, my desire was to invite opposition and create opportunities for dialogue and deep discussion about the purpose, direction, quality, and added-value that I might contribute through my work. I am

fortunate as my advisory committee allowed me access to wonderful depth of experience and knowledge from varying backgrounds and perspectives. I have learned so much and want to continue to grow forward (growth mind-set) into the workforce through these challenging, informative, and productive interfaces. Thus, the paper you are now reading does not resemble the paper in the form that was present at my Defense. The substantial dialogue that came from my defense has allowed my thesis to evolve and improve on so many levels. Rather than defending my work, I allowed others to provide insight and other ways of looking at these complex issues and problems. My defense was a prime example of the types of discussions that I highlight throughout my paper of multidisciplinary perspectives coming together to discuss, learn, and evolve towards better solutions, or more appropriately, to manage wicked problems. This life-changing process as WE engaged in my 'Thesis Dialogue" was an exhausting, eye opening, wonderful, and incredibly difficult experience worth every second of anxiety.

I would like to provide some context as to my previous background and experiences while defending my research in undergraduate settings. It is important to understand the emotional work I had to undertake, to once again engage in the "Defense" of my research. During my undergraduate degree, I was involved in undergraduate research for the purpose of resume building and gaining experience in a professor's biochemistry research lab to move beyond my lab courses. One part of graduating in that particular program was that you, as the student, needed to present your research project at the end of your program to a group (like a committee) of faculty who were in charge of leading questions and grading your performance. If you did not have your own research, you could present a research paper instead. Since I had completed my research on protein engineering with a faculty member, I decided to present on the topic of copper binding in protein molecules. Sadly, some politics (conflicting relationships) came into play during my particular research experience, as considerable friction existed between my research advisor and another faculty member whose research overlapped and conflicted. Unfortunately, this opposing faculty member happened to be on my "committee" of judges. During the questions at the end of my presentation, this faculty member asked some particularly difficult questions that I attempted to answer. My responses led to other questions. This committee member eventually talked me into a circle in which I felt

frazzled, embarrassed, and stupid. If it wasn't for the obvious smirking and posturing by this faculty member (likely due to my visible discomfort), it might have been a positive learning experience. Instead, I lost what little respect and trust that I had left for researchers/ science professors and had to work for a very long time to recover from this experience.

The purpose for telling this story is for a couple of reasons. First, I want to enlighten those who may not be aware of the way that students can fall victim to the petty politics that can occur between faculty members within universities. Also, to highlight the type of environment that can be bred from programs that focus too heavily on competition, not only between students but also among faculty members. Thirdly, I wanted to set the stage to describe what I was personally experiencing going into my thesis defense. Finally, to illustrate the differences between these two experiences.

In my first experience, I was trying to defend my research as well as my own intelligence. That "defense" promoted the "us versus them" mentality that was discussed earlier in this thesis (pg 11). For some reason, it seems that many people believe if they don't know the answer to something, they will be perceived as unintelligent. I believe this goes back to the ideology of "we are the experts" that can come from the drive towards perfection combined with competition. That perception can often lead to a quick transition from open communication to one or both parties going on the defense inhibiting imagination, creativity, and innovation. From my own experiences in "defending my research," I found that there is something freeing when you admit when you don't know something and understand that the way you tried to do something is not necessarily the best way. Rather, inviting others to help you provide an answer or discuss a potential solution instead of circling around the question you can learn so much more about the issue. During my thesis defense, the open and supportive dialogue allowed a new perspective, which in turn, evolved into the transformation of my project. In contrast, my undergraduate "defense" was closed off and left me feeling inferior and traumatized. One experience leads to confidence entering the workforce, the other does not.

By inviting rich discussion, my thesis committee and I were able to identify particular issues with the way I had worded certain phrases that conveyed something other than my

meaning. We were also able to identify that the standard linear thesis format in which the majority of thesis's are written, does not work for my research project. I initially wanted to follow the standard format so that someone who is used to traditional scientific writing could follow along and understand my project. We found through the dialogue in my Defense, that the traditional format does not do what I intended, and instead, rather poorly portrayed the concepts I was trying to describe. To better convey my findings, I switched to writing the thesis in a more storytelling format that follows the iterative cycle of PAR.

Summary and Conclusions:

In a society where communities are interconnected and interdependent across local and global markets, problems do not have simple solutions and fall under the category of wicked problems. These problems require evolving multidisciplinary collaboration across sectors, disciplines, and cultures to find solutions through continual adaptation to changes in society. Since wicked problems occur on a systems scale, understanding the functionality of systems is imperative. Similarly, ecologic systems and food webs require biodiversity while accommodating natural fluctuations within the system to function smoothly. The food system requires a diverse package of perspectives and interdisciplinary inputs, feedback loops, and outputs to manage innovative solutions to address the many wicked problems, such as those catalyzed by the Covid-19 pandemic. Issues such as food waste, climate change, food insecurity, and sustainability are inherent issues that have been amplified over time from the compartmentalization of disciplines and consequent competitive environments that leads to misunderstanding between parties.

From my understanding, collaboration and effective communication are essential in the battle to restore and improve our food system. To achieve this goal Nutrition needs to be reinserted into the food system discussion by coherently connecting all three intellectual traditions of nutrition based on our food system, through situational analysis and design. Food and nutrition professionals (Nutritionists and dietitians) are on the frontlines with consumers on a daily basis, where they influence purchasing choices through dietary

recommendations in one-on-one coaching, making them an important part of the food system. At the same time, food and nutrition professionals have a responsibility to educate people on how food choices affect not only individual human health, but also how food choices affect environmental sustainability and other aspects of the food system. In addition to educating the general population, improvement can be made in the communication between academics and policy makers for more wholistic coordination in research-based policy decisions. Current food production focuses on large amounts of cheap, calorie rich, shelf stable food, based on the needs of the past. With current populations increasingly suffering from non-communicable diseases like obesity and malnutrition, we need to transform our quantity focused supply chain into a quality focused food system. In other words, the nutrition profession would become more relevant if quality food would be accessible, available, and consumed by residents allowing for practical, affordable, and easier food choices. Thus, an effective and efficacious food choice can meet the sustainable development goals on an international, domestic, and local level. Yet, this requires a reconfiguration of how we train our food and nutrition professionals, how we work with the food system to create, make, and deliver efficacious and easy food choices for consumers, and how we work within the context of culture, community, and business to allow food choice to benefit humanity and the planet within a cohesive whole world environment.

If researchers and policymakers improve their communication by learning how to work together, we can work towards reducing the gap between policy and evidence that stems from inadequate understanding, communication, and action within and across food systems. Adding professionals trained in bridging the gap between scientists and policymakers, like boundary spanners, would help in the facilitation of these discussions. We need people with varying perspectives to tackle wicked problems, and professionals like boundary spanners who are capable of combining those perspectives into more wholistic and coherent solutions.

Currently there is a skills shortage gap that shows higher education is missing the mark on what type of training is needed to support our current and future workforce. Employers are finding it difficult to recruit employees with the proper training so they are

turning to training recent graduates themselves. Google has taken one step farther and has created a certificate program to train students straight out of high school. This certificate program is more time and cost effective taking only 6 months in comparison to the 4-year degrees offered by universities. The high cost and time commitment of traditional universities in combination with less comparative gained outcomes increases the likelihood for students to choose certificate programs like the one offered by Google over traditional university degrees (Cappelli, 2020)(Fain, 2019).

> The department prepared me for the science, but not how to apply that science. (Anonymous graduate student, personal communication, May 1, 2022)

A shift in higher education over the years towards specialization, linear thinking, and reductionist approaches has contributed to the skills shortage gap, such as communication, building collaborative relationships, systems thinking, problem solving, interdisciplinary work, and facilitation. The University system has turned out outstanding specialists, yet specialization has dampened our ability to apply collective knowledge involving complex situations, which extenuates less understanding and appreciation of the dynamic interrelationships between components within systems. Universities have a responsibility in addressing the skills shortage gap because they are currently the main source of training for people entering the workforce. Without drastic changes, universities run the risk of becoming obsolete in the face of upcoming innovative education systems that are better able to prepare students for the workforce and address the skills shortage gap in less time and for less money.

> Student motivation is down across the nation. Students aren't showing up and aren't putting in the effort. Now is the time to examine and improve our program, but unfortunately, it seems like there is no motivation within the department to make changes. (Anonymous graduate student, personal communication, May 1, 2022)

The University of Minnesota has a great opportunity to tackle the skills shortage gap and a lack of student motivation, especially related to food systems education. The University of Minnesota is not only a land grant university working with the communities through extension, it also has departments that cover all portions of the food system and is

surrounded by a hub of large food corporations, farms, farmers markets and grocery stores. This central placement of the University provides it with plenty of resources for setting up a remarkable interdisciplinary food systems graduate degree program that utilizes both reductionist and systems thinking to prepare the new generations of professionals entering the workforce. Thus, a professional trained in this manner as a food systems analyst becomes proficient in using the two forms of thinking to tackle the wicked problems within our food system.

> We have the resources to make a change. We can increase student satisfaction, and now is the time to do those things as we continue to navigate COVID and post COVID world. (Anonymous graduate student, personal communication, May 1, 2022)

In the current university format, it is difficult for students to explore interdisciplinary programs due to siloed departments across campuses. Though the resources are there, the structure is not set up in a way to facilitate this type of dynamic learning. There are students who are pushing the boundaries to obtain that interdisciplinary education, but it needs to be more accessible to the general student body. The students who are paving the way have access to supportive, individualized interaction with faculty members who recognize the issues internal and external to the university system. Another beneficial outcome of individualized interaction between students and faculty is that it adds to the professional and personal growth of not only the students but also the faculty members working along with them.

This project utilized an anthropological approach using observations, qualitative data collection, and conversations with people of differing perspectives to understand the issues within the current academic system from the perspective of fellow students, administrators, faculty, staff, alumni, and other professionals outside the university system. Participatory action research which combines action, practice, theory, and reflection was also used in this process through my own experiences and observations while participating (matriculating) within the university system. In contrast to conventional research methods, human experiences and personal interactions through anthropological approaches allows a more holistic approach to document the current state

of student education within the university system. The qualitative feel within the educational system suggests potential adaptations that might better meet student-centered learning. An important contribution attributed to qualitative data collection is the utilization of human interest, emotions, beliefs, and culture that has always and will continue to impact the University's mission of research, education, and outreach.

Through participant observation and in-depth interview, the number of required courses were identified as a point of frustration within the departmental and college curriculum related to constraints placed upon individual and personal decision-making around student education. Allowing flexibility within course options increases the opportunity to build student self-efficacy to personalize their degrees to better accommodate desired experiences, educational goals, and expected outcomes.

Figure 18. shows the combined components of the Food Systems graduate program to demonstrate how each part works together to create this individualized program. The

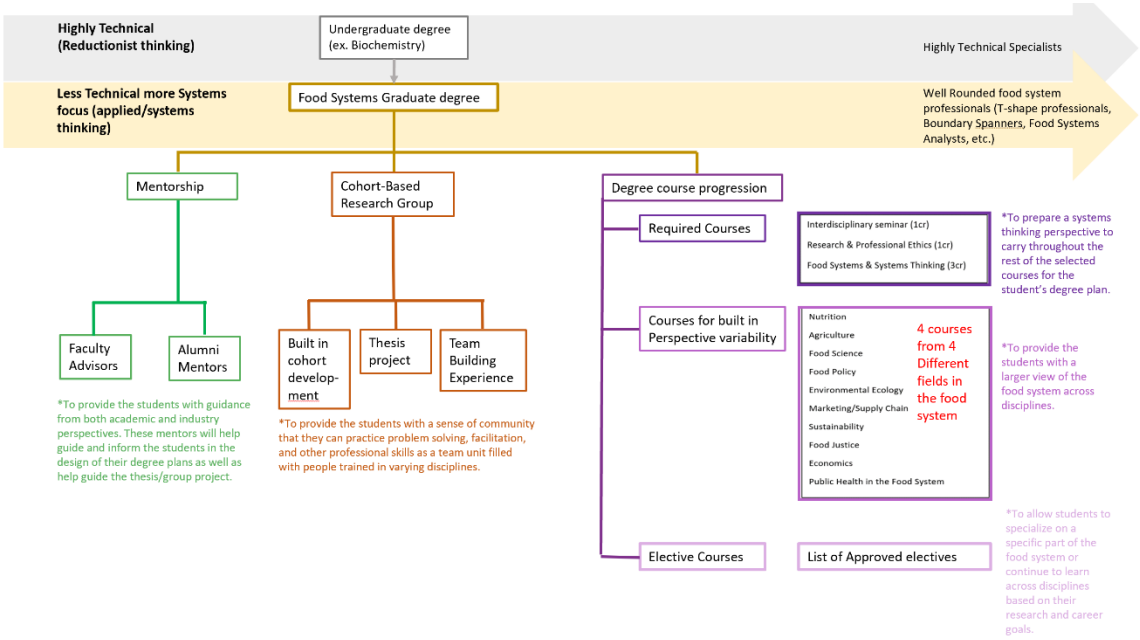


Figure 18. Food systems graduate degree program design.

proposed program consists of three required courses to set the theme of systems thinking for the duration of the program, courses that address at least four different topics within the food system, electives supporting special topics of interest, and a cohort-based research group with a corresponding personal thesis. The list of elective courses will

expand as course offerings evolve to support programs goals and students' interests. The program framework, format, and logistics will be designed to accommodate student needs, wants, and desires, to ultimately confluence departmental, college, and university resources into a coherent and integrated program of study.

The complexity of the food systems and wicked problems span across local and global markets which create a complex web of connections with unexpected outcomes to seemingly unconnected inputs and outputs. That means there is no simple solution to fix a wicked problem. As systems naturally fluctuate, solutions will also need to fluctuate and adapt to the system over time. Covid-19 is a prime example demonstrating the myriad of complex cascading and unexpected affects that occur when the food system is disrupted. The complexity of the food system and wicked problems that it presents, require collaboration and effective communication across all disciplines, including food & nutrition which is often left out of food system discussions and decision-making. By allowing food and nutrition science to participate in these food system discussions, we can improve the relevancy and impact of the nutrition discipline while adding an essential and integral voice to the conversations around the management of wicked problems within the food system. By including perspectives of academics from varying STEM fields (including nutrition, biochemistry, agronomy, ecology, etc.), policymakers, along with the general population, renewed efforts can be made to reduce miscommunication and misunderstanding around important policy decisions that determine the efficiency, effectiveness, and efficacy of change in the food system. In turn, we can create more sustainable, healthful, equitable, and economically resilient food systems, when we approach these issues from a system thinking and doing perspective. Given most university programs tend to emphasize reductionist thinking, this necessitates broader training of new professionals who are capable and willing to use systems thinking to contribute to meaningful and impactful transformation of local and global food systems. The all-encompassing contribution of different sectors, disciplines, culture, socio-economic, and political perspectives are essential to an inclusive, holistic, and comprehensive education program, based on systems approaches. Figure 19. brings

together the academic system and the food systems diagrams mentioned in earlier sections of this paper to illustrate the direct relationship those systems have on each other. This more wholistic diagram exemplifies the interconnectedness of these different

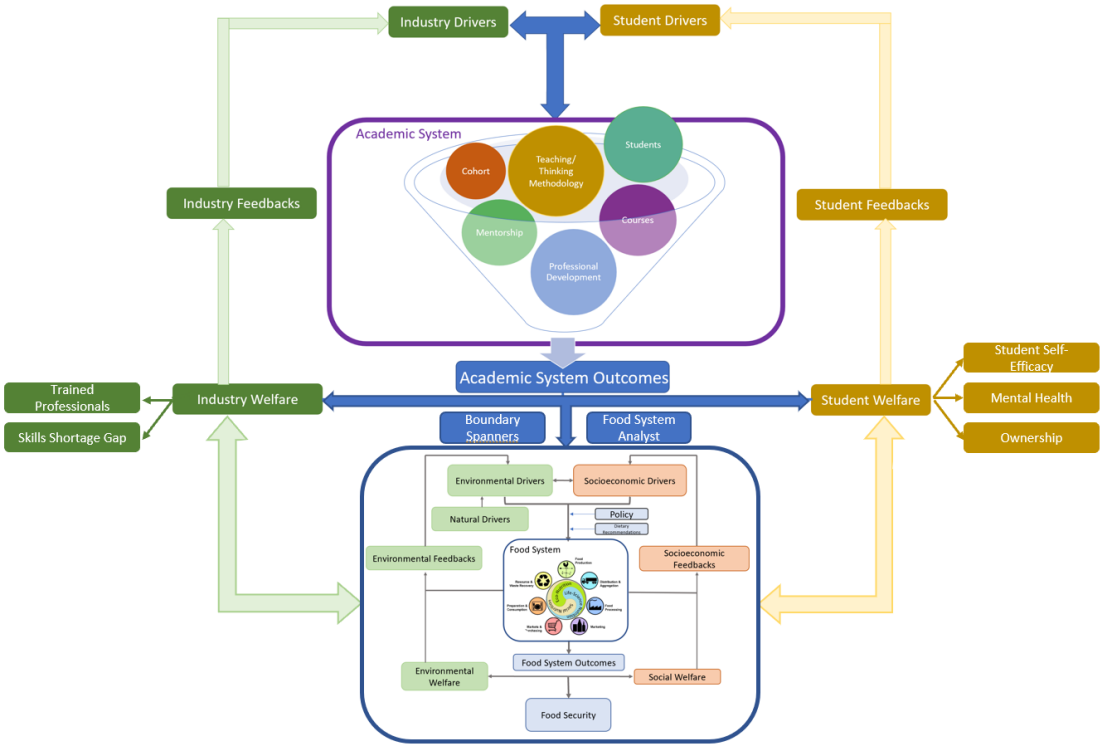


Figure 19. Systems diagram including the academic system, food system, and corresponding facets of society.

systems.

Given the internal and external resources available to the University of Minnesota, there is much opportunity to become a leader in this area and to provide students with an interdisciplinary program that prepares them to tackle the wicked problems of the 21st century. Universities, industry, and policymakers can work together to incentivize these systemic processes to ensure the persistence of human and planetary health. It will take all of us learning how to work together to make strategic changes in our food system. Creating a food systems graduate degree program that uses reductionist thinking while complemented by systems thinking, with interdisciplinary engagement, building self-efficacy within students is a foundational approach to move toward that goal.

Statement of Potential bias

Due to the nature of informal interviews, confirmation bias likely played an implicit, yet significant role in the development of this project. Confirmation bias is the tendency to process information by interpreting information that is consistent with one's existing beliefs (Bettina J. Casad, 2019). The formal interviews that occurred later in the timeline of the project were conducted with students in the hope of getting more detailed and deeper insights into the landscape of perspectives surfaced and brought forward in the informal interviews. While the risk of confirmation bias remains a weakness inherent in this type of project, the more formal, semi-structured interviews and the action/reflection cycle of participatory action research helped to establish the issues expressed by students in this work were of a shared and collective nature that went much deeper than offhand complaints or otherwise more surface reactions to isolated student experiences. One learning or takeaway from engaging in qualitative research that examines human experience is the importance of awareness and recognizing or mitigating the potential effects of confirmation bias on research findings or interviews. I believe this thesis establishes the existing beliefs of students, as described here, represents a reality that should be given serious consideration in attempts to improve the dietetics curriculum.

Postscript: Personal reflections, lessons learned, recommendations, and critiques of the graduate experience.

When I compare my undergraduate and graduate experiences, they could not be more different. My undergraduate experience degraded my self-confidence and taught me that taking risks was detrimental, whereas my experience as a graduate student has strengthened my personal and professional confidence and has helped push me beyond my comfort levels to test the limits of my will and capabilities. These experiences didn't come from the courses I took during my graduate program, but rather from the amazing mentors I found. In my graduate experience, I learned the tremendous impact that mentorship has on the academic experience. In an environment that emphasizes

perfection, standardization, and competition like the academic system, having mentorship that emphasized personal growth, strength, and creativity was key for me.

When deciding to go to graduate school there were two main options presented to me. One was to choose a professor who had funding but where I would be doing research based on their research goals. The other option was to choose a professor without funding but who would support me in making my own research decisions and who encouraged me to take chances and take control of my education and therefore my future. One option was the safe option that provided me funding and a path laid out for me by the institution. The other had a lot more variables that could go awry but with much more to gain. I decided to take a risk and go the nonconventional route, so different from my undergraduate experience. Having mentorship that encouraged me to be my own person, to challenge the status quo, and explore what interested me was the most invaluable part of my graduate experience and helped me bridge the gap between the silos that are the departments of our university. With the support and encouragement of my mentors, I was able to create a project from scratch based on my experiences within the academic system and based on my values and interests beyond academia. They provided me with a safe space to think, be creative, make mistakes, explore options, and reflect on what I was learning. In that process I learned much more than in the courses that I was required to take during my time in graduate and undergraduate school.

In my graduate experience, I learned that technical knowledge is not everything. In the development of this thesis project, I was able to develop my presentation, discussion, and interview skills through our advisor-student dialogue meetings and extensive networking with diverse individuals internal and external to the University. I thrived as I planned, organized, and facilitated discussions, while also learning about the collaborative process and rich dialogue that occurred. These meetings and interviews occurred with a wide range of people, ranging from students, deans, to professionals within the industry. These unique experiences allowed me to develop a better understanding of the diverse lens that people view the world, from different circumstances and locations within society as well as people across sectors and disciplines addressing large complex problems. Understanding these diverse perspectives will allow me to work with people of varying

points of view in the workforce to continue addressing wicked problems in a more collaborative and hopefully more productive manner.

I wanted to focus on improving my professional skills during my graduate experience because there is a general atmosphere of discomfort and an avoidance around professional skills in universities. In higher education professors, administrators, and other mentor figures in students' lives, particularly within STEM disciplines, are heavily inclined toward the prioritization of research and technical skills. The importance of professional skill development, such as presentation skills, communication, facilitation, etc. is well known, however, it is one thing to tell students it is important while showing them otherwise. In my observations of both undergrad and graduate school environments, the current academic environment is heavily weighted toward research. The professionals and mentor figures tout the importance of professional/soft skills but do not lead by example. In practice they focus on their research and the importance of technical skills. This is partially due to the lack of professional development required for faculty by the university system and the competition they are often placed under to obtain and maintain funding and research initiatives. Students pick up on this inconsistency and are more likely to opt for courses in technical skills rather than professional skills because their faculty advisors inadvertently push them in that direction.

Currently, professors are not required to partake in professional development and there seems to be little to no effective accountability for quality of teaching (Anonymous University of Minnesota faculty member, personal communication, February 9, 2021). There are opportunities for professional development of instructional skills at the University of Minnesota, that some feel to be oversubscribed, in which faculty do attend even though they are not required (Anonymous University of Minnesota faculty member, personal communication, May 30th, 2022). However, from my experience, observation, and from what I have heard from many students throughout both graduate and undergraduate courses, is a general frustration in the quality of teaching from certain professors. This contrast brings to question, what is the disconnect between the professional development offerings for professors and the outcome for students? Are the teachers who could benefit /need improvement the most from these professional

development opportunities attending them? There is quite a variety in teaching quality at the higher education level. This variety in teaching quality has made me question whether there was any professional development required and if so, how effective that development was. At the same time, if certain teachers are no longer able to provide the level of teaching quality that students require from higher education (and are paying for), what happens to make change? Within the University of Minnesota, three direct methods of accountability include tenure and promotion decisions, merit (pay) increase decisions, and post-tenure review decisions. (Anonymous University of Minnesota faculty member, personal communication, May 30th, 2022). Further, each department has, or should have, a peer-review of teaching process and the university institutes the student review of teaching process. Some departments and majors institute an end-of-semester sharing session. Some departments and majors engage in writing-enriched curriculum development. (Anonymous University of Minnesota faculty member, personal communication, May 30th, 2022). With those methods of accountability in place, I must raise the question, how effective are they? Several occurrences come to my mind that have slipped through the cracks of these methods. This is certainly not all encompassing for there are many teachers who do a wonderful job. My point is that there have been enough occurrences of professors throughout my academic career who have not been able to maintain that quality of teaching for courses that students are required to take due to curriculum requirements and students get very little out of their time and money for those courses. I do not have the answer for this issue, but it is an important one to discuss.

The emphasis on technical skills and the discomfort with professional development leads students to believe technical skills are the only way to get a job when they graduate. Though technical skills are certainly part of it, there is a dire need to couple and embed professional skills within each student's program if universities are to be most effective for students as they enter the workforce. It is difficult for students to understand the importance of professional skills when they don't see their higher ups demonstrating the significance and long-term benefits of honing these lifelong skills. That is why faculty engagement in professional development is imperative. Leading by example will be critical in making this shift in thinking and doing. Though technical skills do help students get traditional jobs, they don't help students adapt to the workforce and progress

in their field, nor to explore innovation through interdisciplinary and entrepreneurial roles. That is where professional development allows students to have a more open mind, heart, and spirit as they embark on the world. In addition, when I reflect on my varying experiences while interviewing, I have noticed that employers, though they value technical skills and knowledge, they are more focused on professional skills and capacity for growth and learning. Also, in carrying out these interviews I honed my ability to listen, develop personal relationship skills, and learned to facilitate conversations allowing open communication and elaboration on topics of discussion. These skills have already proved useful to me in my re-entrance into the workforce towards the end of my graduate school experience, proving to me their usefulness and importance.

In addition to a focus on technical skills, there is a pervasive problem of perfectionism and fear of failure within the student body. The fear of failure encourages perfectionism and can be counterproductive to progress, learning, and mental health. Fear of failure goes along with lack of confidence and can negatively affect work performance when students enter the workforce. Employers are looking for people who are coachable in the face of failure, not people who are traumatized by mistakes. No one can be perfect, but the current academic environment breeds the idea that perfectionism is the only way to succeed. Not only does fear and perfectionism inhibit creativity and innovation, but it also breeds a negative image of self and low self-worth. When a person inevitably faces failure and that lack of perfectionism, thoughts can lead toward inadequacy, unworthiness, incapability, etc., and is probably one of the leading drivers towards mental health problems in students and young people entering the workforce. This fear of failure and drive towards perfection inevitably creeps into all aspects of our lives. The high bar of perfectionism also can lead to imposter syndrome which “describes an individual who is high achieving yet fails to recognize their success as being earned, but instead attributes it to external factors such as networking, luck, timing, lowering standards, and their charm” (Bravata et al., 2020; Parkman, 2016). This lack of self-confidence and inability to recognize or internalize one’s success fosters a perception of fraudulence and feeds stress (Holden et al., 2021). Universities are making attempts to address mental health issues within their systems but seem to be stuck on tackling the symptoms rather than the causes. University authorities might start by looking at the environment that

breeds perfectionism and other drivers toward mental health problems, then see what can be done to make corresponding changes on system-wide basis.

This thesis project allowed me to practice my facilitation skills through in-depth interviews and meetings, while building my confidence, improving my presentation skills, and learning new perspectives from a wide array of people with diverse backgrounds, experiences, and worldviews. In looking at the larger system I was able to see how technical skills can be adapted to diverse scenarios and how people with different expertise can learn how to work together to address multifaceted problems. This experience has taught me what it is like to push the boundaries beyond what is comfortable. If I would have stayed in my comfort zone, I wouldn't have been able to take classes outside of the nutrition department to learn about how nutrition fits into the larger food system. I would have done another wet lab research project reiterating the skills I already had developed. I also wouldn't have learned as much about myself and what I am capable of being, thinking, and doing. In this project, I am embracing vulnerability by taking a different approach to how we as academics look at STEM fields and the human influence on STEM research. In the creation of this thesis, I hope that change can be made for following generations of students so that they too push the boundaries of what is comfortable for the improvement of our world. I am so thankful for the opportunities that I have had during this experience and look forward to using the skills I have learned throughout my career and my life.

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Appendices:

List of Tables

Networking questions/ Questions for context:	What do you do?
	What are the functions/duties/responsibilities of your job?
	How does a typical day look for you?
	What kind of problems do you face? Decisions you make?
	Why did this type of work interest you, and how did you get started?
	What jobs and experiences have led to your position?
	Which past jobs have been most helpful in getting you to this point in your career?
	What do you like most about working in this industry? Dislike most?
	Why did you choose this organization or company?
	What other jobs can you get with the same background?
	What sort of changes are occurring in your occupation?
	What are major qualifications for success?
	What abilities or personal qualities do you believe contribute most to success in this field/job?
	What are the typical entry-level job titles and functions? Which ones are best for learning applicable skills?
	With the information you have about my education, skills, and experience, what other fields or jobs would you suggest I research further before I make a final decision?
	What's the best advice you'd give to someone interested in this field? Any written materials you suggest I read?
	Where might my (or someone with similar training) skills fit in other fields? Or organizations?
	If I were to apply to your organization, what thoughts would you have for me?
	Who else do you think I should talk to?
	How would you assess my experience in terms of entering this field? What steps do I need to take to become more qualified?
	Do you feel professionals have been appropriately trained for the workforce?
	What skills do you see missing in professionals entering the workforce?
Explain the program I am working on for	What are their thoughts on this type of program?
	What do they think would be important to include in the design/creation of this program?

context of the following questions:	What are the most important skills to obtain from school to prepare students for entering the workforce?
	Other questions that came up:
	Tell me more about the community food systems program and what you do with it?
	How does trade policy impact farmers?
Questions for advisor/counselors within the University of MN:	What are your thoughts on an interdisciplinary degree at the graduate level?
	What type of obstacles and issues should I prepare for when designing this program?
	What are potential paths for success?
	In general, what are you hearing from students about their experiences within the University system?
	What are your experiences with student's career planning and choosing their courses for their programs?
	What are some of the obstacles you see for students?
	What are students doing now to personalize/individualize their education?
Questions for Faculty/Deans:	What are some of the things you are doing with this course that promotes cross-disciplinary learning?
	What are your thoughts on an interdisciplinary degree at the graduate level?
	What type of obstacles and issues should I prepare for when designing this program?
	What are potential paths for success?
	What resources do you recommend I look into for this project?
	What type of jobs are you aware of for students who are interested combining disciplines in the food system/industry?
	What do you think CFANs would think about this degree?
	Why wouldn't we have this major? (Food systems degree for graduate students)
	If we create a new major, do we have to create more courses?
	I understand money has a lot to do with the decisions the university makes. Can you help me understand the money aspect of creating courses and a new major?
	Are there graduate level courses that you know of that could be good in a food systems major?
	What do you think about prerequisites and how to utilize them?
	How would I incorporate systems thinking into curriculum?
	Can you explain how your program was designed?
	How did you address the issue of money?
	Did you take into account flexibility in course selection? How did you go about it and why?

	What kind of opposition did you face?
	Did you see a change in the number of applicants for this program?
	What are some of the political issues within the University that I need to be aware of as I move forward with this project?
	What are your thoughts on courses being required?
	How would you go about attracting students?
	How would you make this work from an administrative perspective?
Faculty/industry professionals:	I know you mentioned some parts of the food system you interact with; can you elaborate on that more?
	What parts of the food system do you think need to be emphasized, what needs work?
	How would you prepare someone to fill that role?
	Are there resources that you think would be helpful to me?
	You mentioned being frustrated with the lack of soft skill development provided by your education. How did you go about addressing those gaps to get to where you are today?

Table 2 – Comparison of Nutrition related graduate level course offerings between the department of Public Health (PubH) and the department of Nutrition (NUTR)……20

Public Health Department Courses involving Nutrition		**Nutrition Department Courses**	
PubH 6915	Nutrition Assessment	NUTR 5625	Nutritional Biochemistry
PubH 6901	Foundations of Public Health Nutrition Leadership	NUTR 5626	Nutritional Physiology
PubH 6914	Community Nutrition Intervention	NUTR 8620	Advances in Nutrition
PubH 6933	Nutrition and Chronic Diseases	NUTR 5622	Vitamins and Mineral Biochemistry
PubH 6907	Maternal, Infant, Child, Adolescent Nutrition	NUTR 5624	Nutrition and Genetics
PubH 6906	Global Nutrition	NUTR 5627	Nutritional and Food Toxicology
PubH 6389	Nutritional Epidemiology	NUTR 8411	Obesity Prevention - From the molecule to the Bedside
PubH 6094	Obesity and Eating Disorder Interventions		
PubH 6900	Topics: Public Health Nutrition		
PubH 6904	Nutrition and Aging		

PubH 6945	From Kid to Community: Personal, Environmental, and Policy Interventions Targeting Youth Obesity		
PubH 6094	Interventions to Address Weight-Related Health and Eating Disorders		
PubH 6110	Foodborne Hazards		
PubH 6181	Surveillance of Foodborne Diseases and Food Safety Hazards		
PubH 6954	Personal, Social, and Environmental Influences on the Weight-Related Health of Pediatric populations		
PubH 6955	Using Policy to Adress the Weight-Related Health of Child and Adolescent Populations		
PubH 6956	Public Health Approaches to Addressing Food Insecurity in U.S. Populations and Developing Nations		

This table shows the course Syllabus that was under development prior to the transition from a course to a full graduate degree program. The purpose of presenting this syllabus in its unfinished form is to provide the reader context for where in development of the course I was at when I transitioned to a full graduate degree program.

CFANS 5XXX: Eco-Nutrition	
Instructor:	TBD
Guest Speakers:	University of Minnesota alumni and other experts in the chosen topics of interest
Teaching Assistants:	TBD
Why do we need this course?	• Lack of graduate level systems courses. • No grad level courses that connect across CFANs disciplines (business, agronomy, health, nutrition, food science, etc.). • To provide students problem solving skills brought in by industry professionals. • Provide student workforce preparation through professional development. • Create a course that provides more to students than subject matter knowledge. • Offer a course that provides individual teaching/instruction, probing questions, and facilitation experience.

Course Description:	This course allows students the opportunity to apply their knowledge with problem-solving skills presented by guest speakers from industry across topics on how food and nutrition relates to climate change, environmental sustainability, health, economics, policy, mental health, and soft system modeling. The topics covered each year will be based on current industry problems. An important part of this class is using a multicultural perspective on health that would include psychology, mental health, and community. Speakers on mental health will be included to talk about its importance and the impact of mental health on students going into the workforce and into life in general. The goal of this course is to provide a more wholistic approach beyond what is currently offered to students in their degree programs. This course will provide new opportunities for networking and fieldtrips virtually or on location. It will be a dynamic course that is able to change with the needs of the students within the department. In addition to that, this course will focus on student facilitation skills, allowing them to learn about and practice facilitation throughout the semester. This course will have a continuous undertone that focuses on workforce preparation and professional development.
Intended for:	This class is intended for any students within CFANs who wishes to learn about how different disciplines are connected within a system. The goal is to bring in students from several disciplines within CFANs to discuss complicated topics from different perspectives and learned backgrounds.
Pre-requisite:	None
Required materials:	None
Student Learner Outcomes:	➢ Bloom's Taxonomy. We want the students to go beyond understanding and remembering, based on levels of bloom's Taxonomy to reach toward application, analysis, evaluation, and even the creation phases. ➢ Improve self-efficacy within students ➢ Develop critical thinking ➢ Expose students to real world situations, and allow interaction with different sectors, disciplines, and cultures besides their own Other potential outcomes for students: • Mentorship • Fieldtrip potential (If a speaker is willing to give a lecture and or tour at their place of work) • Opportunities for a learning experience. • Virtual interaction between the mentor and student • Virtual tour into industry and other places outside the university • Volunteer at place of work (a chance to get out of the classroom) • Hands on learning experiences • Internship potential and networking • Professional development • Practice in facilitation

<table>
<tr><td><u>Teaching Methods</u></td><td colspan="3">In-class and/or online presentations by instructors, practicing professionals, and other guest speakers.
In-class and/or online group discussion of weekly topics based upon guest speaker and readings.
Feedback on oral presentations from instructors, peers, and guest speakers(mentors).
Feedback on written documents from instructors.
In-class and/or online discussion about communication/facilitation skills (based off Barret’s survey).</td></tr>
<tr><td><u>Course Setup:</u></td><td colspan="3">This class is intended for CFANs graduate students. Topics will be taught in 3-week cycles:
One person will instruct/facilitate the course, yet every 3 weeks a different expert/alumni will teach about their topic.
The first week, the expert would present about themselves/their expertise and how their work relates to the field of nutrition. They might highlight other disciplines they work with regularly or occasionally come in contact with.
The second week would be more of a deep dive into the topic. Students will come with prepared questions and there will be a guided discussion on prevalent issues that encompass this area of current nutrition topics and discuss potential issues into the future. This week there would is also the potential for a field trip to the speakers place of employment, if they might wish to provide this opportunity. That way there can be a tour and a discussion while on the tour or at that location (Can potentially be done virtually as well). This is an effective approach to directly expose students to industry, government, non-profits, advocacy groups, and beyond.
The third week would include presentations by students to pitch what has been done and where they need to go next or how to manage the issues discussed in the previous meeting. The guest speaker would be present to give direct feedback on these presentations so that the students can get direct feedback from an expert in the field.

For the first class period, we plan on a facilitation expert come into class to talk about facilitation to prepare the students for practicing and developing their facilitation skills throughout the semester. Depending on the time, an expert on food systems could come in to lay the foundation for food systems as well.</td></tr>
<tr><td><u>Course Topics</u></td><td colspan="3">Will vary depending on the speakers per year</td></tr>
<tr><td rowspan="7"><u>Schedule:</u></td><td>Week</td><td>Day</td><td>Topic</td></tr>
<tr><td rowspan="5">1</td><td rowspan="5">Intro</td><td>Facilitation (what is it? and tips and tricks)</td></tr>
<tr><td>What is a food system?</td></tr>
<tr><td>What is environmental sustainability and how does it relate to food systems?</td></tr>
<tr><td>How the semester is going to go and expectations for the course</td></tr>
<tr><td></td></tr>
<tr><td>2</td><td>Guest speaker</td><td>Agriculture or Nutrition or Agriculture</td></tr>
<tr><td>3</td><td>Discussion</td><td></td></tr>
</table>

	4	presentation	
	5	Guest speaker	Nutrition or Business or Business
	6	Discussion	
	7	presentation	
	8	Guest speaker	Economics or Health or Health
	9	Discussion	
	10	presentation	
	11	Guest speaker	Policy/Regulatory/Government
	12	Discussion	
	13	presentation	
	14	Workday	Tips and tricks for debating
			How to make a concept map
			Work time for prepping for the debate with their group
	15	Debate	**Current Debate topic options**
			Strategies for pursuing sustainable development from each of the 4 perspectives
			Or
			Best way to address environmental sustainability from each of the 4 perspectives

Grading:	Attendance Reflection Sheets Prepared questions for speakers Career and life goals concept map Final reflection essay based on the debate? Talk about pros and cons of each perspective. Chalk talk style presentation Expectations of students - Students will fill out reflection sheets from each presentation to provoke deeper thoughts What did they think about that speakers' job? What did they like about it? What didn't they like about it? How can that person's job be related to what you might want to do with your degree of choice? How might you interact on a professional level with someone in that field of work? Etc. - The goal here is to get students to think about how these topics are connected to their fields and how different disciplines work together. We also want them to start thinking about themselves and what might be a good or bad fit for them. A moment to introduce them or give them time to do some deeper thinking since most college students don't have enough time to do it outside of class. - Have the students come prepared with questions. Can observe how these questions change as the class goes on. Do the questions become more in depth and more developed? - Concept map of their career and life goals. Reflection essay that would be due at the end of class. - In this class, the focus should be more on the process than the outcome. - Final question at the end of the course: You have done all this stuff, how does this stuff work for you in the future?

Table 4 – Course exchange for the author's personal program requirements……..25

Remove	**Add**
NUTR 5622 Vitamins and Minerals Biochemistry (3 credits)	APEC 5451 Food Marketing Economics (3 credits)
NUTR 5624 Nutrition and Genetics (2 credits)	APEC 5832 The Business of food systems (1 credit)
Research methods course requirement (2 credits)	PUBH 6901 Foundations of public health nutrition leadership (2 credits)
Other potential Courses to add to meet credit load requirement	
PUBH 6101 Environmental health (2 credits)	
PUBH 6113 Public policy and risk: strategies for effective decisions and discourse (3 credits)	
PUBH 6134 Sustainable development and Global public health (2 credits)	

Student 1	Student 2	Student 3
• Nutritional Biochem • Presentation Skills • Biostatistics I • The Business of Food Systems • Nutritional Physiology • Advances in Nutrition • Food Marketing Economics • Sustainable Agri Concepts • Public Health Nutrition Leadership	• Nutritional Biochem • Presentation Skills • Biostatistics I • Nutritional Physiology • Advances in Nutrition • Vitamins and Mineral Biochem • Plant Reading Principles • Using risk analysis tools • Food Marketing Economics • Nutrition and Genetics • Public Health Research • Surveillance of food borne disease	• Maternal and Infant malnutrition • Qualitative research methods • Policy on child and adolescent weight health • focus group interviews • directed study: evaluating writing community-based grants • +nutrition core classes

Ringling, K. (2020). *Interdisciplinary , Cross-Supply Chain Approaches to Food Systems Improvement* (Issue October).

Department / College	**Contribution**
Agronomy and Plant Genetics	improving crops and developing sustainable farming practices
Bioproducts and Bio Systems Engineering	develops methods for processing raw materials into food ingredients
Food Science and Nutrition	evaluates end-use, sensory, and nutritional qualities, and safety of raw materials and finished products
Applied Economics and the Carlson School of Business	evaluate the production and supply chain economics
School of Public Health	can evaluate the broader health implications of production and consumption
Institute on the Environment	can assess sustainability impacts

List of Figures

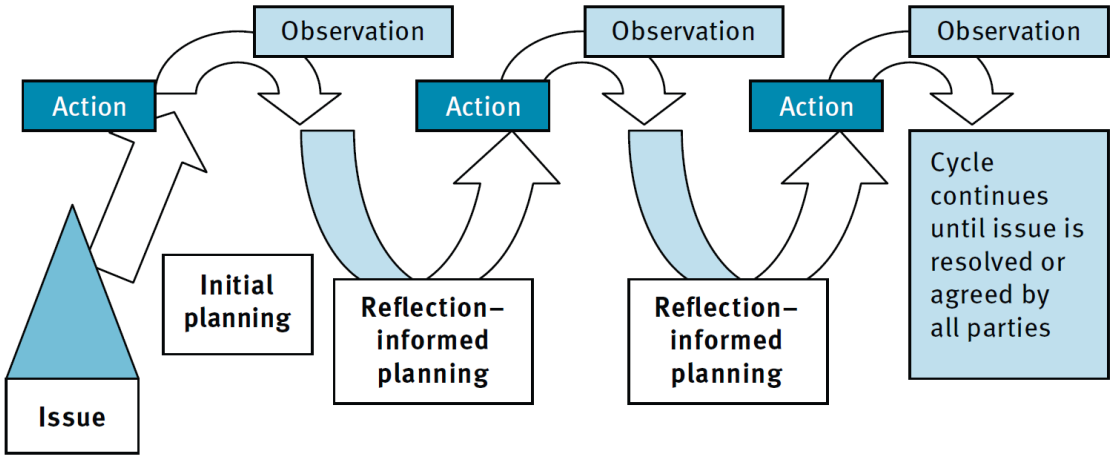
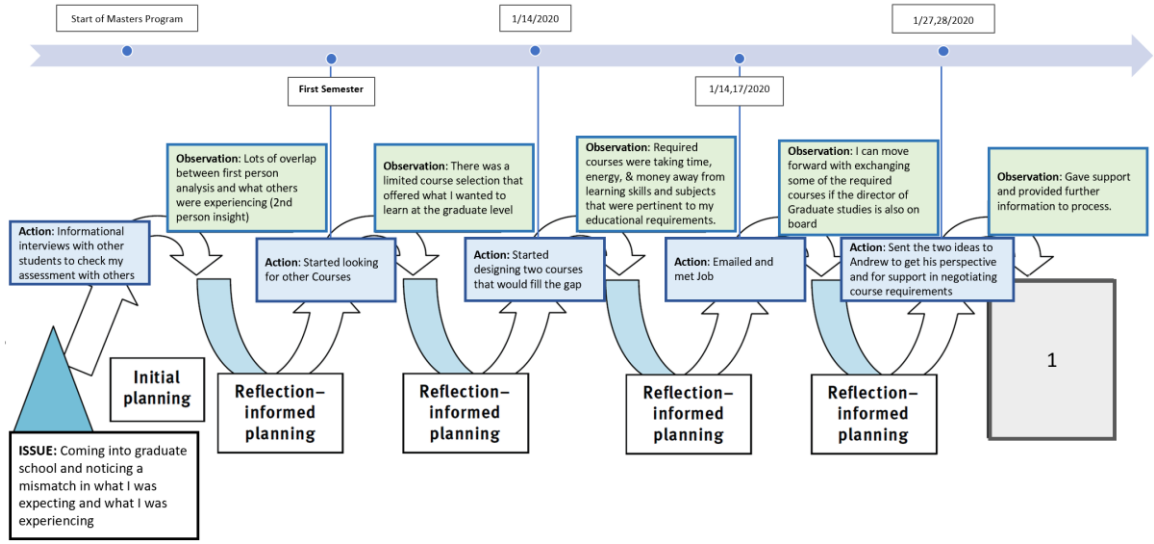
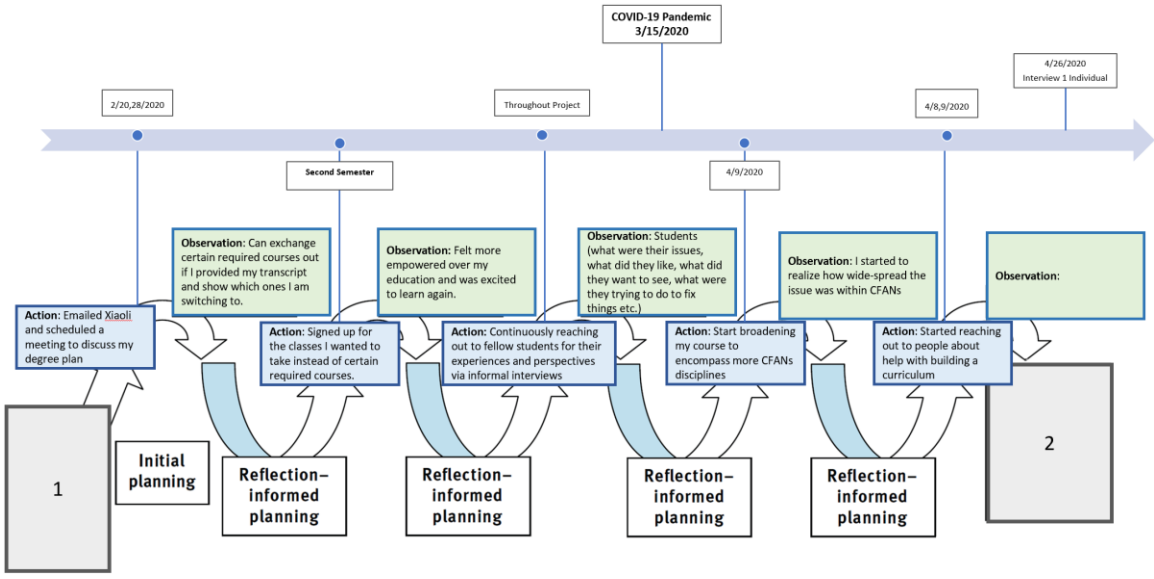
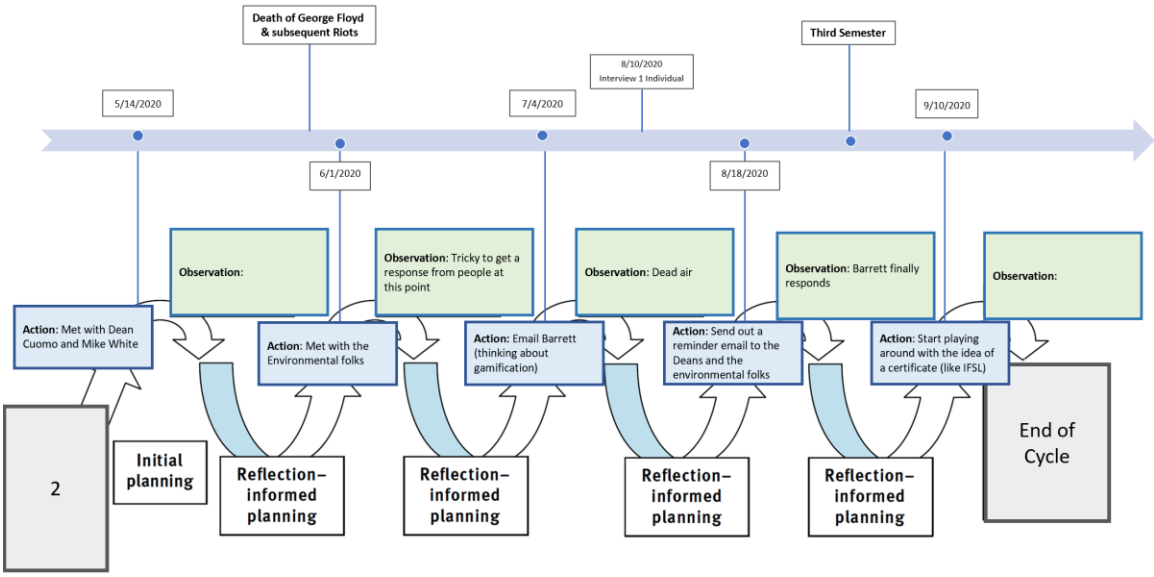
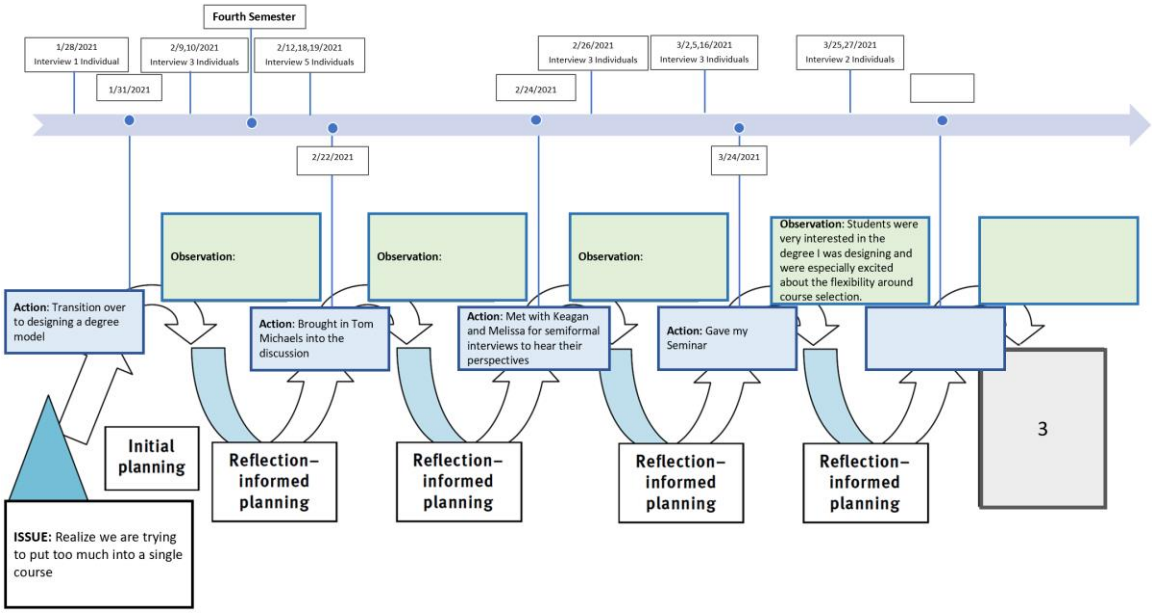


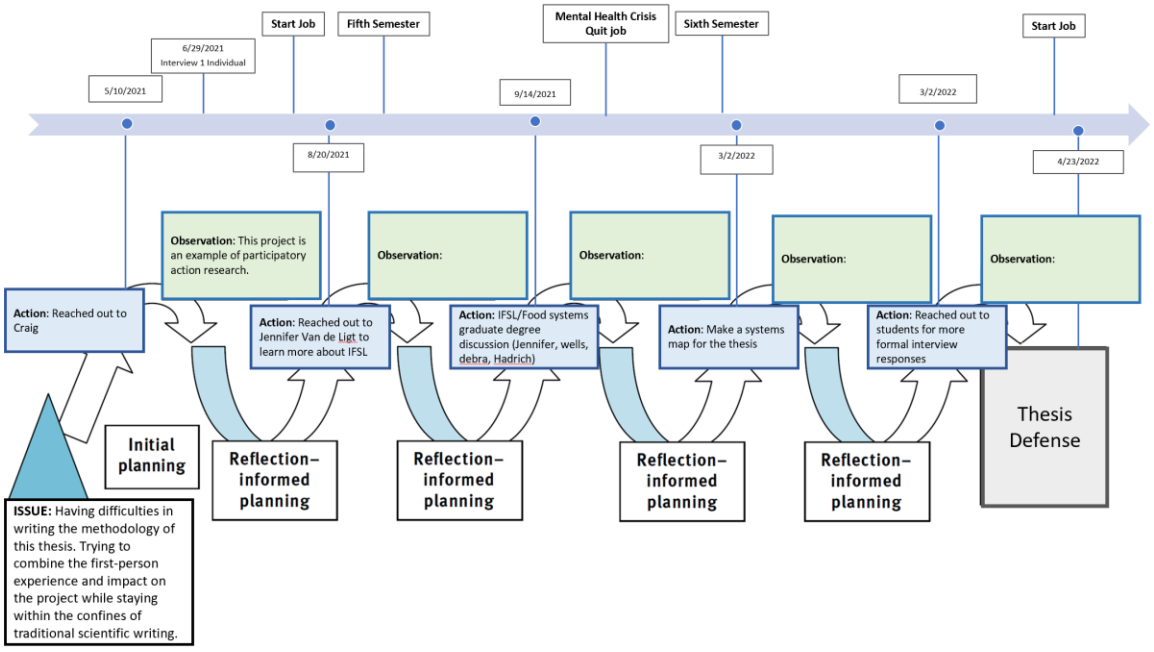
Figure 1. The iterative cycle of participatory action research (PAR)




COVID-19 Pandemic
3/15/2020
4/26/2020
Interview 1 Individual
2/20,28/2020
Throughout Project
4/8,9/2020
Second Semester
4/9/2020
Observation: Can exchange certain required courses out if I provided my transcript and show which ones I am switching to.
Observation: Felt more empowered over my education and was excited to learn again.
Observation: Students (what were their issues, what did they like, what did they want to see, what were they trying to do to fix things etc.)
Observation: I started to realize how wide-spread the issue was within CFANs
Observation:
Action: Emailed Xiaoli and scheduled a meeting to discuss my degree plan
Action: Signed up for the classes I wanted to take instead of certain required courses.
Action: Continuously reaching out to fellow students for their experiences and perspectives via informal interviews
Action: Start broadening my course to encompass more CFANs disciplines
Action: Started reaching out to people about help with building a curriculum
1
Initial planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
2


Death of George Floyd & subsequent Riots
Third Semester
8/10/2020
Interview 1 Individual
5/14/2020
7/4/2020
9/10/2020
6/1/2020
8/18/2020
Observation:
Observation: Tricky to get a response from people at this point
Observation: Dead air
Observation: Barrett finally responds
Observation:
Action: Met with Dean Cuomo and Mike White
Action: Met with the Environmental folks
Action: Email Barrett (thinking about gamification)
Action: Send out a reminder email to the Deans and the environmental folks
Action: Start playing around with the idea of a certificate (like IFSL)
2
Initial planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
End of Cycle


Fourth Semester
1/28/2021
Interview 1 Individual
2/9,10/2021
Interview 3 Individuals
2/12,18,19/2021
Interview 5 Individuals
1/31/2021
2/22/2021
2/26/2021
Interview 3 Individuals
3/2,5,16/2021
Interview 3 Individuals
2/24/2021
3/24/2021
3/25,27/2021
Interview 2 Individuals
Observation:
Observation:
Observation:
Observation: Students were very interested in the degree I was designing and were especially excited about the flexibility around course selection.
Action: Transition over to designing a degree model
Action: Brought in Tom Michaels into the discussion
Action: Met with Keagan and Melissa for semiformal interviews to hear their perspectives
Action: Gave my Seminar
Initial planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
3
ISSUE: Realize we are trying to put too much into a single course


Start Job
Fifth Semester
Mental Health Crisis Quit job
Sixth Semester
Start Job
6/29/2021
Interview 1 Individual
5/10/2021
8/20/2021
9/14/2021
3/2/2022
3/2/2022
4/23/2022
Observation: This project is an example of participatory action research.
Observation:
Observation:
Observation:
Observation:
Action: Reached out to Craig
Action: Reached out to Jennifer Van de Ligt to learn more about IFSL
Action: IFSL/Food systems graduate degree discussion (Jennifer, wells, debra, Hadrich)
Action: Make a systems map for the thesis
Action: Reached out to students for more formal interview responses
Initial planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
Reflection–informed planning
Thesis Defense
ISSUE: Having difficulties in writing the methodology of this thesis. Trying to combine the first-person experience and impact on the project while staying within the confines of traditional scientific writing.

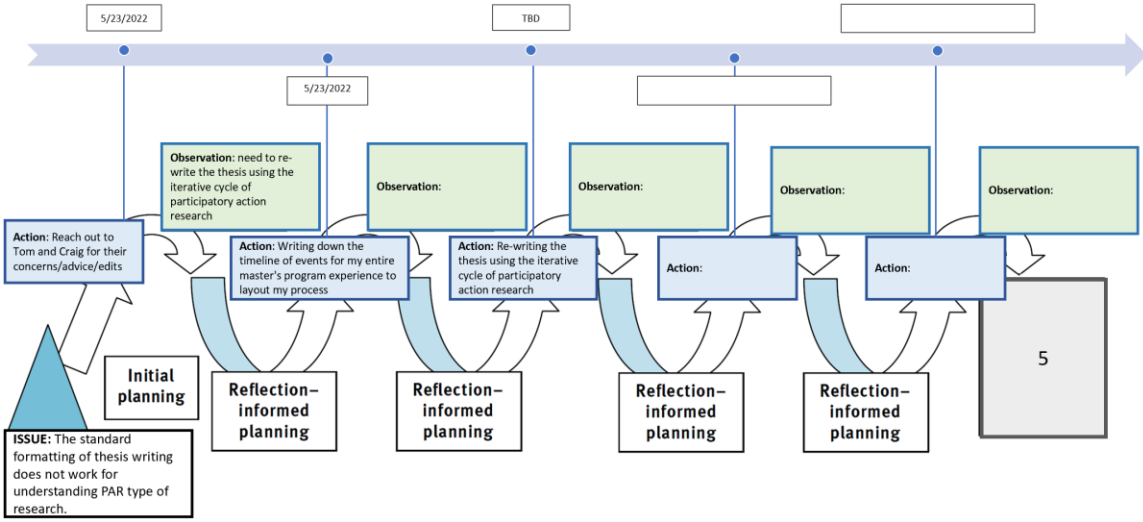
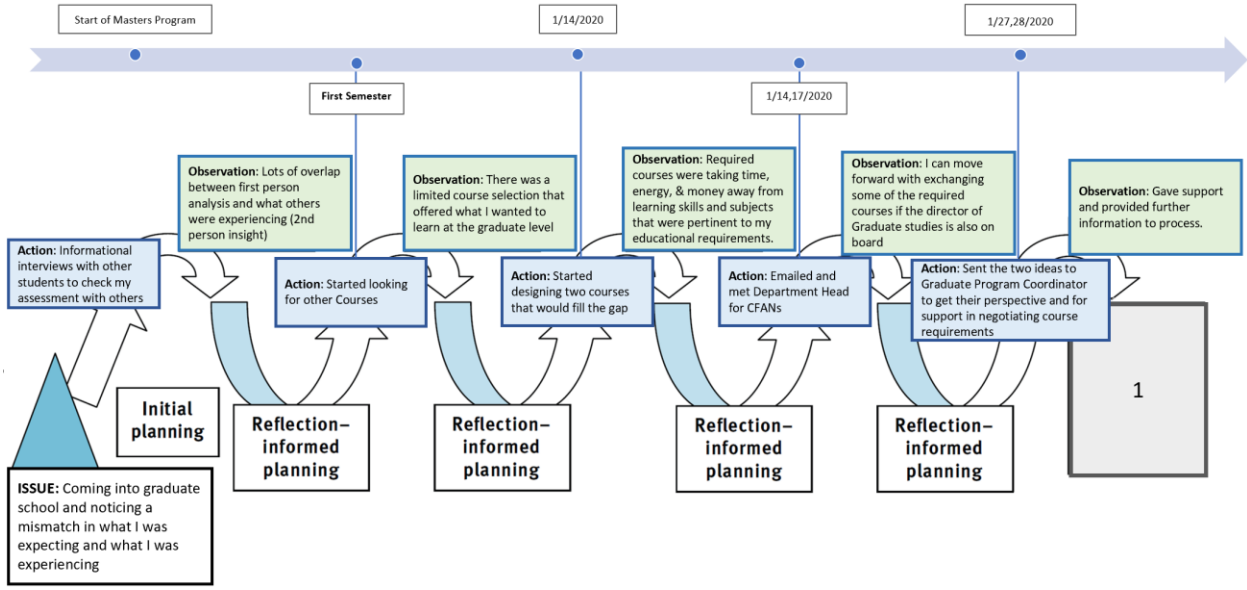
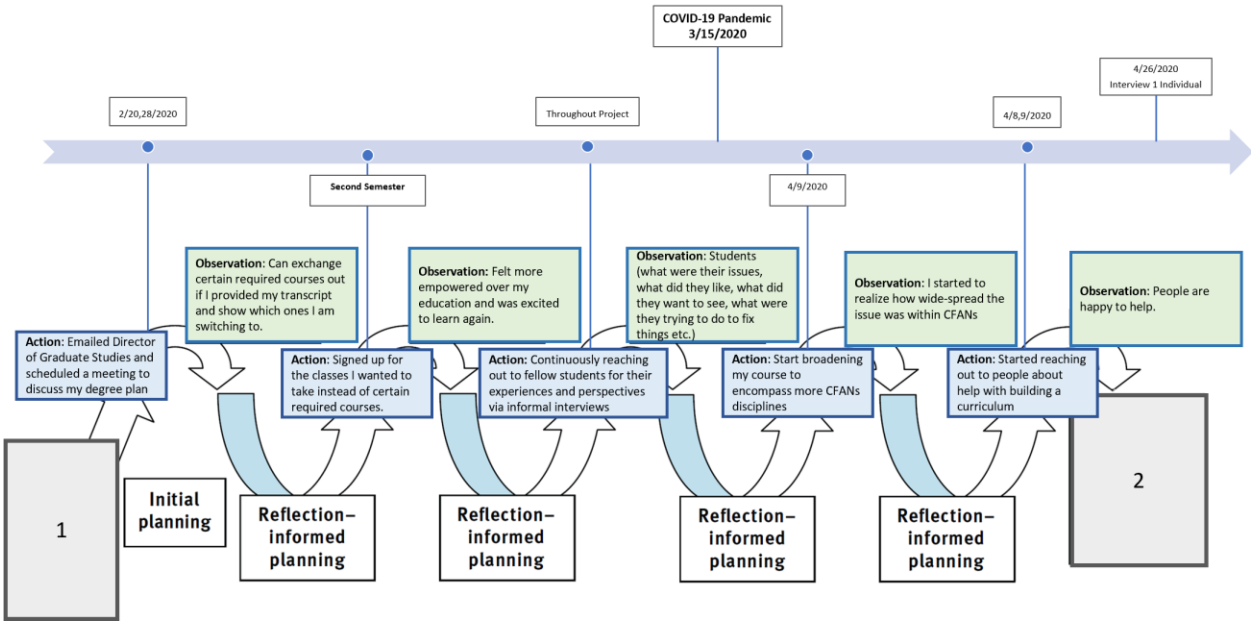


Figure 3. - Cycle 1. The Foundations for course development ……18





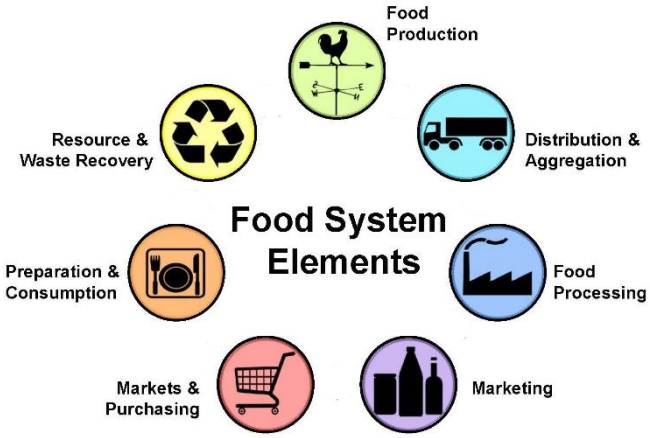


Figure 5. Food System Elements Diagram Modified from an adaptation by Christy Shi, Center for Environmental Farming Systems.

From: Wilkins, J. and Eames-Sheavly, M. Discovering the Food System; An experiential learning program for young and inquiring minds. Cornell University, Departments of Nutritional Science and Horticulture. http://www.discoverfoodsys.cornell.edu/

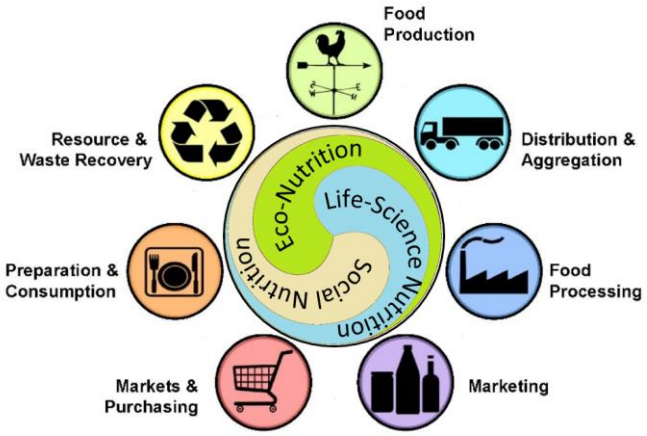


Figure 6. Food System Elements Diagram adapted from a diagram by Christy Shi, Center for Environmental Farming Systems to include the three Nutrition traditions.

From: Wilkins, J. and Eames-Sheavly, M. Discovering the Food System; An experiential learning program for young and inquiring minds. Cornell University, Departments of Nutritional Science and Horticulture. http://www.discoverfoodsys.cornell.edu/

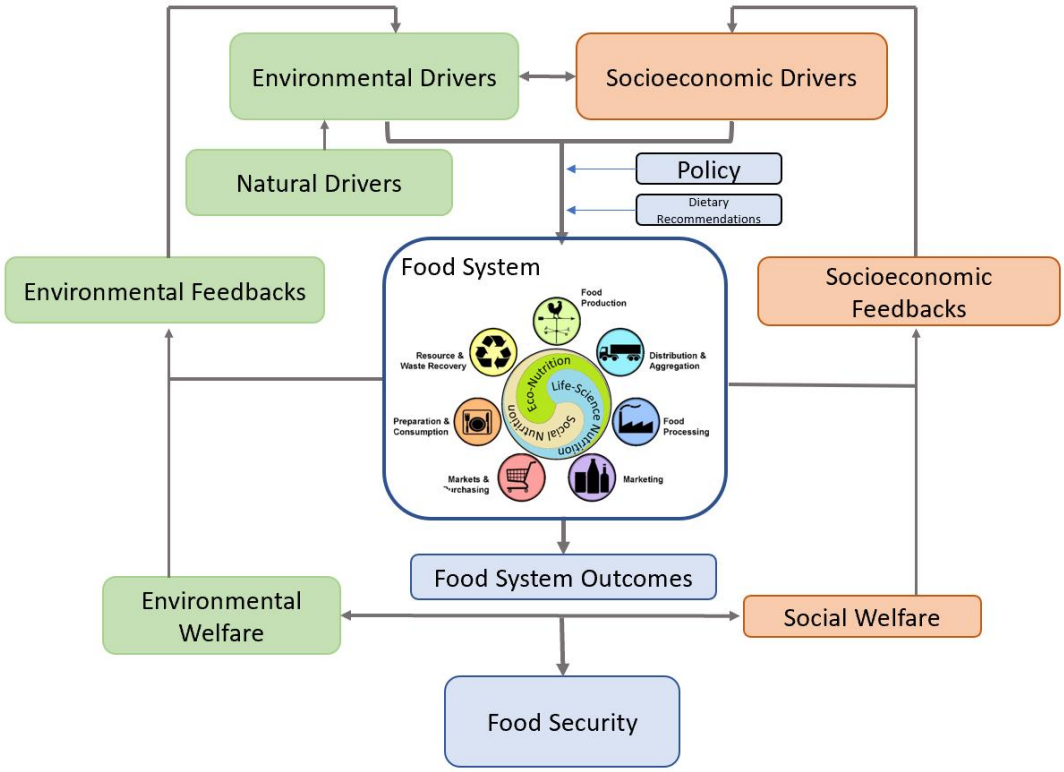
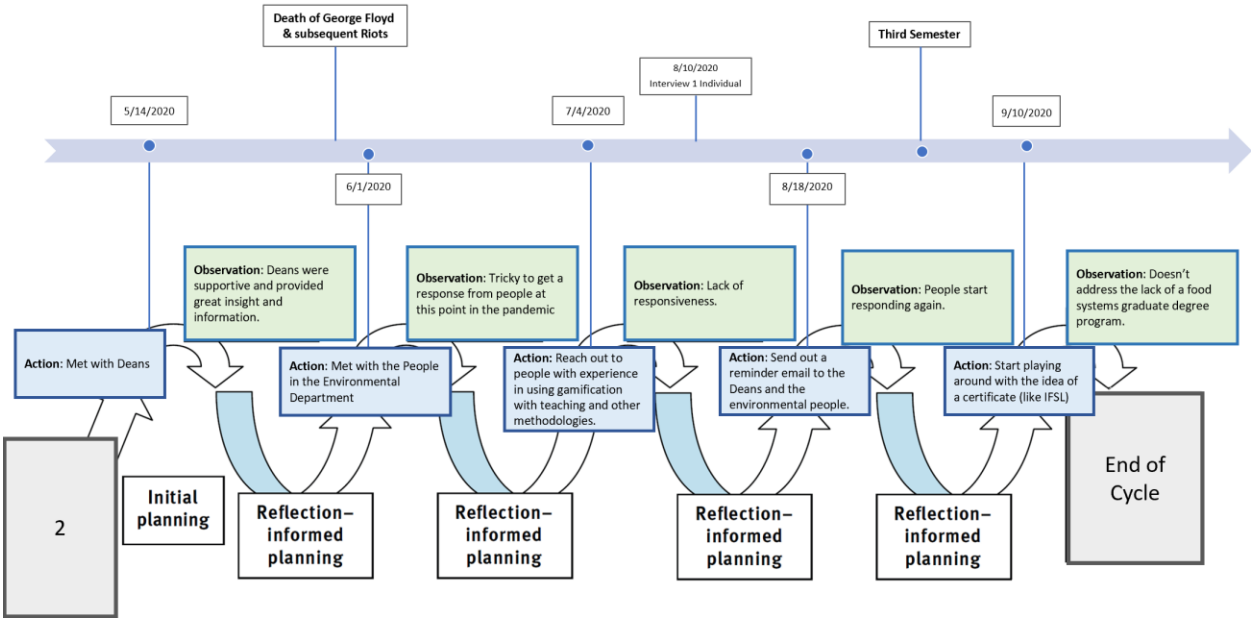
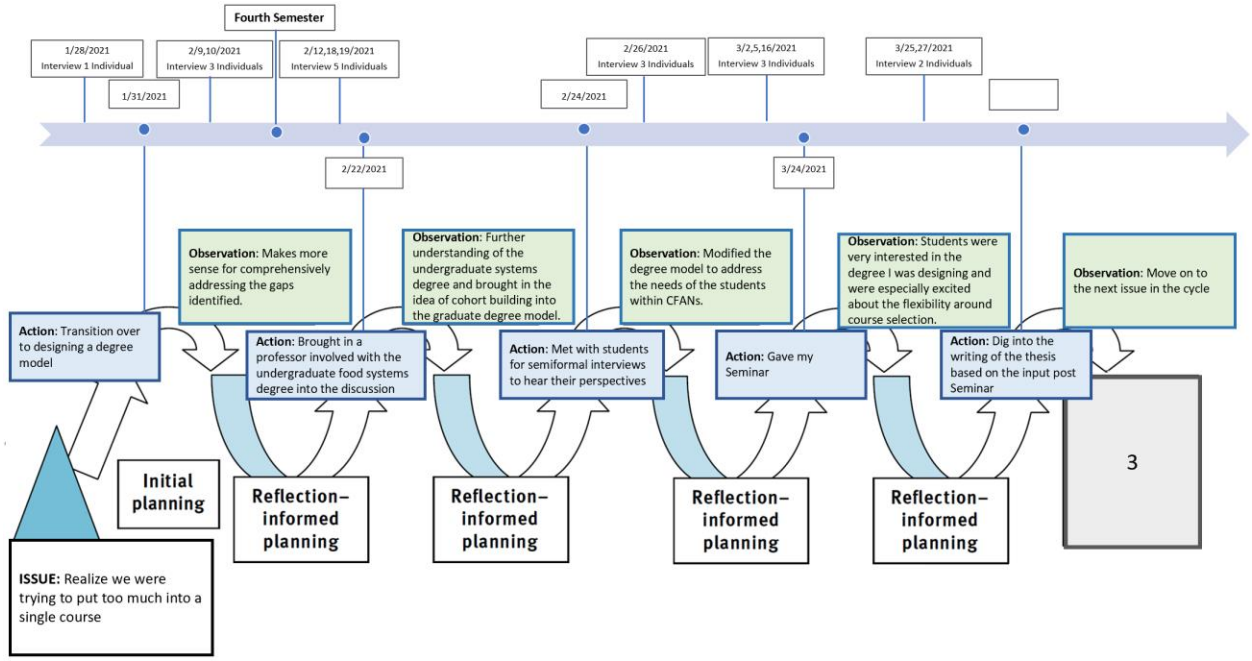


Figure 7. Food systems diagram

Adapted from https://www.futureoffood.ox.ac.uk/what-food-system and incorporating a modified diagram from Wilkins, J. and Eames-Sheavly, M. Discovering the Food System; An experiential learning program for young and inquiring minds. Cornell University, Departments of Nutritional Science and Horticulture. http://www.discoverfoodsys.cornell.edu/





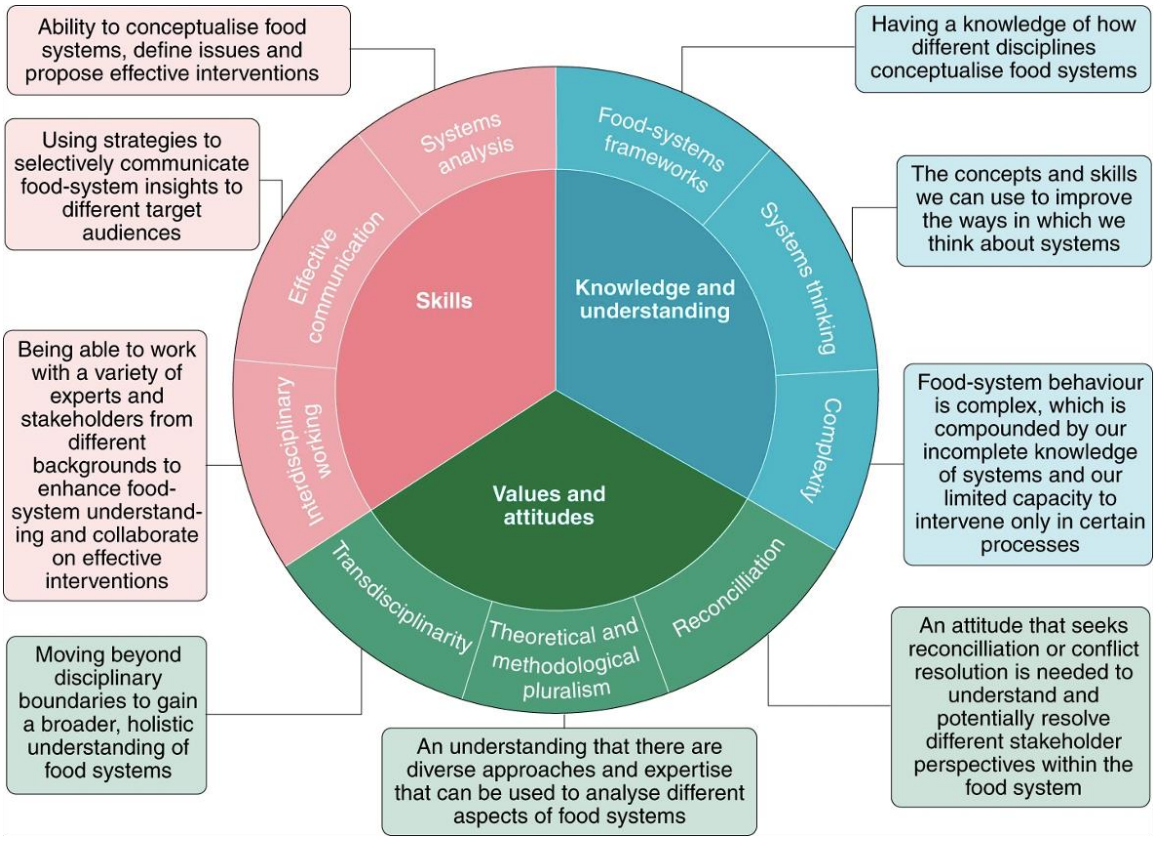


Figure 10. Food systems analyst diagram of skills, values and attitudes, and knowledge and understanding.

Ingram, J., Ajates, R., Arnall, A., Blake, L., Borrelli, R., Collier, R., de Frece, A., Häsler, B., Lang, T., Pope, H., Reed, K., Sykes, R., Wells, R., & White, R. (2020). A future workforce of food-system analysts. *Nature Food*, *1*(1), 9–10. https://doi.org/10.1038/s43016-019-0003-3

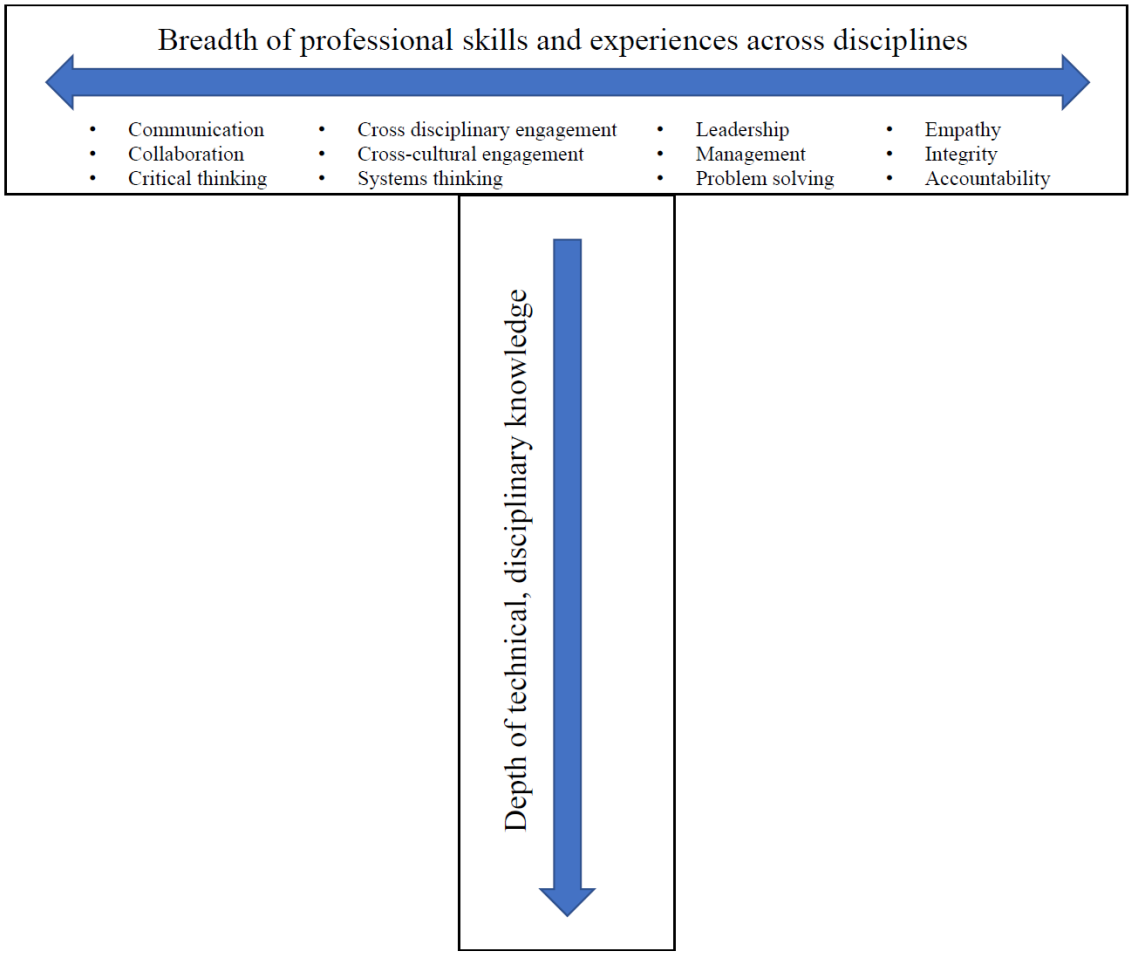


Figure 11. T-Shaped Model

Ringling, K. (2020). *Interdisciplinary , Cross-Supply Chain Approaches to Food Systems Improvement* (Issue October).

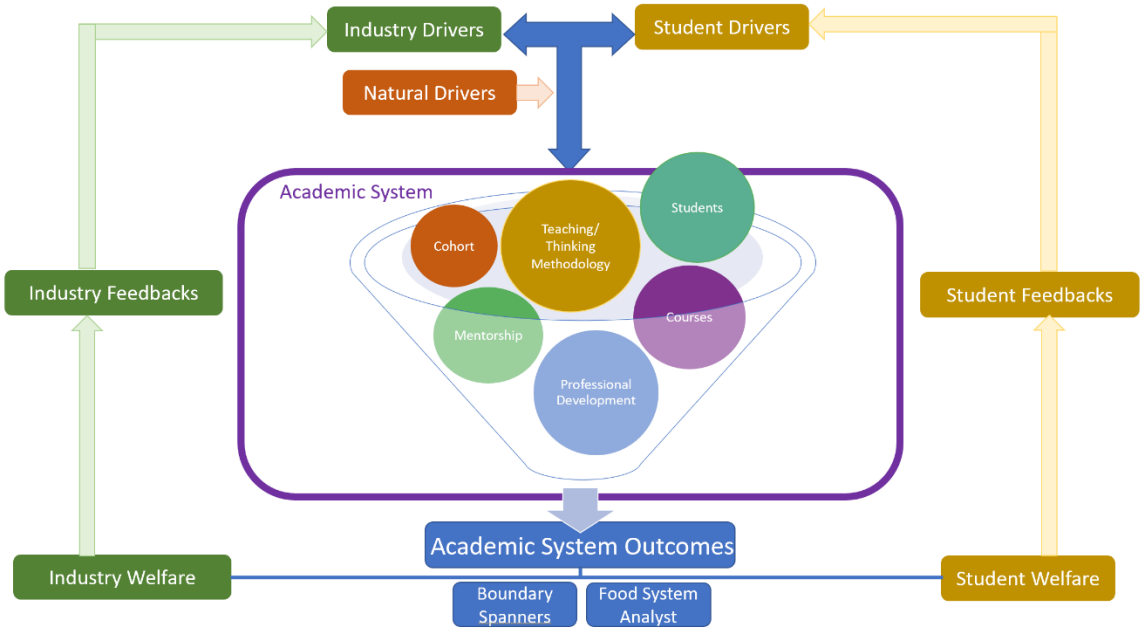
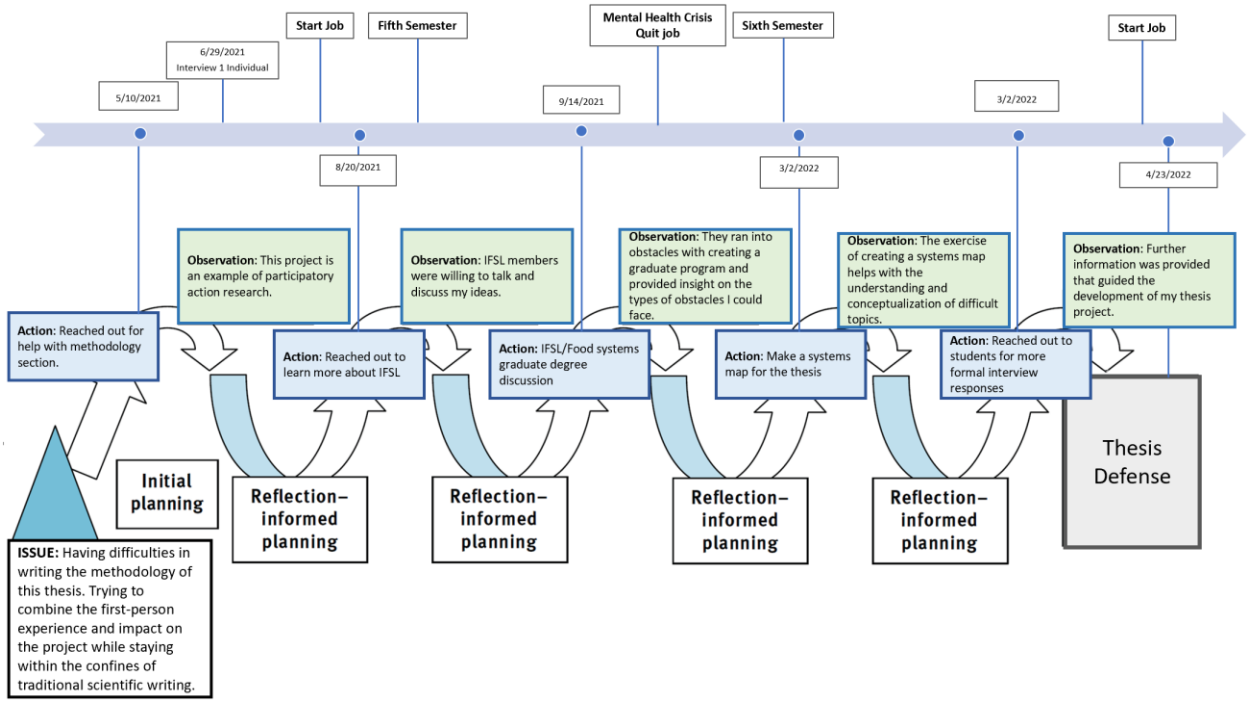


Figure 12. Academic System Diagram



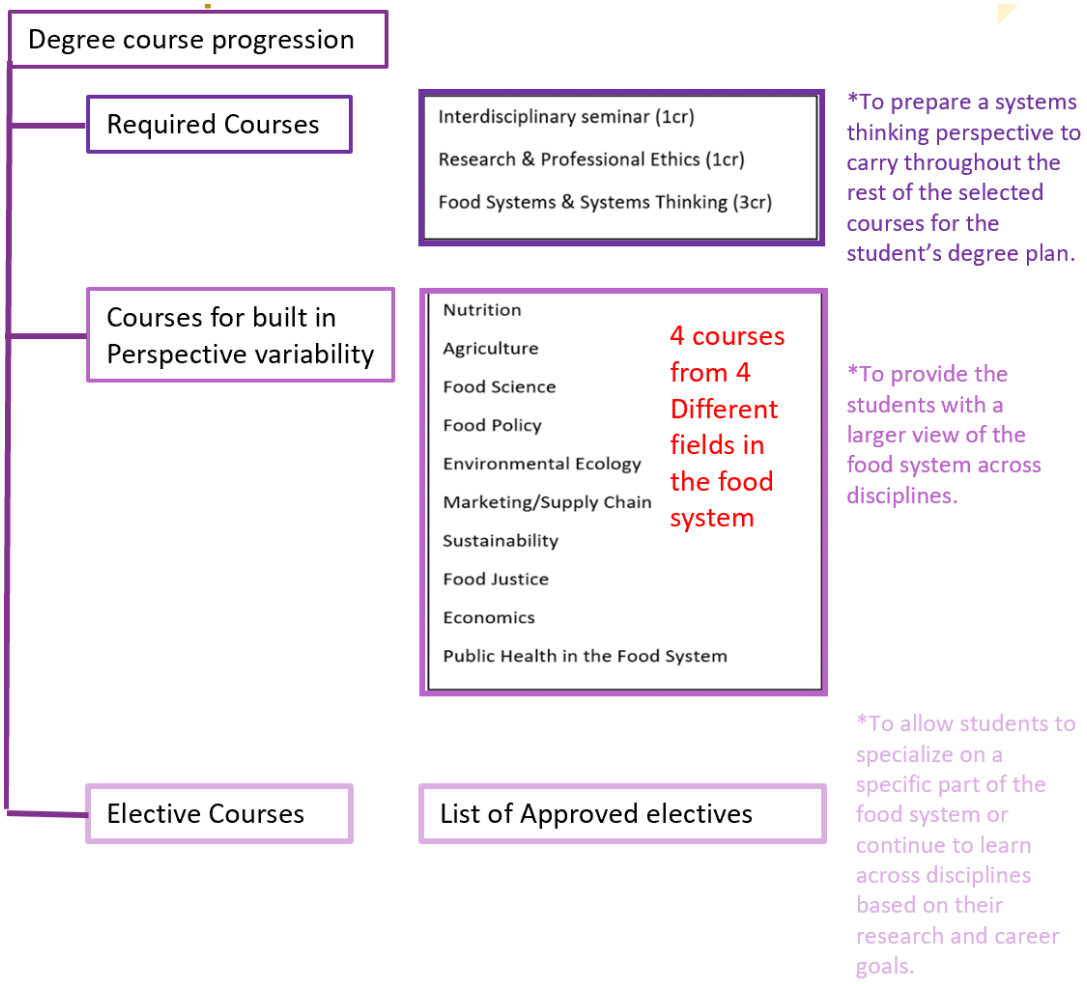


Figure 14. Food System graduate degree program course format.

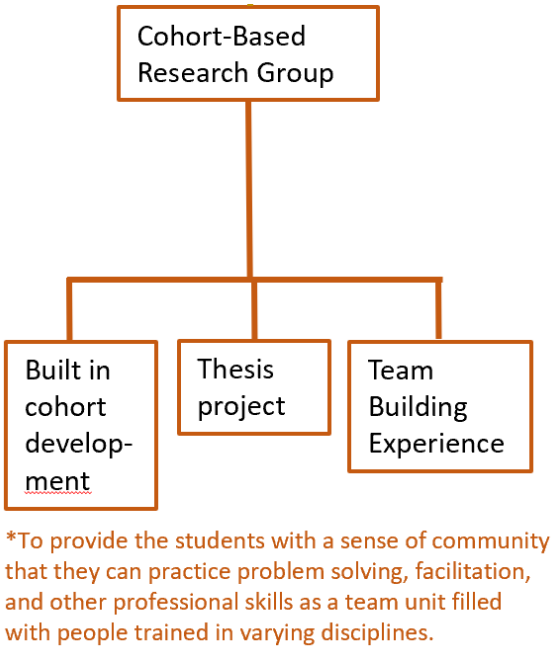


Figure 15. Food system graduate degree Cohort-Based Research Group components.

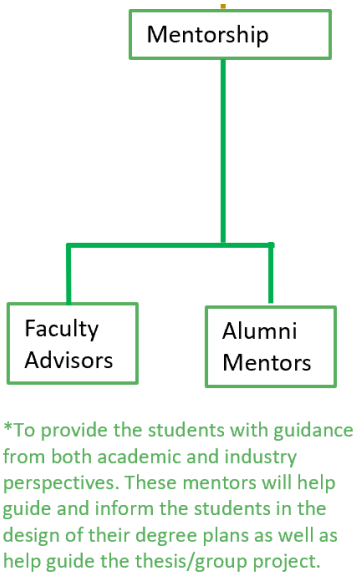
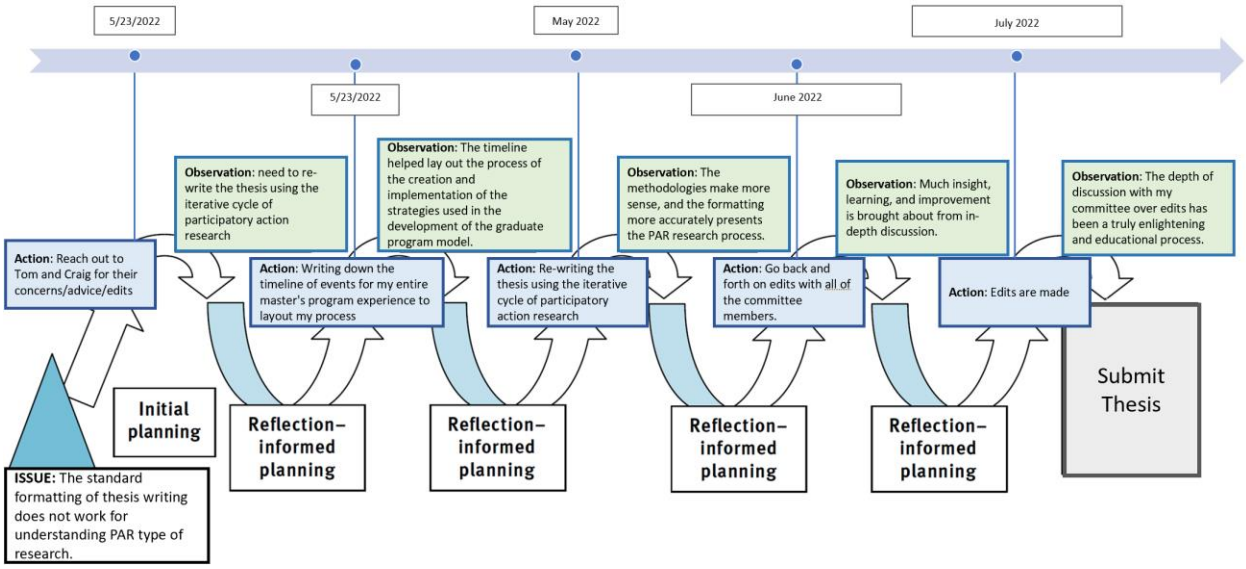


Figure 16. Food system graduate degree program forms of mentorship.



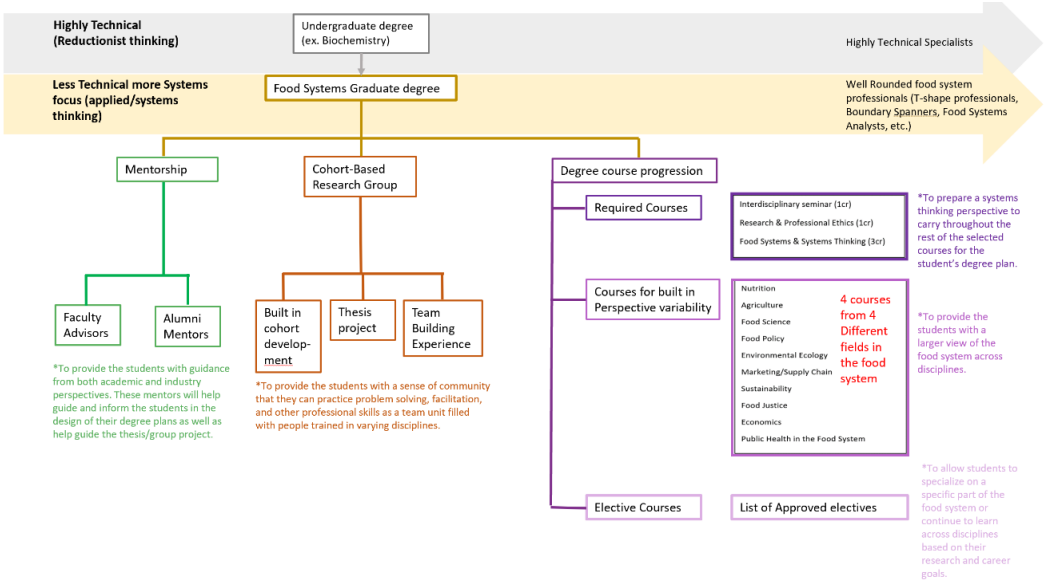


Figure 18. Food systems graduate degree program design.

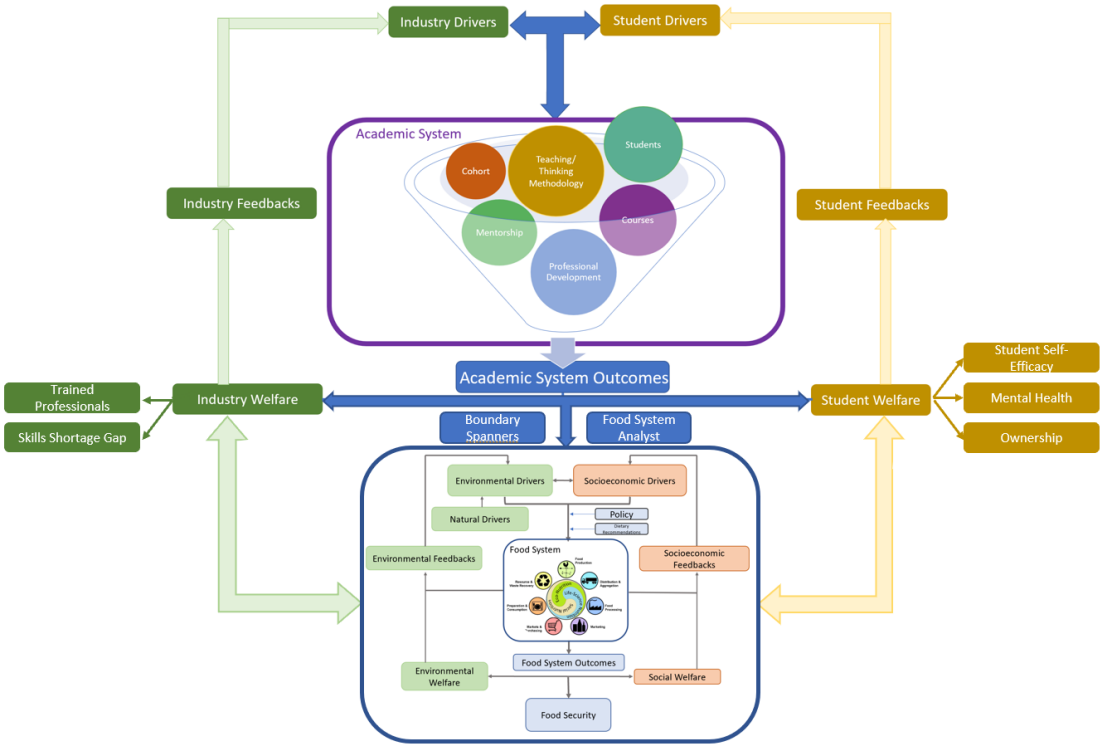


Figure 19. Systems diagram including the academic system, food system, and corresponding facets of society.